1020912 December 2000

Source : CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD, DECEMBER 12, 2000, (http://www.chemsafety.gov), Disclaimer: The Chemical Incident Reports Center (CIRC) is an information service provided by the U.S. Chemical Safety and Hazard Investigation Board (CSB). Users of this service should note that the contents of the CIRC are not intended to be a comprehensive listing of all incidents that have occurred; many incidents go unreported or are not entered into the database. Therefore, it is not appropriate to use the CIRC database to perfrom statistical analysis that extends conclusions beyond the content of the CIRC. Also, although the CSB never knowingly posts inaccurate information, the CSB is unable to independently verify all information that it receives from its various sources, much of which is based on initial reports. CIRC users should also note that the CSB receives more comprehensive reports about incidents that occur in the U.S.; comparisons made between U.S. incidents and those in other nations should take this fact into consideration.

Location : Hansville, USA

Injured : 0 **Dead :** 0

Abstract

A safety disc on a vessel ruptured releasing a cloud of hydrochloric acid. Fortunately no one was injured in the incident. An investigation into the build up of pressure within the vessel is underway.
[overpressurisation, bursting disc failure, gas / vapour release]

Lessons

[None Reported]

1317131 October 2000

Source : CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD, OCTOBER 31, 2000, (http://www.chemsafety.gov), Disclaimer: The Chemical Incident Reports Center (CIRC) is an information service provided by the U.S. Chemical Safety and Hazard Investigation Board (CSB). Users of this service should note that the contents of the CIRC are not intended to be a comprehensive listing of all incidents that have occurred; many incidents go unreported or are not entered into the database. Therefore, it is not appropriate to use the CIRC database to perfrom statistical analysis that extends conclusions beyond the content of the CIRC. Also, although the CSB never knowingly posts inaccurate information, the CSB is unable to independently verify all information that it receives from its various sources, much of which is based on initial reports. CIRC users should also note that the CSB receives more comprehensive reports about incidents that occur in the U.S.; comparisons made between U.S. incidents and those in other nations should take this fact into consideration.

Location : Mumbai, INDIA

Injured : 6 **Dead :** 0

Abstract

A fire occurred at a chemicals company. The fire occurred near a petroleum storage tank at the facility. Fortunately the tank was not involved in the incident. Approximately one hundred fire fighters took nearly to hours to control the blaze. Six fire fighters were injured in the incident.
The cause of the fire is not known.
[fire - consequence, storage tanks, injury, unidentified cause]

Lessons

[None Reported]

1307415 September 2000

Source : CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD, SEPTEMBER 17, 2000, (http://www.chemsafety.gov).
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Location : Phoenix, USA

Injured : 0 **Dead :** 0

Abstract

A fire occurred at an explosives test facility. The fire occurred when approximately 50 pounds of unknown chemicals were being mixed. Buildings in the surrounding area were evacuated.
The cause of the incident is not known. No one was injured in the incident.
[fire - consequence, mixing, evacuation, unidentified cause]

Lessons

[None Reported]

1307013 September 2000

Source : CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD, SEPTEMBER 14, 2000, (http://www.chemsafety.gov).
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Location : Bowling Green, USA

Injured : 40+ **Dead :** 0

Abstract

An unknown amount of sulphuric acid mixed with an amnionic shield conditioner spilled at a plastics coating plant injuring at least forty people and leading to the building being evacuated. The forty workers injured in the incident were treated for the effects of fumes. Clean-up of the plant is now underway.
[evacuation, gas / vapour release, injury, unidentified cause]

Lessons

[None Reported]

1306508 September 2000

Source : CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD, SEPTEMBER 11, 2000, (http://www.chemsafety.gov).
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Location : Rogers City, USA

Injured : 0 **Dead :** 0

Abstract

A fire occurred at a warehouse containing unknown amounts of fertilisers, herbicides, insecticides and pesticides. The fire totally destroyed the building. The cause of the fire is not known.
A half-mile area surrounding the fire was evacuated as a precaution.
[fire - consequence, warehousing, evacuation, unidentified cause]

Lessons

[None Reported]

1297808 August 2000

Source : CHEMICAL SAFETY AND HAZARDS INVESTIGATION BOARD, AUGUST 9, 2000, (http://www.chemsafety.gov).
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Location : Gebze, TURKEY

Injured : 0 **Dead :** 0

Abstract

A fire occurred at a refinery. It is reported that the fire apparently occurred due to an overheated tank. A series of explosions followed sending several barrels of oil flying into the air. Fortunately no injuries occurred.
[fire - consequence, refining, overheating]

Lessons

[None Reported]

1293619 July 2000

Source : CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD, JULY 21, 2000, (http://www.chemsafety.gov).
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Location : Willoughby, USA

Injured : 1 **Dead :** 0

Abstract

A series of explosions and fires occurred at a plant. The explosion was caused by a spark or static electricity, which ignited gas leaking from overfilled cylinders. One person was injured in the incident.
An investigation found that an estimated 900 of 1,1000 cylinders were leaking from safety relief valves. The building was evacuated.
[burns, fire - consequence, overflow, evacuation, injury]

Lessons

[None Reported]

1284017 July 2000

Source : BBC NEWS, 17 JULY, 2000, (http://www.bbc.co.uk).
Location : Ho Chi Minh City, VIETNAM

Injured : 10 **Dead :** 16+

Abstract

A road transportation incident. A bus carrying chemicals exploded killing at least sixteen people and seriously burning ten others.
The cause of the explosion is not known but approximately twenty containers of unknown chemicals were on board at the time of the incident.
[fatality, explosion, burns, unidentified cause, injury]

Lessons

[None Reported]

1275729 June 2000

Source : CHEMICAL HAZARDS IN INDUSTRY, JUNE 2000,; CHEM. MARK. REP., 3 APR 2000, (http://www,chemexpo.com/cmronline).
Location : Texas, USA

Injured : 0 **Dead :** 0

Abstract

Personnel were evacuated from a plant and surrounding plants in the vicinity when a 250,000-gallon tank containing 80,000 gallons of acrylic acid overheated. [evacuation, overheating]

Lessons

[None Reported]

1251417 May 2000

Source : CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD, 18 MAY, 2000, (http://www.chemsafety.gov)
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Location : Deerfield Beach, Florida, USA

Injured : 0 **Dead :** 0

Abstract

A chemical fire occurred at a laboratory. Fire fighters used dry-chemical extinguishers as they feared that the chemicals involved may react with water. The cause of the fire is not known.
[fire - consequence, laboratory work, unknown chemicals, unidentified cause]

Lessons

[None Reported]

1275824 March 2000

Source : CHEMICAL HAZARDS IN INDUSTRY, JUNE 2000,; CHEM. WEEKBL., 27 MAR 2000, (DUTCH) (http://www.chemischweekblad.nl/).
Location : Arnhem, NETHERLANDS

Injured : 0 **Dead :** 0

Abstract

An explosion occurred in a thermoreactor at a production site used to incinerate waste gases from the production process.
The incident occurred due to excessive pressure in a pipeline leading into the vessel. Production was stopped immediately after the explosion.
The plant makes synthetic polymer dispersions (latex) from styrene and butadiene.
No one was injured and no harmful emissions occurred.
[overpressurisation, processing]

Lessons

[None Reported]

12336 20 March 2000

Source : CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD, 20 MARCH, 2000, (http://www.chemsafety.gov).
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Location : Corunna, Ontario, CANADA

Injured : 21 **Dead :** 0

Abstract

A refinery stack flare went out causing low levels of hydrogen sulphide and mercaptans to be released into the atmosphere.
At low levels these substances have a very unpleasant odour and may cause headaches, nausea and coughing.
[gas / vapour release, flameout, injury]

Lessons

[None Reported]

1233117 March 2000

Source : CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD, 20 MARCH, 2000, (http://www.chemsafety.gov).
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Location : North Salt Lake City, USA

Injured : 0 **Dead :** 0

Abstract

A fire occurred as an employee was checking equipment while a tank truck was being filled at a loading dock at a refinery. Nearby fuel tanks were damaged in the blaze fortunately they did not explode.
The incident occurred when surplus gas from fuel hoses was being emptied into a steel bucket, which apparently built up static electricity and burst into flames. The operator threw the bucket away from his body causing an explosion.
The refinery offices were evacuated and underground pipes transferring petroleum products were shut-off.
[fire - consequence, road transport, damage to equipment, evacuation]

Lessons

[None Reported]

1244616 March 2000

Source : CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD, 16 MARCH, 2000, (http://www.chemsafety.gov)
Disclaimer: The Chemical Incident Reports Center (CIRC) is an information service provided by the U.S. Chemical Safety and Hazard Investigation Board (CSB). Users of this service should note that the contents of the CIRC are not intended to be a comprehensive listing of all incidents that have occurred; many incidents go unreported or are not entered into the database. Therefore, it is not appropriate to use the CIRC database to perfrom statistical analysis that extends conclusions beyond the content of the CIRC. Also, although the CSB never knowingly posts inaccurate information, the CSB is unable to independently verify all information that it receives from its various sources, much of which is based on initial reports. CIRC users should also note that the CSB receives more comprehensive reports about incidents that occur in the U.S.; comparisons made between U.S. incidents and those in other nations should take this fact into consideration.

Location : Corunna, Ontario, CANADA

Injured : 21 **Dead :** 0

Abstract

A flare went out on a refinery releasing gasses into the atmosphere. Twenty-one people were taken to hospital suffering affects of the released gas. Two hundred workers in a nearby building complained of nausea and sore throats after a strong sulphur smell was reported.
[gas / vapour release, flameout, people]

Lessons

[None Reported]

1288927 July 1999

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A relief valve on a HF alkylation unit acid settler failed to operate under overpressure during an emergency shutdown of all process units following a power failure.
A subsequent release of hazardous materials occurred.
[valve failure, overpressurisation, gas / vapour release, damage to equipment, power supply failure, processing, chemicals unknown]

Lessons

[None Reported]

1220311 May 1999

Source : CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD, FEBRUARY 14, 2000. (http://www.chemsafety.gov).

Location : Dacatur, USA

Injured : 1 **Dead :** 3

Abstract

An explosion occurred when workers were reassembling a tetrafluoroethylene (TFE) pipeline.
The cause of the explosion was due to a combination of air remaining in the lines at the purification tower and a sudden pressurisation of TFE. The flammable TFE was highly pressurised and was released into the air in the lines, which resulted in a sudden eruption and caused the flammable gas to ignite.
An investigation into the incident found the following:
The line and piece of equipment had been taken apart and the workers were trying to take out a blockage that was causing a low flow.
The workers then connected the two lines, which were separated by a valve, one side had the TFE in, and the other was a newly repaired one.
There should have been no air in the repaired line, it should have been a vacuum, but air had been left in the line. The valve was opened too quickly.
When the valve was opened, the TFE burst into the air filled line and caused the explosion.
There was no external source of the explosion, no smoking and no welding.
A further investigation is still being carried out.
[overpressurisation, operation inadequate, fatality, maintenance, injury]

Lessons

[None Reported]

8099 28 March 1999

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

A fire occurred at the start of a routine gasoline wash operation of lines containing concentrated TEL fluid. The vent valve inside an enclosed ethyl blending building was inadvertently left open by the operator. The enclosed transite building housed an 8,500 gal weigh tank, scales, eductor, eductor pump and manifold. TEL and gasoline were pumped through the vent line and spilled down on to the transite road. Ignition occurred from an unknown source and the resulting fire caused significant damage to about three quarters of the building transite. The fire was brought under control and extinguished in approximately 35 minutes with no loss of TEL fluid from the storage tanks. Repair work commenced soon after the fire and 3 days later, blending was done from the reserve tank.
[fire - consequence, damage to equipment, operational activities, unidentified cause]

Lessons

The source of ignition is unknown but evidence points to it being immediately outside the front (east) door. Possible sources such as the operator's jeep, another passing vehicle, faulty electrical fixtures, an enclosed light over the doorway, the air-purged instrument panel just inside the front door, several motors inside the building and static electricity have all been considered but no particular reason was pointed at.
Through discussion with TEL suppliers, it was concluded that the following revisions should be made:
1. Relocate vent line from a point just above valve No.12 out through the building to a point a safe distance away. The lateral piping would be installed at a sufficient angle to avoid low spots in the line.
2. Relocate eductor pump to minimise hazards which would occur in the ethyl building from leakage at the pump.
3. Ventilation in the ethyl building will be improved as much as possible.
4. Fire protection - an investigation to determine the feasibility of a fail-safe interlocking device to prevent operation of the gasoline wash valve unless vent valves are closed.

2113 1999

Source : CHEMICAL HAZARDS IN INDUSRY, OCTOBER 1999,; LOSS PREVENTION BULLETIN, 147, PAGE 15-16.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A fire occurred on two separate offshore compressor stations on the same day. Considerably damage occurred to the electrical systems. Purge gas was ignited in both incidents by static generated by a snow-storm. Fires occurred later on, in the power turbine exhaust compressor units. Venting, in one case, caused a severe increase in the stack flame such that the crew had to take shelter.
[fire - consequence, damage to equipment, weather effects, fuel gas]

Lessons

The following recommendations were made:
1. Investigation of the reliability of fuel gas supply.
2. Improvement in the instrument air supply.
3. Check unit vent valves.
4. Review choice of actuators and location of systems under winter conditions and reconsidering certain venting and staffing issues.

128601999

Source : QUARTERLY SAFETY SUMMARY, 1976, VOL.47, NO's. 185, 186,; CHEMICAL HAZARDS IN INDUSRY, OCTOBER 1999,; LOSS PREVENTION BULLETIN 147, PAGE 17.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A monomer charge pump casing ruptured at the joint whilst out of service and unattended on a vinyl chloride monomer (VCM) tank farm. A release of liquid and vapour occurred and explosively ignited.
Many of the possible causes include, accidental starting of the pump when liquid filled and valved off, or the decomposition of instable compounds, or internal vapour/air ignition, the probable one was considered to be a combination of overpressurisation due to liquid VCM expansion in a completely full and leak tight system coupled with a weakened case joint due to over-tightened replacement mild steel studs in weakened holes where high tensile stud should have been fitted.
[gas / vapour release, explosion, fire - consequence]

Lessons

The following recommendations were made:
1. Regular maintenance and corrosion inspections to be carried out.
2. Improvements to operational practice, plant management and Hazop were sugested.

128871999

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A fire occurred in a vacuum bottoms tank when the roof weld joint failed spilling hot oil in the surrounding dike/bund.
The most probably cause of the weld failure was due to a minor internal explosion or overpressure due to the ignition of flammable vapour by pyrophoric deposits. The tank contents were at an unusually high temperature at the time.
[fire - consequence, overpressurisation, oil - hot]

Lessons

[None Reported]

1029920 December 1998

Source : ICHEME
Location : ,

Injured : 0 **Dead :** -

Abstract

A barge exploded whilst docked. Residual jet fuel was being vacuumed from the tanks and being emptied into a petroleum road tanker on a pier at the time of the explosion. The vessel had just delivered aviation fuel and the tank was being cleaned out for an new load of heating oil.
Investigations into the incident found three prime possibilities for the explosions.
Matches, which were found near the body of a crewman may have ignited the fuel vapours. Or one of the barge workers may have dropped and broken a flashlight, causing the blast. Another cause may have been due to the plastic hose which is used to vacuum the fuel accumulated enough static electricity to exploded the fumes.
Traces of alcohol were found in two of the crew members.
[river transport, cleaning, human causes]

Lessons

[None Reported]

1232404 December 1998

Source : CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD, 29 JULY, 1999, (http://www.chemsafety.gov).
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Location : Port Comfort, Texas, USA

Injured : 35+ **Dead :** 0

Abstract

An explosion and fire occurred at a chemical plant, injuring at least 35 people. The incident occurred when a processing tank exploded for unknown reason. An investigation is being carried out.
[fire - consequence, injury, unidentified cause]

Lessons

[None Reported]

1290707 November 1998

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A storage sphere partially collapsed due to vacuum. The incident occurred during blending operations. Blending was immediately stopped and the sphere blocked in, the area was evacuated and nitrogen was introduced into the sphere to relieve the vacuum. The material in the sphere was transferred to a crude tank.
An investigation into the cause revealed that introduction and removal of flow natural gasoline to and from the sphere, which was not designed for a vacuum.
[evacuation, design or procedure error]

Lessons

The following lessons were learned:
1. Vessels designed for a low pressure may not withstand a vacuum.
2. Vacuum may be created by a number of factors including a high pumping out rate, lower ambient temperature, lower vapour pressure of the liquid in the vessel.

11478October 1998

Source : BBC NEWS, MAY 10, 1999,
(http://www.bbc.co.uk).

Location : , OFFSHORE

Injured : 2 **Dead :** 0

Abstract

An explosion occurred on an oil platform injuring two men. The mechanics were installing a pump and motor unit when flammable gases near a drain ignited causing an explosion and fire in which both men suffered burns. The explosion possible resulted from static electricity igniting the gases.
It took 30 minutes to extinguish he blaze but damage to the platform was minor.
The company was fined £20,000 (1999).
[fire - consequence, exploration, offshore, maintenance, injury]

Lessons

[None Reported]

1280628 May 1998

Source : CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD, JULY 16, 2000, (http://www.chemsafety.gov).
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Location : Harrisburg, USA

Injured : 0 **Dead :** 0

Abstract

An ammonium hydroxide tank collapsed releasing an unknown quantity of the chemical. The cause is not known.
[spill, unidentified cause]

Lessons

[None Reported]

1040304 January 1998

Source : LOSS PREVENTION BULLETIN, 139, 22.; THE CHEMICAL ENGINEER, 15 JANUARY 1998.
Location : ,

Injured : 1 **Dead :** 0

Abstract

One fire fighter was injured and 3000 people evacuated following a fire at a fertiliser plant. The fire burned for over sixteen hours before being brought under control. The cause is still unknown, however the two explosions which rocked the plant are thought to have involved propane gas tanks.
Fire fighters chose not to douse the flames due to the fear that runoff water would pollute the nearby river. The site contained chemicals including, methyl bromide, ammonium nitrate, paraquat, endosulphan and carbofuran and 400 tonnes of ammonia nitrate bagged on-site. A decision was made to let the fire burn out most of the pollutants before finally being extinguished.
[injury, unidentified cause]

Lessons

[None Reported]

1136711 November 1997

Source : LLOYDS LIST, 12 NOV, 1997.
Location : , USA

Injured : 1 **Dead :** 0

Abstract

A fire occurred at a loading terminal of a petroleum storage facility whilst three road tankers were being loaded. A series of explosions occurred as a result. The cause of the fire is not known.
[fire - consequence, unidentified cause, injury]

Lessons

[None Reported]

1114810 June 1997

Source : ICHEME
Location : , TURKEY
Injured : 0 **Dead :** 1

Abstract

A shift supervisor received severe burns and later died after a flexible hose used to transfer hydrogen to the catalytic reformer was overpressured and caught fire.
Hydrogen is supplied from three modules each consisting of 12 x 1m3 cylinders at 150 bar (2205 psig) pressure. Each cylinder is fitted with a needle valve and the twelve are connected together with steel tubing. Each module has a filling connection (with no pressure regulator) and a discharge connection equipped with a pressure regulator and a pressure safety relief valve set at 14 bars (206 psig) pressure. The Cat Reformer has two hydrogen connecting points to the recycle gas compressor's discharge line which is normally used to charge the unit. Only one of these connecting points is fitted with a pressure relief valve in addition to the PSVs fitted to the individual modules. Each hydrogen module is connected to the Cat Reformer's injection points with 1 inch flexible steel hoses from the outlet of the H2 module's pressure regulator. On June 9, 1997, No. 1 and No. 2 hydrogen modules were connected to the recycle gas compressor using the correct outlet points after the pressure regulators. No.1 module was emptied and replaced by No.3 module. Hydrogen from No.2 module was still connected to the injection without the PSV and 3 cylinders had emptied into the unit. The normal sequence of hydrogen injection is to open the block valves starting at the recycle gas compressor downstream from the injection point and then open the valve on the hydrogen module after the regulator. Whenever the operation is stopped these block valves are closed in the reverse sequence. On June 10, the process operators continued to empty No.2 module (9 cylinders were left). They noticed that the pressure in the unit was building up too slowly. The Shift Supervisor decided to switch the flexible hose from the end, after the regulator on the module, to the module's filling line which is not equipped with a regulator. The switch over was authorized under a cold work permit and carried out by maintenance department personnel who warned the Shift Supervisor against it. Six cylinders were then emptied one by one by the area operator in 35 minutes and the unit was pressured up to 7 bars (103 psig) . The area operator then closed the cylinder needle valve at the hydrogen module followed by the three block valves on the filling line to the recycle gas compressor. As the Cat Reformer's pressure decreased and as the area operator had other tasks in hand, the Shift Supervisor decided to discharge the remaining three cylinders alone. Failing to remember that the block valves downstream to the compressor were shut, he opened a cylinder discharge needle valve and the module's filling valve. The flexible steel hose was subjected to the full cylinder pressure of 150 bar. The hose connection flew off and hit the Shift Supervisor causing him to faint from a broken shoulder bone. The hydrogen immediately ignited whereupon the Shift Supervisor became exposed to flames.
It was discovered that process operators had used the module's filling line connection before whenever they had difficulty with the pressure regulator at the module's proper discharge connection.
The pressure regulator and some needle valves were dismantled. Broken pieces of Teflon seats from the needle valves were blocking the pressure regulator's passage ways. The needle valves were damaged due to over tightening with wrenches. The shift supervisor was wearing a cotton shirt with trousers (pants) made of special material at the time. Although these suits (jacket and trousers) are issued to all process personnel, many complain about wearing the complete suits in hot weather.
There is no operating procedures manual covering the discharge of hydrogen from the modules to the plant. Only one of the connection points to the recycle gas compressor has a PSV fitted upstream of the block valves.
Flexible hoses used for the transfer of hydrogen from the modules to the plant had been tested to 70 barg (4 times their normal working pressure) when they were originally received from the supplier. They had not been tested since. These hoses were placed in store when not being used for hydrogen transfer.
The immediate cause of the accident was the use of the wrong connection at the hydrogen module which bypassed the pressure regulator.
Major contributory factors to the accident were the absence of a pressure relief valve at the recycle compressor's injection point upstream of the isolation valve and failure to operate the system valves in the correct sequence
[material transfer, overpressurisation, fire - consequence, fatality, operation inadequate]

Lessons

The following recommendations were made:
1. Non routine (startup, shutdown, etc.) and maintenance activities must be included in the periodic hazard analysis (e.g., HAZOPS) of process units.
2. Stepwise operating instructions must be available for all high risk activities.
3. Changes to normal operating practices must be subject to a formal "Management of Change" review with the appropriate level of management approval.
4. The failure to apply the Management of Change to the bypassing of any critical safety device (in this case the pressure regulator) without the appropriate level of authority in writing should be identified as a "Near Miss" and investigated in respect of its potential severity.

1115011 May 1997

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

At 04:45 hrs., a tube leak was discovered in a naphtha treater furnace. The furnace was built in 1958 with one and a quarter percent chrome aluminised tubes. Most of the tubes were replaced with 5% chrome in the late 1950s and early 1960s because of tube failures due to overheating. The tube that failed was a 1960 replacement tube. The designed firing rate was 47.9 MM BTU/Hr. Presently, it runs at 71.5 MM BTU/Hr. This change in operating conditions went through the "management of change" procedure in February, 1997. Although the furnace would not have meet the companies recommendations for burner to tube spacing in a new installation, it was determined to be an acceptable safe operation if tube skin temperatures were monitored and kept under 925 degrees F (496.1 degrees C).
Over the past year, the refinery had started the implementation of a furnace management program on this particular furnace. Some of the items addressed were burner maintenance and adjustment, additional instrumentation and calibration with operator training. Improvement was noted in its operation since then, but the furnace tube failed anyway.
Prior to the incident, the operation of the furnace and process unit were normal. The furnace tube leak occurred in a bottom row tube of the south coil. Smoke was detected coming from the convection heater stack at 04:45 hrs. by two supervisors as they were exiting the control room's south door. The furnace tube leak was verified by a supervisor who, was able to see the smoke coming out of the naphtha treater furnace stack and the flames in the fire box. He warned others to stay away from the furnace. Several operations personnel went on to the eastside deck to verify the leak, but because of the flames in the box they were not able to see where the leak was. They went to the westside deck and were able to view inside the box, then left the furnace area. Less than a minute after their departure, at about 04:58 hrs., according to the process alarm, the tube massively failed and engulfed the furnace structure in flames. For the operations personnel who had been on the furnace deck, this was truly a "near miss" event.
The fire alarm was sounded, security was called to page the emergency response team, and the fire department was summoned. A decision was also made to shut down the other units. The furnace was quickly isolated (about 05:15 hrs.) and the fire was contained to the furnace area and under control within 20-30 minutes.
Total loss was about $3 million (£1.7 million) (1997). Business interruption accounted for $2.2 million (£1.2 million) (1997) and property damage $0.8 million (£0.6 million) (1997). The naphtha treater furnace was recommissioned on May 24, 13 days later.
An investigation found that the failed tube, which was a 5 Cr tube, was coked locally in between two burners closest to the east end of the furnace (south pass). A tight adherent layer of coke, about a quarter inch in thickness, was inside the tube located on the fire side of the tube. This layer of coke could be expected to raise the temperature of the tube close to 300 degrees F. This led to longer term overheating and eventual longitudinal bulging. A crack occurred causing the initial release of naphtha into the firebox. This was followed a few minutes later by the tube being ripped open circumferentially releasing 600 psig naphtha into the furnace. This type of failure is not typical, but is more likely to occur in high pressure services.
[heating, furnace, tube, furnace tube, overheating, tube failure, fire - consequence, rupture]

Lessons

The following recommendations were made:
Continued flame impingement on tubes in any hydrocarbon furnace will lead to localised coking and eventual tube failure. Management of change procedures must be applied when changes to materials are proposed, or when duty beyond original design is required.
Tube leaks in furnaces operating at high pressure are likely to have a sudden and catastrophic failure. Attempting to make further visual inspections is a significant risk.
Emergency response plans should be regularly tested, and include the communications and "call out" systems.
Process operators must be trained in the actions to be taken following a tube rupture.

1133708 May 1997

Source : ENDS REPORT, MARCH 1997.
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A backup of effluent during commissioning of new pipework resulted in a major spill/release of acidic effluent into the a near-by river. The release also knocked out a sewage works and caused serious pollution of a river.
[drains & sewers, backflow]

Lessons

[None Reported]

1197712 March 1997

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A static discharge occurred whilst a solvent with a flash point of -2degrees C, was being transferred to a drum. This caused ignition of the drums contents, the fire spread to two adjacent drums. The fire was quickly extinguished.
[material transfer, fire - consequence]

Lessons

[None Reported

7615 1997

Source : CHEMICAL HAZARDS IN INDUSTRY, 1997, SEP.
Location : Dorset, UK

Injured : 0 **Dead :** 0

Abstract

A fire occurred in a plating factory. Firefighters wearing breathing apparatus and chemical protection suits were sent into the factory to find the core of the fire and gauge the danger of the chemicals. It was known that some of the chemicals reacted with water, others would produce highly toxic gases if involved with fire and others were known to be marine pollutants. Therefore, the fire had to be tackled with minimum amounts of water.
The presence of cyanide and the risk of chemical explosion prompted the evacuation of about 300 people from the surrounding area. The intensity of the fire forced firefighters to retreat outside the building and continue operations from there. The fire was contained on the first floor area and extinguished.
Investigation showed that the cause of fire was the overheating of an electrical rectifier, used to convert AC supply to DC for the electroplating process.
Estimated loss was £1,000,000 (1997).
[fire - consequence, toxic gas, cyanide fumes]

Lessons

[None Reported]

9013 1997

Source : CHEMICAL HAZARDS IN INDUSTRY, 1997, SEP.

Location : ,

Injured : 1 **Dead :** 0

Abstract

A located in a drain line of a diluent dryer at a polyethylene plant, blew out whilst the dryer was being prepared for registration. The operator was showered with glass and liquid isobutane, receiving minor cuts, a scratched eye and cold burns to the face. Possible causes of the incident were overpressure of the drain line or failure of the sight glass below its rated pressure. Neither of these was established as the cause of the accident.
[overpressurisation, blowout, draining]

Lessons

[None Reported]

112061997

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

As is common on many compressors, the flash gas compressor has a seal oil reservoir venting to the miscellaneous vents system, and a lube oil reservoir venting to atmosphere. This incident occurred when back pressure in the vent header caused an increase of pressure in the seal oil reservoir, leading to migration from the seal oil system to the lube oil system. The gas entrained in this oil then escaped to atmosphere from the lube oil reservoir vent. The restriction in the vent header arose due to an incorrectly applied isolation on the drains system, which had been put into place to allow change out of a submersible drains caisson pump. Drain lines from various locations on the platform pass through sand pots, or seal pots, before entering the caisson. These pots vent to the miscellaneous vents header. Isolations were applied on the outlet of the pots, but not on the inlets or vent lines. As a result, water entering the drains backed up into the vent system, leading to the oil contamination incident described above.
[processing, compressor, vent, backflow, isolation inadequate, vent blocked, gas / vapour release]

Lessons

The availability of an unrestricted vent is critical to compressor lube/seal oil systems.

1298 1997

Source : CHEMICL HAZARDS IN INDUSTRY, 1997, SEP.

Location : ,

Injured : 0 **Dead :** 0

Abstract

An incident occurred during a telescoped iron reduction/acetylation process. The reduction was carried out in the presence of an anhydride and the reduction product, an aromatic amine, was converted in situ to the corresponding acetylamino species. The process began when heat was generated in the normal manner but following the addition, the batch self heated at an increased rate. It boiled and the reactor over-pressurised. A substantial amount of the batch was subsequently ejected from the vessel.

[reactors and reaction equipment, overpressurisation, spill, processing, uncontrolled reaction, unknown chemicals]

Lessons

[None Reported]

1233705 November 1996

Source : NATIONAL TRANSPORTATION SAFETY BOARD, 1999, (http://www.ntsb.gov),; LOSS PREVENTION BULLETIN 155, 16-17.
Location : Murfreesboro, Tennessee, USA

Injured : 0 **Dead :** 0

Abstract

An incident occurred whilst preparing for maintenance on an 8-inch pipeline containing diesel fuel. The incident occurred during isolation and purging when approximately 84,700 gallons of diesel fuel was released due to overpressure rupture. The line section containing the leak was isolated.
Fortunately the incident did not cause a fire or explosion and no one was injured.
[overpressurisation, operator error, spill, near miss, preparation for maintenance, operation inadequate]

Lessons

[None Reported]

1114125 August 1996

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

An high pressure cooling water supply line ruptured necessitating reduced feed to the FCC. Water hammer shock coupled with bending stress is the likely cause of the failure which is estimated to have cost $88,000 (£52,700) (1996), of which $62,000 (£37,100) (1996) was production loss.
The line rupture was discovered when the general operator observed a temperature increase at the FCC second stage drum and sent the general operator to the cooling towers to investigate. When the operator arrived at the cooling tower to investigate the problem, he noticed that both high pressure fans were off and that a small trickle of water was accumulating in the roadway. The operator reset the vibration switches on both fans and attempted to restart them, but he was unsuccessful. After attempting to restart the fans, the operator noticed the pressure pump was also off. He was unable to restart it. By this time the flow of water in the roadway had grown substantially, so the operator began to investigate the source of the flow. Operators noticed that the flow of water returning to the cooling tower basin had significantly decreased and observed a loss in the cooling tower level. To maintain cooling and prevent damage to the low pressure cooling circuit, the high pressure cooling circuit was shut down and firewater was added to the basin. Over the next several hours, fire hoses were connected to heat exchangers in the high pressure cooling circuit to provide a temporary water supply. Once electricians were able to examine the equipment, they found that the 600 amp main electrical breaker 114 degrees C, supplying the high pressure pump and fan, had tripped. They also discovered that another fan had shut down due to vibration, unrelated to the circuit breaker tripping. Approximately half an hour after the main circuit breaker was reset, the high pressure pump started to run on its own, even though its switch was in the off position and it had to be shut off by opening its circuit breaker because it could not be shut off using its stop button. Circulation was re-established at 7:30 pm on August 27 after 64 hours.
After an investigation it was concluded that the immediate cause of the pipe fracture was probably due to water hammer combined with a high localised bending stress.
The basic cause was poor piping design and installation.
A contributory cause was probably faulty electrical equipment that caused a pump to trip off and restart automatically.
[design or procedure error]

Lessons

The following recommendations were made:
1. Water hammer even in large industrial systems can cause severe damage to weak points designed into a piping system.
2. Old electrical relay equipment requires significant preventive maintenance
attention if it is to continue to provide reliable service.

8405 08 August 1996

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

Heater tube rupture in a high pressure hydrogenation unit. As a result of an operational upset, the helix coil in the process heater of the 1st stage of the high pressure hydrogenation unit ruptured due to a no flow situation over a prolonged period of time. Tthis was followed by a fire. There was damage to equipment and product loss.
Operators had made adjustments to the system in an attempt to protect the catalyst. Make-up compressors were used to purge the system free of oil with fresh hydrogen.
The cause of this incident was that operating instructions' suggestion to protect the catalyst did not set out exactly how to do it, and the operators did not understand that the system was in a lock-in situation.
[fire - consequence, faulty instructions, processing]

Lessons

Operating instructions to cover emergency situations need to be clear and reflect what is actually possible. Operator training needs to go deeper than just discussing instruction
requirements; e.g., explaining the significance of situations such as no-flow, limitations of temperature indication under no-flow conditions, and the need to seek advice from more senior staff if in doubt. Overriding of trip systems must only be done with the specified level of authorisation.

1113905 August 1996

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

As a result of the change over of desalted crude tower feed pumps, a vacuum tower, on this refinery, became pressured. Vacuum tower bottoms back flowed into the 10 psi steam line and out of the relief vent stack, spraying across private and public property. The total loss is estimated at $900,000 (£539,000) (1996), of which the clean-up cost was $800,000 (£479,000) (1996).
[gas / vapour release, backflow, product loss, overpressurisation, operational activities, pump, line]

Lessons

The following recommendations were made:
1. Major operational changes should be carried out preferably on day shift when more people are available and avoiding the weariness of night shift. Such changes need to be carefully planned, and if possible rehearsed.
2. Operating at rates that require flow controller bypasses to be open implies that the flow rates are beyond design capacity which may put the system at a control risk. This should be reviewed under "Management of Change".
3. Pressure controllers are very difficult to operate on manual and this should be recognized.
4. Compound gauges should always clearly indicate a state of vacuum or pressure to avoid error.
5. A non-return/check valve and upstream bleed are required for all stripping steam connections to hydrocarbon service. 6. Steam lines can achieve vacuum and the pressure in some process systems can rise above the design of some low pressure steam lines.
7. When fractionator tower charge rates are increased or reduced there should be a plan which also sets the product draw-off rates to avoid tower flooding or pumparound loss.

1035825 June 1996

Source : LOSS CONTROL NEWSLETTER, ISSUE 2, 1996.
Location : Texas, USA

Injured : 0 **Dead :** 0

Abstract

One of two catalytic crackers was damaged due to an overpressurisation incident that ruptured some piping and damaged a waste heat boiler.
[damage to equipment, cracking]

Lessons

[None Reported]

1036909 June 1996

Source : LOSS CONTROL NEWSLETTER, ISSUE 3, 1996,; HEALTH AND SAFETY AT WORK JUNE 1997.
Location : Huddersfield, UK

Injured : 0 **Dead :** 0

Abstract

An explosion occurred causing the roof of a plant to be blown off. This was due to overpressurisation of the reactant tank.
The firm was fined £50,000 (1996) after an explosion demolished half of its premises. The reactor explosion happened after added a chemical nitrosyl sulphuric acid which was too low for it to react. He turned off the reactor's cooling water when he thought the process was complete. The temperature actually built up until the explosion occurred from a runaway reaction. The reactor top went through the roof and landed 100 metres away. The base went downwards through one floor and embedded itself in the concrete floor below. A previous incident in August 1995 2 tonnes contents of the reactor erupted through the lid at 270 degrees C.
[reactors and reaction equipment, methyl nitrophenol, runaway reaction, processing, methyl nitrophenol, nitrosyl sulphuric acid]

Lessons

[None Reported]

8709 10 February 1996

Source : SEDGWICK LOSS CONTROL NEWSLETTER, ISSUE 1, 1996.
Location : North Ontario, CANADA

Injured : 0 **Dead :** 0

Abstract

A rail transportation incident. Six rail tankers carrying liquid sulphur careered into a river. Due to freezing conditions most of the sulphur solidified.

Lessons

[None Reported]

8660 16 January 1996

Source : SEDGWICK LOSS CONTROL NEWSLETTER, ISSUE 1, 1996.
Location : Ludwigshafen, GERMANY

Injured : 3 **Dead :** 0

Abstract

A tank containing amine burst while firemen were trying to prevent it from overheating. No air pollution was found outside the plant from the spillage.
[storage]

Lessons

[None Reported]

8401 1996

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 1

Abstract

Fatality during maintenance on Fluid Catalytic Cracker Unit (FCCU) heat exchanger.
During steaming of heat exchanger shell covers, to facilitate removal, the lower cover blew off, striking an operator. The tight fit between the shell cover and floating head restricted the path of steam flow, creating an overpressurisation. This was due to the minimum clearance between the shell cover and floating head being less than that required by design.
[fluid cracker]

Lessons

When using steam for heating equipment for disassembly, a free path to vents must be available and maintained; e.g., not blocked by sludge.
Personnel need to be aware of the potential force of steam, nitrogen, air, used as a maintenance aid and not build up uncontrolled pressure in equipment.

1263417 December 1995

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A dust explosion and fire occurred in a primary degasser bin. The bin had been charged with a 50 tonne blend of powder grade from the loop reaction system, and was fifty minutes into the one-hour air degassing/powder recirculation cycle when the incident occurred.
The emergency services and the plant manufacturing teams quickly extinguished the fire. Both reactors were immediately shut down. No injuries were reported.
The explosion occurred due to a build-up of a non-conducting skin of antioxidant, polymer and wax on the walls of the degassing bin and pipework. The likely source of ignition was static, thought to have resulted from a propagating brush discharge inside the vessel.
[fire - consequence, processing, reactors and reaction equipment,

Lessons

The report stated the following conclusions:
1. The incident was caused by a build-up of a non-conducting skin of antioxidant, polymer and wax on the wall of the degassing bin and associated pipework. It is thought that this caused the system to accumulate static charge similar to a capacitor, generating a propagating brush discharge, which initiated a dust explosion inside the vessel. An investigation into this theory is being carried out.
2. The build-up of the non-conducting skin found in the degassing bin, and other degassing, intermediate and final product vessels was caused by the addition of an aqueous antioxidant compound.
3. The degasser reached temperatures in excess of 600 degrees C. Internal damage was limited to some minor distortion of vessel cross members and the top of the vent bag filter housing. Minimal damage to equipment external to the source of ignition occurred.

7632 09 October 1995

Source : LOSS PREVENTION BULLETIN, 132, 9-11,; LLOYDS LIST, 1995, OCT, 10.
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A fire broke out in a storage of polypropylene finished products.
A major emergency was declared and the site emergency plan was initiated. The scale of the fire escalated rapidly ultimately resulting in the attendance of some 200 fire fighters and 40 appliances which included support from an outside county.
The intensity of the fire resulted in a large thermal updraught which tended to convey the plume of black smoke over nearby buildings, over the local towns and out to sea, carried by a southerly wind. The site toxic gas alarm was sounded primarily to restrict movement around the site with the impending shift change to allow access for emergency services.
The public immediately downwind were advised by the media and police to stay indoors and to keep doors and windows closed.
The fire was eventually brought under control and the site emergency was ended.
Nobody suffered any injury as a result of the fire. There were no reported medical treatments from any member of the public. Damage was restricted to the warehouse, an adjacent pipebridge, an office and adjacent workshop and polypropylene bin compound.
A detailed examination of the warehouse, tests and other information concluded that the probable cause of the fire was related to a failure in a fluorescent light fitting which resulted in overheating and flaming acrylic sheeting dropping on to the polypropylene product stored beneath. A combination of the continuous operation of the lighting system and the age and design of the light fittings contributed to the probable source of the ignition. This developed into a fire during a period when the warehouse was unmanned.
[fire - consequence, warehousing]

Lessons

The following recommendations were made:
1. Lighting systems in warehouses should be checked as some of the older designs are potentially more hazardous in the event of an electrical fault.
2. The design, location, alarms and annunciation of smoke and fire detection systems should provide effective and accurate early warning of a fire.
3. The provision of sprinkler systems should be considered for large warehouses when stock losses could be high particularly if early fire detection cannot be guaranteed or if rapid fire fighting response is not possible.
4. Management systems and controls should be regularly audited to ensure that procedures and standards do not deviate from their original intent and to ensure that the potential risks associated with any changes or developments are recognised and addressed.
5. Risk assessments and hazard reviews should be prepared which consider the potential hazards and consequences of a major fire particularly where there could be an off site impact.
6. Existing warehouses and their materials of construction should be checked for potential hazards which could result from the impact of a fire or features which could encourage the spread of a fire.
7. The location of warehouses should be reviewed with respect to potential hazards they may pose to adjacent plants and services and vice versa.
8. The presence of other facilities and activities within warehouses should be reviewed from an operational and potential hazard aspect.
9. Design and maintenance of the lighting system were considered to be at fault.
10. Subsequently the light design and the previous 'breakdown' approach to light fitting maintenance were replaced by formal inspection and maintenance approach.

1173101 October 1995

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

A serious fire occurred on a drier. The fire was first spotted in the dryer exhaust duct and up into the exhaust fan and ductwork on the top of the drier. The fire was difficult to extinguish because of poor access and the extreme heat in the middle of the drier. The CO2 system was set off three times and fire hoses were used extensively before the fire was brought under control. Other problems encountered in the incident were:
1. Inadequate availability of SCBAs and spare bottles.
2. Poor location of clock-out machines.
3. Inadequate visibility for fire fighters caused by lack of lights on drier roof.
4. Poor access to top of dryer because of congestion at ladder.
The root cause was not established. Possible causes were:
1. Material build-up in the ductwork ignited by overheating or a spark.
2. Overheating elsewhere not detected by instrumentation.
[fire - consequence, normal operations]

Lessons

The following actions were suggested for consideration:-
1. Improve access to ducts to allow fire fighters to get firewater inside ducts.
2. Change out ducts when build-up is considered excessive.
3. Install temperature sensors in ductwork.
4. Consider sprinklers inside ductwork (manual or automatic).
5. Keep spare ducts ready for quick replacement.
6. Check ducts are correctly labelled.

8373 01 October 1995

Source : ICHEME
Location : ,

Injured : 7 **Dead :** 0

Abstract

Fire at hydrofiner compressor on a refinery. During recommissioning, the west recycle gas compressor on a hydrofiner was overpressurised. The cylinder head was blown off, resulting in explosive decompression and fire. It was found that the discharge valve was installed in the wrong direction. The cause was the criticality of the task to replace the valve not being understood or reflected in procedures. Though the compressor was purchased to the standard of API 618, which
requires a design that prevent valves from being installed in the wrong direction, the equipment did not meet specification.
Production losses and repair costs were estimated at $500,000 (1995) (£318,300) and $400,000 (£254,600) (1995), respectively.
[fire - consequence, overpressurisation, installation inadequate, product loss]

Lessons

There have to be measures in place, as part of contractors' and suppliers' quality assurance programs, where critical issues on machines are identified and reviewed.

8193 10 September 1995

Source : HAZARDOUS CARGO BULLETIN, 1995, NOV.
Location : Brisbane, Queensland, AUSTRALIA

Injured : 0 **Dead :** 0

Abstract

A marine transportation incident. Hose coupling on marine tanker failed during discharge at wharf during unloading. Small spillage of oil due to prompt shut down of pump.
[coupling failure]

Lessons

[None Reported]

8381 21 August 1995

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

Oil spill at a refinery. During the transfer of base oil from one storage tank to another, a flexible hose failed, resulting in a spill of 250 tonnes. The cause of this incident was continuous utilisation of the hose at a pressure very close to its maximum working pressure.
[material transfer, storage tanks, hose failure, overpressurisation]

Lessons

Hose selection requires careful consideration as regards maximum operating pressures to be used, frequency of use and testing, handling methods, and curvature in use.

1477 01 August 1995

Source : THE CHEMICAL ENGINEER, 1995, SEP, 14,; LLOYDS LIST, 1995, AUG, 19,; EUROPEAN CHEMICAL NEWS, 1995, AUG, 21.
Location : Oldbury, West Midlands, UK

Injured : 0 **Dead :** 0

Abstract

The explosion in phosphoric acid plant was caused by overpressurisation within a column used to condense phosphorus pentoxide formed by phosphorus burning in air in a reactor at the bottom. This caused a bursting disc to rupture.
[reactors and reaction equipment, processing]

Lessons

[None Reported]

1196415 July 1995

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

An overflow occurred on a tank containing bitumen and white spirit when water flowed into the tank. The maximum possible overflow for the tank was 4.5 tonnes containing 43% white spirit. It is not known why the water flowed into the tank.
It is thought that the majority of the material was retained on site but an unknown amount was lost into the nearby river causing a slick.
[spill, unidentified cause]

Lessons

8407 14 July 1995

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

Depentaniser bottoms pump failure. A fire started in the seal area of the depentaniser pump, fuelled by leaking process fluid.
It was found that the pump's bulb drain plug had fallen out and the loss of oil caused overheating and failure of the pump bearings, eventual deformation of seal and subsequent product leakage. When the plug was removed for maintenance, at some time, it was not completely re-inserted. Over a period of time, the plug backed out of the housing, probably due to vibration.
[fire - consequence, processing]

Lessons

Checking for system tightness is essential on equipment, such as pumps, after maintenance, including oil changes. Records should be available of maintenance, lube oil changes, etc. to establish pump history.
Adequate pump isolation facilities e.g., remotely actuated and protected isolating valves are usually recommended for hydrocarbon duties depending on characteristics of fluid being pumped (volatility, toxicity, temperature, etc.).
Deluge systems need to be regularly tested and flushed through, and pipe work and nozzles preferably constructed of materials not subject to corrosion and blockage.

1855 05 July 1995

Source : SEDGWICK LOSS CONTROL NEWSLETTER, 3RD QUARTER, 1995.
Location : Songkhla, THAILAND

Injured : 0 **Dead :** 1

Abstract

Marine transportation. 2 million litres of benzene were destroyed in an explosion in engine room and fire when marine tanker was offloading at this storage facility. Fatality.
[fire - consequence]

Lessons

[None Reported]

8399 12 June 1995

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

Natural gas pipeline system overpressure. A pilot diaphragm in a metering station supplying the plant with natural gas failed. Due to several other compounding issues, the pilot failure caused the stand-by let-down station to go wide open, and resulted in a serious overpressure of the plant's natural gas distribution system. The incident was caused by failure of a diaphragm on the second stage PCV pilot which sent natural gas to the pilot vent line; the pressure equalising across the diaphragm simulated a low sensing pressure and caused the second stage PCV to go wide open, creating overpressure in system. There was no regularly scheduled programme of servicing and testing on meter station valves and instrumentation. Servicing was sporadic and minimal. The pilot diaphragms were not replaced according to manufacturer's recommendations, based on minimum expected life. Near miss.
[overpressurisation, operation inadequate]

Lessons

For utility supplies entering petrochemical plants:
1. Don't assume that they are adequately protected. Analyse the risks and assess the safeguards associated with these interfaces.
2. Ensure there is ongoing maintenance of equipment and instrumentation whose reliability impacts on your plant.

8374 10 May 1995

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

Isocracker explosion at a refinery. While pressure testing discharge valves on an out-of-service reciprocating compressor, 2100 psig process pressure blew out a gasket at the blinded flange in the system. A vapour cloud was released and subsequently ignited. It was found that the temporary compressor side blank failed due to pressure above its design capability. Operations personnel conducting the pressure testing were not familiar with the pressure limitations of the blind that was in place.
[vapour cloud explosion, overpressurisation, refining]

Lessons

Need to ensure that correct blinding is always used to meet the maximum pressure capability of the system. Need to ensure that Operations personnel are knowledgeable of the application limitations of various blinding systems which may be used.

8390 23 April 1995

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

Isocracker heat exchanger flange leak at a refinery. An Isocracker Unit was shutdown due to a small pinhole leak found in the first stage feed/effluent exchanger outlet piping. After disassembly of the piping system, the flange revealed extensive cracking.
Losses including damage to equipment, product loss, and materials and labour amounted to $1.3 million (1995). It was found that chloride stress corrosion cracking caused the incident. All four criteria for chloride stress corrosion cracking were present: Material of cracked flange was austenitic type stainless steel, known to be vulnerable to chloride cracking. Flanges were overcompressed and the joints had not been hydraulically torqued during previous turnaround. Even low overall concentration of chlorides got into grooves and pits during cycling and went undetected for many years/cycles.
[refining, cracking]

Lessons

Chloride stress corrosion cracking propagates during start-up and shutdown periods, even in low overall concentrations of chloride, concentrating in grooves and pits.

8527 15 February 1995

Source : HAZARDOUS CARGO BULLETIN, 1995, APR.; EUROPEAN CHEMICAL NEWS, 1995, FEB, 27.
Location : Essen, GERMANY

Injured : 4 **Dead :** 1

Abstract

An explosion and fire occurred at a chemical plant applying silicone coatings. The blast occurred when some polymethyl hydrogen siloxane was accidentally fed into a reactor, together with the correct feedstock, allyl glycidyl ether. The two epoxides reacted, overheated and hydrogen burst out of a ruptured pipe into the building, where it mixed with air and exploded. The 5 workers were caught in the resulting fire. According to the Company, the police believe that human error is to blame. Although both chemicals were labelled, they were stored in drums of the same colour. Damage is put at DM 10m $6.7m (1995). Fatality.
[fire - consequence, human causes, damage to equipment, identification inadequate, overheating, chemicals added incorrectly, charging reactor, reactors and reaction equipment]

Lessons

[None Reported]

1193403 February 1995

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

During commissioning of a distillation column, operation of the ESD system resulted in pressurisation and failure of a bursting disc. Repeated reset and initiation of the ESD resulted in flooding of the column. This flooding resulted in the discharge of about 2 tonne of 5% aqueous acetone into the bund when the bursting disc opened.
A bursting disc was provided, as it was believed at the time that no suitable relief valve was available. The column normal operating pressure was 3.5 psig and the design pressure was 5 psig.
[bursting disc failure, spill, overpressurisation]

Lessons

The investigation concluded that: -
1. The installation of the level switch that initiated the ESD should be reviewed. It appeared that the switch spuriously indicated low level when the effluent pump was started.
2. The location of the bursting disc and its vent line should be reviewed to consider whether it is acceptable to allow an uncontrolled release of a flammable vapour and liquid into an accessible bund.
3. The operating procedures should be reviewed with particular emphasis on restarting the column after an ESD.
Subsequently the possibility of rating the column for a higher design pressure (8 psig versus 5 psig) and installing relief valves was considered.

3317 31 January 1995

Source : ICHEME
Location : Scotland, UK
Injured : 0 **Dead :** 0

Abstract

Overheating batteries, in a control room resulted in a strong and obnoxious smell of hydrogen sulphide. The batteries were Valve Regulated Lead - Acid (VRLA) type, in which the electrolyte (sulphuric acid) and gases produced during operation, are particularly immobilised in a porous fabric or gel.
Most of the gas re-combines to produce water, so little topping up is required.
The batteries had been receiving an overcharge current (40 amps) and had overheated with resultant battery casing damage. When high current circumstances exist, the H_2SO_4 electrolyte decomposes to release hydrogen sulphide.
[gas / vapour release]

Lessons

VRLA type batteries have a recommended lifetime of approximately 10 years. These batteries were about 6 years old. However, they had been operating at about 30 degrees C, at which temperature, lifetime would be expected to be reduced to about 5 years.
Thus, they had exceeded their effective expected life span.
Repeated earth fault alarms occurred in the two weeks prior to the incident, but this was never acted upon. The activation of this alarm is indicative of high current conductors.
The stated the following recommendations:
Recommendations were implemented to address the issues of:
1. Failure to respond to earth fault alarm.
2. Failure to respond to pressure of odour (H_2S).
3. Need for improved training in the understanding of alarm situations.
4. Need for better battery inspection regimes.
5. Need to ensure a lower operating temperature for batteries.

8141 16 January 1995

Source : SEDGWICK LOSS CONTROL NEWSLETTER, ISSUE 1, 1995.
Location : Melbourne, AUSTRALIA

Injured : 0   **Dead :** 0

Abstract

A fire arising from leak of crude oil from a nipple on crude distillation unit which failed following excessive pressure caused reduction by a third of refinery output.
[fire - consequence, processing, overpressurisation, high pressure]

Lessons

[None Reported]

8377 January 1995

Source : ICHEME
Location : ,

Injured : 0   **Dead :** 0

Abstract

Fired heater tube failure. A heater tube failed during the start-up of a naphtha hydrotreater unit, causing damage to equipment and product loss. It was found that a liquid seal stopped flow while heater was firing and the tube failed due to ductile overload/severe overheating (blockage). The incident was caused by changes to process conditions and modifications to unit that led to the development of liquid seals.
[tube failure, design or procedure error]

Lessons

Modifications to process design conditions and equipment must be subject to technical assessment and safety review.
Fired heaters require adequate instrumentation to ensure that overheating/uneven heating of tubes does not occur, e.g., individual pass flow and temperature monitoring, skin thermocouples, etc.

8359 January 1995

Source : ICHEME
Location : ,

Injured : 1 **Dead :** 0

Abstract

Asphalt release from blowing tower at a refining company.
An operations technician was burned by hot asphalt, released from a lifted rupture disc located at the top of the asphalt blowing drum. Overpressure in the blowing drum caused the rupture disc to lift and asphalt to be released. The basic cause was that the blown asphalt unit was operated outside designed operating parameters. In addition there was a lack of knowledge and inadequate written procedures which permitted abnormal operation and led to the malfunctioning of instrumentation and mechanical equipment.
[overpressurisation, instrumentation failure, mechanical equipment failure, design or procedure error, spill, refining, burns]

Lessons

Operators of asphalt (bitumen) blowing units need to have sufficient understanding of the chemistry of the process to appreciate what can result from changes in blowing air and the limitations of instrumentation.

6786 06 December 1994

Source : SEDGWICK LOSS CONTROL NEWSLETTER, 4TH QUARTER, 1994.
Location : Samson; Alabama, USA

Injured : 0 **Dead :** 0

Abstract

Fire at plastics plant caused evacuation of 3000 people. Liquid blowing agent left in mixer, where it suffered a decomposition, overheated and burned.
[overheating, fire - consequence, processing]

Lessons

[None Reported]

1171316 November 1994

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

An explosion and small fire occurred in a tri-acetate mill hopper. The hopper explosion relief panel lifted but the explosion relieved through a bag-filter door. There was limit damage to the plant and no injuries. A blockage had occurred in the transfer line from the base of the rotary drier. The valve at the base of the drier has stopped presumably due to choking. The blockage was clearer following standard practice. The explosion occurred during the unblocking operation. The cause of the explosion remains unclear. An explosible dust concentration was ignited within the hopper. The most likely ignition sources are tramped material or thermal degredation of tri-acetate material.
[solids processing equipment, flow restriction, cleaning, unwanted chemical reaction, overheating]

Lessons

1. Restrict access to the processing area - it was fortunately that no one was exposured to the force of the explosion.
2. Formalise procedures for clearing blockages.
3. Review instrumentation and control requirements for system to prevent blockages and allow automatic shutdown to be instigated.

8376 November 1994

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

Catalytic cracker vapour line deformation. During start-up of the reduced crude conversion unit (a heavy oil cracker), the reactor vapour line was heated up to a temperature sufficient to ignite coke in the line, resulting in overheating and deformation of the line. There was damage to equipment.
It was found that the line was heated beyond it's maximum capability. The cause was due to inadequate instructions, concerning operating limits, in the start-up procedure for the operators. In addition an air line heater outlet temperature indicator was not properly calibrated to read above the maximum allowable temperature.
[faulty instructions, cracking]

Lessons

Start-up procedures should include consequences of deviation as well as procedural steps to take to control temperatures and quench the reactor.

6733 19 October 1994

Source : OIL & GAS JOURNAL, 1994, 26 DEC., 27.
Location : Torrance; California, USA

Injured : 21 **Dead :** 0

Abstract

LPG pipeline was being brought back on line after maintenance work when there was a leak at a flange which ignited.
[flange leak, fire - consequence, start-up, inspection inadequate]

Lessons

[None Reported]

6717 04 October 1994

Source : HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1994, OCT.
Location : Rastanura, SAUDI ARABIA

Injured : 0 **Dead :** 0

Abstract

Loading overpressured a wing tank on a marine tanker causing an oil spill.
[overpressurisation]

Lessons

[None Reported]

6665 15 August 1994

Source : HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1994, OCT.; LLOYDS LIST, 1994, 18 AUG, & 24 AUG.
Location : Baton Rouge; Louisana, USA

Injured : 4 **Dead :** 0

Abstract

Explosion on a marine transport barge of toluene led to a fire at the hall buck marine terminal. Lack of an earth on the flexible hose probably ignited flammable vapours during cleaning of the barge.
[lack of earthing, static, fire - consequence]

Lessons

[None Reported]

8362 August 1994

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

A fire occurred on an absorber tower piping. After an equipment modification, there was a severe surge created, with major vibration. Flange leaks, loss of containment, and fire followed. There was damage to equipment. It was found that the control valve was oversized which led to surge condition within piping. The basic cause was that the management of change system did not require engineering specialist reviews for control valve changes.
[maintenance inadequate, fire - consequence, management system inadequate]

Lessons

Management of change processes should include clear requirements for the various types of equipment, and, as a minimum, should cover the following: pertinent documentation, relevant calculations, and special reviews by engineering.

6645 26 July 1994

Source : SEDGWICK LOSS CONTROL NEWSLETTER, 3RD QUARTER, 1994.
Location : Inchon; Seoul, SOUTH KOREA

Injured : 16 **Dead :** 5

Abstract

An explosion was caused by a furnace overheating. Fire extinguished in 1 hour. Substance involved butane. Fatality.
[processing]

Lessons

[None Reported]

6621 07 July 1994

Source : HSE REPORT, STATEMENT OF NUCLEAR INCIDENTS AT NUCLEAR INSTALLATIONS. 5, JAN.1995
Location : Windscale, UK

Injured : 0 **Dead :** 0

Abstract

A flask handling uranium oxide leaked contaminated water when moving from vertical to horizontal position. Quantity spilt exceeded notification level but was termed level 0 no safety significance. The water came from an unknown source.
[spill, unidentified cause]

Lessons

[None Reported]

8350 July 1994

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

Fouling in vacuum distillation unit at a refinery. Excessive build-up of fouling material in the top pumparound circuit forced an unscheduled shutdown. Fouling was found in the top pumparound circuit.
The most likely cause of this incident involved a series of circumstances leading to the processing of a feedstock containing unsaturated gas oils, more susceptible to coking and slowly cracked over time by a combination of air ingress and localised temperature excursions.
[thermal degradation, stress corrosion cracking, refining]

Lessons

Assuming that feedstock purchase decisions cannot be radically altered then some degree of fouling is inevitable.

1157901 May 1994

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A leak of benzene occurred at a jetty after a ship had been loaded with the material. There were no injuries but in the course of the investigation traffic on a public road was halted for a period. The quantity lost was estimated at less than 10 gallons. Initial estimates based on instrument reconciliation however, put the leak at 20 tonnes. While investigating the suggested 20 tonne spillage, site personnel discovered some hydrocarbons on mudflats near the outfall to the river. These were subsequently found not to be associated with the benzene spill. A small pool of liquid under a flange on the benzene loading line was also discovered.
The leak was caused by pressurisation of the line. This was because a valve between the thermal relief valve and its discharge to the storage tank was closed. The calculated discrepancy was caused by an error in a level instrument on a tank that had not previously been used for benzene.
The hydrocarbon on the mud flats had accumulated over a long period. An expanding plug left in a drain after maintenance work had been preventing contaminated water from flowing to the correct route. As a result the material overflowed into the river directly.
The joint was re-made and pressure tested and the line returned to service.
The internal enquiry recommended:-
1. Improving procedures for returning relief valves and other safety devices to service after maintenance.
2. Reviewing the drainage systems in the jetty tank farm area to ensure proper hydrocarbon containment.
3. A review of procedures for contacting external parties in the event of an emergency.
[loading, overpressurisation, design or procedure error]

Lessons

1. Maintenance procedures for safety items were inadequate.
2. Drainage systems in a tank farm area should be reviewed.
3. Off-site emergency contact procedures should be reviewed.

1170623 April 1994

Source : ICHEME
Location : , GERMANY

Injured : 0 **Dead :** 0

Abstract

A series of three explosion occurred within a few seconds in the waste incinerator of a chemical site during a night shift. There were no injuries and the damage sustained was slight. The incinerator burns waste from acrylics and viscose plants.The incinerator was operated for 20 years without any significant incidents. Salts (sodium sulphate and sodium hydroxide) were being charged and collecting as a molten pool in the rotary kiln section. A quantity of this residue had been allowed to build up. The explosion occurred within 2 minutes of a 14 drum charge being made to the system. On-site inspections suggested the damage caused was greater than that consistent with mild over-pressure but there had been no equipment failure. A Rapid Phase Transformation (or Physical explosion) caused by very hot molten salt entering the quench bath (containing water) from the kiln was seen as the most likely cause. This might have been triggered by a small transient over-pressurisation.
[charging, processing, overpressurisation, damage to equipment, accidental mixing]

Lessons

1. Inventories of molten salt to be minimised within the incinerator. The best means of achieving this is not to change salts containing metal ions to the system.
2. A programme of regular inspections of the kiln should be instigated to ensure that residues are not allowed to build up.
3. Restrict access to the area at the bottom of the kiln, especially during and after charging.

6494 05 April 1994

Source : HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1994, JUN.; LLOYDS LIST, 1994, 7 APR.
Location : Sui, PAKISTAN

Injured : 0 **Dead :** 0

Abstract

Fire and explosion following a leak in a pipeline between purification plant and compressor supplying natural gas from an installation. The suspected cause was overheating of the pipe.
[fire - consequence]

Lessons

[None Reported]

6472 18 March 1994

Source : PETROLEUM REFINER, 1995, FEB.
Location : Piper Bravo; North Sea, UK

Injured : 0 **Dead :** 0

Abstract

Two men were draining hydrocarbon from a sealpot using buckets. A fire began due to static in one bucket and spread to the mens clothing. The fire was extinguished quickly and neither were hurt. Neither of the buckets were bonded to earth. Company were fined £5000 (1994).
[fire - consequence, lack of earthing]

Lessons

[None Reported]

1092122 January 1994

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

A section of utility piping failed in a new distillate desulfurization unit at a refinery. The failure was as the result of internal overpressure generated from water freezing in a dead leg section of piping.
There was a release of hot product from the stripper section of the hydrotreater. The resulting vapour cloud ignited, and fire damage to nearby equipment released additional hydrocarbon.
The fire was brought under control in approximately one hour, and it was extinguished in 2 hours.
There were no injuries to personnel. Although the unit was quickly isolated, there was extensive damage to pumps, several air coolers, analysers, instrumentation, electrical conduits, and process piping. Direct damage to the unit was $5.9 million (1994), and the unit was down for 52 days.
The dead leg piping was a result of improper piping design and inexact project execution.
[overpressurisation, cold weather, mechanical equipment failure, vapour cloud explosion, gas / vapour release, damage to equipment, design or procedure error, fire - consequence, processing]

Lessons

1. Ensure that design teams identify expertise needed at an early stage; e.g., cold weather design experience was needed.
2. Resolve HAZOP issues, not items, making sure that the group which resolves actions communicates back to the HAZOP team, to ensure that true concerns are adequately addressed.
3. The Pre-Startup Safety Review (PSSR) should not only verify installation detail but that systems will function as intended. Piping configurations and other construction detail can sometimes cause systems to work poorly, or not as designed.
4. Ensure that new plant has an adequate provision of fire protection, both in terms of equipment and emergency response.

6340 14 December 1993

Source : LLOYDS LIST, 1993, 16 DEC.
Location : Prudhoe Bay; Alaska, USA

Injured : 0 **Dead :** 0

Abstract

A crude oil pipeline pressure surge caused a spill of 30 gallons of oil water mixture over an acre of snow covered tundra. The accident occurred at a well pad where production was restarting after maintenance work. The surge raised the pipeline from its supports and one of the supports punctured the pipeline.
[start-up]

Lessons

[None Reported]

8322 14 November 1993

Source : ICHEME
Location : ,
Injured : 0 **Dead :** 0

Abstract

Bitumen blower column overpressurised at a refinery. During start-up of the bitumen blowing unit, the bitumen blowing column was overpressured. Residue was blown from the top of the vessel and fell for a distance of about 150 metres. Water, that had entered the column undetected, vaporised to steam when it reached high temperature zone. Start-up procedures were slightly modified by individual experience of different shifts. Contributing was poor communications within the shift on at the time of the incident. The cause was due to start-up procedures being modified, albeit slightly; and no procedure existed for checking the guilty steam line.
[overpressurisation, refining, design or procedure error]

Lessons

Operating instructions must be carefully followed to ensure that water/light oils are not allowed to contact hot oils to avoid overpressurising equipment with possible rupture.

8361 October 1993

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

Spent acid failure. The alkylation unit's spent acid tank overpressurised, causing the roof and shell to separate completely from the floor, the reaction force propelled the tank into an adjacent tank. Hydrocarbons were released, and a fire ensued. There was equipment damage. It was found that weakly alkaline water was pumped into the spent acid tank, and the dilution of spent sulphuric acid in water released heat, increasing the temperature of the hydrocarbon layer, resulting in the tank overpressurising. The basic cause was insufficient monitoring to prevent weakly alkaline water from entering spent acid tanks.

[overpressurisation, spill, fire - consequence, damage to equipment, design or procedure error]

Lessons

When transferring liquids in a system containing acids and water solutions, account must be taken of the heat of dilution released by the chemical reaction of mixing acids with water or alkaline water mixtures. As was demonstrated, this can be sufficient to initiate equipment damage.

6233 22 September 1993

Source : EUROPEAN CHEMICAL NEWS, 1993, 11 OCT.
Location : Mirande De Ebro; Castille, SPAIN

Injured : 1 **Dead :** 0

Abstract

An explosion of 5 tonnes of vinyl chloride monomer (VCM) ocurred at a polyvinyl chloride (PVC) plant, leaving one worker with minor injuries and disrupting production for about 1 month. The polymerisation reactor on one of the plant's two lines sped up, increasing the pressure inside and forcing vinyl chloride monomer out through a valve and into the air, when it exploded. Total capacity of 72000 tonnes per year not severely affected as plant not operating at full capacity.
[explosion, overpressurisation, reactors and reaction equipment, injury]

Lessons

[None Reported]

8347 September 1993

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 1

Abstract

Steam pipe failure due to water hammer. Upon opening a steam valve, inside a pit, the valve failed from the force of the water hammer. There was some equipment damage. It was found that the valve was opened too quickly to allow the system to adjust, and a confined work space restricted action. In addition the cast iron valve was not strong enough to withstand water hammer.
Contributing was the unsuccessful use of a reach rod to open the valve, this caused the operator to fall into the pit. The basic cause was lack of written instructions for performing this task, and the operator had received no training or instruction. In addition the valve was not in a place easily accessible, and the material of construction was not a suitable material for steam valves, which are always liable to be affected by water hammer.
[damage to equipment, faulty instructions]

Lessons

Operating team as a whole needs to be aware of the hazards of water hammer in steam mains.

6208 27 August 1993

Source : CHEMICAL AND ENGINEERING NEWS, 1993, 6 SEP.; EXECUTIVE NEWS, 1993, 27 AUG.
Location : Elyria; Ohio, USA

Injured : 50 **Dead :** 0

Abstract

Two massive and several minor explosions hit this organic peroxide plant causing extensive damage to plant. A cloud of hydrochloric acid drifted over industrial and residential areas causing the evacuation of 5000 people. Explosion caused rupture of 2 above-ground sulphuric acid tanks. First explosion occurred in catalyst blending building following overheating of pump after it had gone dry. Fire then spread to adjacent building.
[fire - consequence, processing]

Lessons

[None Reported]

1089302 August 1993

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

Operators noticed an overheated line at an offgas treater unit. At that time, preparations were in hand to shut the unit down the following day, for a scheduled shutdown to screen the catalyst. The overheated section of line runs between the sulphur plant tail gas diverter valves and the treater unit in-line burner. A breech of this line would have led to a significant release of hydrogen sulphide to the atmosphere.
The line was red hot in locations near the treater unit in-line burner when the problem was discovered.
The in-line burner was promptly shutdown and the gas flow diverted to the incinerator stack. Nitrogen was introduced into the treater unit to cool the piping. The emergency response team was activated, and a nearby building in the refinery was evacuated as a precaution. An advanced warning was given, of the situation, and the potential for a leak. However, since the situation was promptly brought under control, only an "all clear" call was necessary. No environmental excursion resulted, no injuries were sustained.
[overheating, shutdown, evacuation, near miss]

Lessons

1. Operators must frequently be reminded of the hazard of high concentration hydrogen sulphide, found particularly in sulphur plant areas, and the need to wear safety equipment when responding to emergencies or breaking equipment containment in any way which can lead to escape of gas or sour liquids.
2. Overheating of lines due to uncontrolled combustion/sulphur pockets is not uncommon on such units; operators must be aware of rapid actions to take to prevent line or vessel rupture as was done successfully in this incident.
3. The provision of remote isolating facilities and skin couples on lines where experience indicates problems.

8310 02 August 1993

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A SCOT Unit at this refinery was scheduled for shut down on 3 August, to screen catalyst, as a high pressure drop across the reactor was limiting sulphur production. The shutdown procedure had been issued the week before, and it was re-issued again over the weekend in preparation for the shutdown. At 11.30 hours on 2 August, in preparation for the unit shutdown, and in order to stabilize the unit operation, the 16" start-up blower suction valve on the absorber overhead line, was cracked open. This move lowered the back pressure on the No. 2 Sulphur Train, allowing more process gas and air flow into the sulphur train. While the air to the train was being adjusted the heater outlet temperature dropped slightly. Fuel gas flow was increased to compensate for this temperature drop. Outside operators checked heater firing and reported the flames as slightly hazy. Additional fuel gas flow cleared this haze. Heater outlet temperature stabilized and unit operation looked okay. At about 15.30 hours the 16" blower suction valve on the absorber overhead line was opened further, and shortly afterwards, at about 16.00 hours, the SCOT heater inlet line was reported to be "cherry red". This line is insulated and has no temperature indication installed on it. Hydrogen to the SCOT unit was cut off immediately, the heater shutdown, and unit feed (Claus tail gas) diverted to the incinerator. Nitrogen flow was started through the heater via the blower suction line.
After the heater inlet line began to cool, additional nitrogen was added to the heater hydrogen supply line and later to the start-up blower discharge piping to aid in cooling. The 16" blower suction valve on the absorber overhead line was closed to prevent drawing heat back from the inlet line towards the incinerator. The heater outlet temperature dropped steadily and no further problems were noted.
An Incident Investigation Committee was set up and came to the following conclusions and recommendations.
1. The normal loop used for the blower operation was suspected to be plugged based on previous blower operation and the use of x-rays, it was recommended that the normal loop (Quench Tower Bypass) be insulated (this has been done).
2. The pressure drop across the SCOT reactor was too high for stable operation of the Sulphur Train; therefore develop shutdown guidelines based on plant performance, sulphur dioxide emissions versus allowable.
3. The lack of temperature indication on the inlet of the SCOT heater provided no early warning of an abnormal condition in the inlet line, so local skin couples should be installed on the line. Temperature sensitive paint will also be evaluated.
Other factors and recommendations arising from the incident:
1. There is a need for control room indication of the SCOT reactor pressure drop.
2. Operators responding to the incident should have worn self-contained breathing apparatus; this requirement will be incorporated into the Emergency Response Manual, other guidance.
3. A backflow prevention device on the blower is required and a request for a check valve should be submitted.
4. The ability to divert tail gas and the use of nitrogen purge could be hampered by the location of equipment; therefore, an engineering request will be submitted to specify the use of equipment needed for both the manual and automatic systems for nitrogen purge and for remote switches on the diverter valves.
[refining]

Lessons

Operators must frequently be reminded of the hazard presented by high concentration hydrogen sulphide found particularly in sulphur plant areas and the need to wear PPE when responding to emergencies or breaking equipment containment in any way
which can lead to escape of gas or sour liquids.
Overheating of lines due to uncontrolled combustion/sulphur pockets is not uncommon on such units, and operators must be aware of the rapid actions to take to prevent line or vessel rupture, as was done successfully in this incident.

8324 August 1993

Source : ICHEME
Location : ,
Injured : 0 **Dead :** 0

Abstract

Vacuum residue tank roof to shell seam failure at a refinery.
An atmospheric tank containing vacuum bottoms overpressured, releasing material into the immediate area and the community. There were no injuries. Previous damage to the tank roof went unfixed and was viewed as "normal" by operators.
Total dollar losses were in excess of $200,000 (1993).
The temperature of the product elevated due to pluggage of vacuum unit box cooler and the tank roof was damaged, possibly admitting higher oxygen content.
It was found that there was insufficient knowledge as to the safe operation of heavy oil tankage, and the tank used in a way other than that for which it was designed, it was used
beyond its design capabilities, and there was insufficient monitoring/observation of cooler while changes were being introduced.
[overpressurisation, refining, storage, damage to equipment, design inadequate, human causes]

Lessons

1. Rundown temperatures of residue to storage must not exceed safe levels.
2. Damaged tanks retained in service may exacerbate problems at a later date.
3. Temperature indications for storage tanks are usually poorly provided, giving operators limited reliable information. This needs to be considered when working close to safe temperature limits.

6171 August 1993

Source : ENDS REPORT NO. 232, 1994, MAY.
Location : Seal Sands; Cleveland, UK

Injured : 0 **Dead :** 0

Abstract

An explosion of a 50 tonne effluent waste storage tank occurred when hydrogen peroxide was passed to the tank. An oxygen rich atmosphere and the solvent vapours were possibly ignited by static generated by splash filling of the tank.

Lessons

[None Reported]

6166 29 July 1993

Source : HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1993, NOV.
Location : Richmond; California, USA

Injured : 0   **Dead :** 0

Abstract

A rail transportation incident. A rail tanker leaked sulphuric acid which formed a cloud 1000 ft high and 6 to 8 miles long. Industrial area evacuated. Workers were moving the tanker when pressure inside the tanker lifted the safety relief valve.
[overpressurisation, evacuation, spill]

Lessons

[None Reported]

8320 July 1993

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A cooling tower brominator failure. A rapid overpressurisation of a brominator resulted in the PVC cap and exit piping to be blown free from the brominator's fibreglass shell.
Overfilling of the brominator with product minus the proper accompanying water level together with a higher than specification process additive content created an environment for exothermic product decomposition leading to generation of gases and subsequent pressure build-up. There were inadequate procedures for delivery and for verification of water level. The impact of incorrect levels in the brominator and change in chemical additive were not assessed.
[cooling equipment, overflow, design or procedure error]

Lessons

Routine operations, if not done properly, can be a link in a chain of events leading to an incident.

6039 20 April 1993

Source : LLOYDS LIST, 1993, 21 APR.
Location : Kythnos Island, GREECE

Injured : 0 **Dead :** 0

Abstract

20 mile by 20 yards oil spill from unknown source.
[unidentified cause]

Lessons

[None Reported]

6038 19 April 1993

Source : LOSS PREVENTION BULLETIN, 113, 25-25.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Vinyl acetate odour was noticed inside a reactor shed coming from an atmospheric Pre-Emulsion (PE) tank. The manway cover had lifted off the tank and emulsion was present on the deck in front of the manway. The PE tank held a complete pre-emulsion (monomers, maleic anhydride, surfactant, ferrous sulphate and water) since the previous shift on Friday night. Sometime between Friday evening and Sunday evening, a reaction began in the PE tank and was still taking place when the start-up crew arrived at midnight on Sunday. The Shift Supervisor shut the agitator off, recorded the PE tank temperature (60 degrees C) and evacuated the reactor area. Incident Command was established. Personnel donned breathing apparatus and rain gear and entered the area carrying an LEL/O2 meter. They started the agitator on the PE tank. A sudden pressure surge again lifted the manway cover off the tank. They stopped the agitator and evacuated the area. Moments later they returned to the PE tank, replaced the manway cover, began circulation of the pre-emulsion through the heat exchanger and left the area. Periodic entry to the area to monitor the PE tank temperature while the area was continually monitored for flammables and oxygen (O2). The Safety, Heath & Environment Manager arrived and called the Fire Department. She also contacted the Distribution Safety Manager who advised her to create a water quench in the reactor and transfer the pre-emulsion from the PE tank into the quench. Water and inhibitor were added into the cleaned reactor. The pre-emulsion was slowly metered into the reactor while monitoring the PE tank temperature and the filled space inside the reactor. Once they confirmed that the temperature was holding steady, they increased the pre-emulsion transfer rate. Approximately two-thirds of the pre-emulsion was transferred into the reactor resulting in a temperature drop to 23 degrees C effectively quenching the reaction. Water and inhibitor were added to the remaining pre-emulsion in the PE tank and the material was circulated through the heat exchanger. After confirming that the PE tank temperature was stable, the PE agitator was started. The PE tank temperature dropped from 54 to 37 degrees C. Conditions remained stable on both the reactor and the PE tank and an end to the emergency was declared.
The key findings were:
1. There were a number of problems associated with the emergency response actions and equipment availability.
2. Some formulations called for adding catalyst or other additives to the pre-emulsion tank.
3. The pre-emulsion tank was not monitored.
[reactors and reaction equipment, runaway reaction, spill]

Lessons

Key actions taken were:
1. No monomer mix or pre-emulsion will be left unattended or monitored.
2. Remove catalyst and activators from the pre-emulsion tank.
3. Establish written procedures for minimising hold times of pre-emulsion and monomer mix for handling non-typical (e.g. polymerisation) situations.
4. Improve written emergency response procedures and employee emergency response training.
5. Remove heat sources from pre-emulsion vessels.
6. Complete the ongoing process vessel high temperature/high level alarm project.

6026 09 April 1993

Source : THE CHEMICAL ENGINEER, 1993, 29 APR.
Location : Te Rapa; Hamilton, NEW ZEALAND

Injured : 0 **Dead :** 0

Abstract

Pin-hole leak in spray nozzle within drier caused overheating at this wholemilk powder factory. Fire began on top floor.
[fire - consequence]

Lessons

[None Reported]

1088731 March 1993

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

The roof of a tank which was located in an Effluent Treatment Plant lifted off the tank and flew some 175 feet south. The roof knocked over an area lighting pole, severed some power lines, bounced on the ground, and eventually came to rest near a railway track. The gauger's platform was also separated from the tank and travelled some 100 feet east, landing near a filter house.
Witnesses in the area reported hearing an explosion, seeing flames coming from the tank, and seeing subsequent arcing coming from the power transmission lines. Witnesses reported that the flames were present only during the initial flash and that smoke dissipated after a short time. Witnesses also reported hearing a turbine-like roar which lasted several seconds or more immediately preceding the incident.
After the explosion, the tank wall and floor remained intact. No leakage of the tank contents after the event were noted. There were no injuries.
It has been determined that the roof on the tank failed due to the ignition of a flammable mixture in the vapour space of the tank. While numerous sources could potentially create a flammable vapour space in the tank, the most probable source was normal variations in the volatility of the Dissolved Air Flotation (DAF) float combined with changes in sealing and scrubbing of the DAF units required by environmental regulations.
Evidence points to overheating of the carbon drum on the tank vent as the source of ignition.
[explosion / pressure release, mechanical equipment failure, gas / vapour release]

Lessons

[None Reported]

5972 02 March 1993

Source : HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1993, MAY.; LLOYDS LIST, 1993, 4 MAR.

Location : Agioi Theodoroi, GREECE

Injured : 7 **Dead :** 0

Abstract

An explosion occurred during the testing of an empty oil tank by hydraulic pressure. Substance: water.

Lessons

[None Reported]

8304 March 1993

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

Tank explosion attributed to reaction in carbon drum on vapour recovery system. An explosion in a tank lifted the roof and deposited it 175 feet southward. After the explosion, the tank wall and floor remained intact. There was no leakage of tank contents noted after the event. The most likely cause was the presence of a mixture in the vapour space of the tank and overheating of the carbon drum on the tank vent presented a source of ignition.
[unwanted chemical reaction, drums]

Lessons

Installation of vapor recovery measures can introduce "hidden" hazards to a site.

5962 22 February 1993

Source : CHEMICAL HAZARDS IN INDUSTRY, 1993, APR., 4.; CHEMISTRY IN BRITAIN, 1993, MAY., 380; EUROPEAN CHEMICAL NEWS, 1993, 22 MAR., 6.

Location : Frankfurt, GERMANY

Injured : - **Dead :** 0

Abstract

Two tonnes of o-nitroanisole, a dye preparation intermediate, was released from a plant. The leak occurred after a worker failed to activate a stirring instrument, causing a batch to overheat and blow through a safety valve.
The foreman, the plant manager and the site manager were fined a total of DM500,000 (1993) over the major leak. A fourth employee who operated a stirring instrument wrongly causing the discharge was given a six-month suspended sentence on charges of violating air pollution laws and causing bodily injury through negligence.
[pollution, operation inadequate, overheating, reaction]

Lessons

[None Reported]

1053721 January 1993

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 1

Abstract

During the unplugging of a steam mixer with steam (steam purge), the increase in pressure forced the material back up the chute and into the washer. The impact of the expelled material blew off the partial hood of the pulp washer. The hood (approximately weight: 1,000 pounds) landed on a nearby worker and killed him.
Steam mixers are used to increase the effectiveness of bleaching chemicals on pulp by raising its temperature. They are meant to operate at atmospheric pressure.
[fatality, purging, high pressure, explosion / pressure release, reverse flow]

Lessons

The following recommendations were made:
1. It is recommended that the purging of a plugged steam mixer be done using low-pressure water and/or by physically opening the vessel to manually remove the stock. These methods are currently in use in many mills.
2. If steam is to be used to purge a plugged mixer, all workers to be evacuated from areas at risk of rupture and discharge (e.g. washer and steam mixer areas) to a safe location during a steam purge operation.
3. Although a fully enclosed hood on the washer (as opposed to a partial hood) may not contain a steam purge, it would improve containment of periodic steam "blow-backs" which occur during normal operation when a steam mixer is downstream of a washer.
4. Any opening in the full-enclosure hoof (e.g. inspection doors, sampling ports) shall be offset at least 10 feet from the pipe connecting the washer to the steam mixer.

1088602 January 1993

Source : ICHEME
Location : Florida, USA

Injured : 0 **Dead :** 1

Abstract

An explosion and fire occurred on a tank, 100 feet in diameter, with a covered floating roof (steel pan).
The tank's content was unleaded gasoline with added butane to increase RVP. Exact composition of fuel not known.
A tanker was unloading gasoline to the tank when, during the night of 2 January, 1993, an overflow occurred. The overflow from the tank was estimated to be about 50,000 gallons in size. Intended transfers to another tank had not occurred. At about 03.15 hours there was a tremendous explosion which rocked the area, with a fireball sent hundreds of feet into the air.
Only one operator was on duty and had, at some time, driven his vehicle (gasoline engine) into the bunded area presumably to monitor tank filling.
It was subsequently established that the incoming fuel flow was such that fuel was ejected through the top roof vent so that thousands of gallons of fuel covered the area both inside and outside the bund. Potential ignition sources included the operator's company vehicle (his body was found about 10 feet from the vehicle), overhead power lines, or other sources outside the bunded area.
[fire - consequence, floating roof tank, static, road transport, fatality]

Lessons

[None Reported]

5743 10 August 1992

Source : THE CHEMICAL ENGINEER, 1992, 15 OCT.
Location : St Fergus; Peterhead; Scotland, UK

Injured : 1 **Dead :** 0

Abstract

During commissioning of a process heater a rise in gas pressure extinguished the flame by blowing it off the burner. This allowed a build-up of gas which was ignited by the pilot light. The resulting explosion badly damaged the heater. Substance: oil.
[overpressurisation, damage to equipment]

Lessons

[None Reported]

1080210 August 1992

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A day tank became overpressured, resulting in the release of approximately 24 tonnes of light polymer mixture to atmosphere. Nobody was injured. The plant had been shutdown.
The incident occurred when mixing liquid water with high temperature light polymer mixture. The resultant flashing of the water produced enough pressure to bevel the base of the tank by 4 inches and generate a 50 foot plume of light polymer mixture. The water is considered to have originated from the plant wash section which is flooded with condensate to displace all hydrocarbons when the plant is shutdown for a de-butaniser column wash.
All contaminated pipework was drained to removed all traces of water from the system.
The spread of light polymer mixture to the plant drains was minimised by tankfarm bund walls and the use of absorbent material as makeshift bunds. A clean up plan was formulated and put into action immediately. This did not, however, prevent the site combined effluent being out with consent at a level of 34 ppm total oil (consent = 30 ppm).
[overpressurisation, gas / vapour release, contamination]

Lessons

[None Reported]

5723 23 July 1992

Source : ASSOCIATED PRESS; HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1992, OCT.
Location : Orem; Utah, USA

Injured : 0 **Dead :** 0

Abstract

Power supply failure while adding materials, trimethyl phosphite and methyl chloroacetate, to a vat stopped a mixer and the mixture overheated causing a release of vapours.
[overheating, agitation failure, gas / vapour release, mixing]

Lessons

[None Reported]

5694 24 June 1992

Source : FIRE, 1992, NOV.

Location : Banbury; Oxfordshire, UK

Injured : 1 **Dead :** 0

Abstract

A pressure build-up in a silo was believed to have blown off an inspection manhole and caused a vacuum which then sucked in a worker. A hydraulic platform was used to rescue him.

[silo/hopper]

Lessons

[None Reported]

5668 25 May 1992

Source : THE CHEMICAL ENGINEER, 1992, 11 JUN.
Location : Ekofisk; North Sea, UK SECTOR

Injured : 0 **Dead :** 0

Abstract

Cleaning of gas turbine with high pressure water and chemicals had been completed and the gas alarm turned off as it was affected by the cleaning chemicals. On running up the gas turbine to full power a flameout occurred but because the gas alarm had not been reset the build-up of gas in the combustion chamber went undetected. On re-ignition there was an explosion which set fire to the inlet air filter.
[fire - consequence, operation inadequate]

Lessons

[None Reported]

1079606 May 1992

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A small fire occurred in an ethylene oxide unit when a flange leak caught fire. An orifice flange had developed a leak and was dripping ethylene oxide. The oxide dripped onto a cable tray underneath. The PVC of the cables was weakened by ethylene oxide attack. A short circuit was made which ignited the ethylene oxide. The leak became bigger due to expansion of the long bolts used to assemble the orifice flanges.
[fire - consequence]

Lessons

[None Reported]

5633 13 April 1992

Source : LLOYDS LIST, 1992, 6 MAY
Location : Belding; Michigan, USA

Injured : 0 **Dead :** 0

Abstract

A fire occurred at a fiberglass plant that destroyed the filament wound tank plant. The fire started in the area where revolving tanks where being sprayed with resin. Ignition was believed to be due to static.
[fire - consequence]

Lessons

[None Reported]

5235 April 1992

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

In April 1992, an operator detected two leaking flanges at joints in the overhead transfer line at a catalytic cracker reactor.
Measures taken to avoid ignition were successful.
In August 1991, a hydrocarbon leak was detected on the overhead system. The leak was repaired, however, during the installation, thermal lagging was erroneously applied over the flanges and their bolts on the two inlet nozzles of the reactor.
The basic cause for the leakage can be attributed to covering the flanges with thermal insulation. This was done for the whole of the reactor overhead transfer line at the August, 1991, repairs. This allowed the flange bolts to reach temperatures close to the process ones (approximately 515 degrees C), and at this temperature the bolt material of 21Cr/Mo/V 57, enters the yielding area (stress relaxation). With increasing service time, material elasticity is lost as follows:
Length of exposureRemaining Tension
1,000 hours of service50%
10,000 hours of service25%
In this way the flange surface pressure is reduced after a given service time to below-the-design requirements, and a leak will result. In this case the service time was approximately 5,500 hours.
After removing the insulation from the flanges, and successively replacing all the bolts and raising their tension (to about 75% compared to room temperature), both flanged joints became tight again.
Insulation on all flanges in the reactor overhead transfer line, and flange connections to that line, was removed.
[reactors and reaction equipment, flange leak, cracking]

Lessons

According to Quantitative Risk Assessment (QRA), flanges in such hot services should not be covered by thermal insulation, because:
1. Bolts can reach temperatures close to the process temperature, with high temperatures increasing the probability of leakage due to bolt stress relaxation.
2. The severity and extent of damage is higher in the case of leakage under thermal insulation, since the leaked product can spread unnoticed and be absorbed by the insulating material.
Heavy oils being transferred in thermal insulated piping presents a very high risk of fire in case of leakage since they flow at temperatures higher than their auto-ignition temperatures (over about 200 degrees C).

5551 17 January 1992

Source : EC COMMISSION OFFICIAL JOURNAL, 1992, 14 SEP.
Location : Drapetsona, GREECE

Injured : 0 **Dead :** 0

Abstract

Overheating led to a release of phosphoric acid, sulphuric acid, ammonia and methane into the air.
[fire - consequence, gas / vapour release]

Lessons

[None Reported]

7611 13 January 1992

Source : LOSS PREVENTION BULLETIN, 129, 11.
Location : Texas, USA

Injured : 0 **Dead :** 0

Abstract

A reaction vessel in a raw material process unit at this chemical plant ruptured during a cleaning operation. This vessel was a centrifugal feed tank with an 31,000 litre capacity and maximum allowable working pressure of 15 psi (1.03 bar).
The rupture and subsequent plant damage was caused by steam pressure that was generated by heat from a chemical reaction. A continuously increasing, highly exothermic reaction provided the heat source for the expanding supply of steam. The decomposition of this material resulted from overheating the vessel with steam to the coils during the cleaning operation.
The reconstruction of the new facility was completed one to two months ahead of schedule.

Lessons

[None Reported]

7872 January 1992

Source : LOSS PREVENTION BULLETIN, 109, 7-10.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A centrifuge feed tank, of 30 m3 capacity, manufactured of rubber lined carbon steel and containing an aqueous slurry of iminobaisacetonitrile (IBA), ruptured due to overpressurisation caused by decomposition reactions during a cleaning operation. Although personnel injuries were minor, there was extensive damage to plant facilities. The cost of plant rebuilding and the business interruption loss amounted to the equivalent of well over £10 million (1992).
On the day of the incident a large build-up of solids was noticed on the internal coil and in the tank headspace, and level instrumentation problems were experienced. Further investigation revealed that the tank vent was blocked and causing the level transmission errors by allowing a vacuum in the tank. Realising that tank clean out was necessary, operational staff stopped transfers into the tank and continued feeding forward to the centrifuge via a side outlet. When the level dropped to this outlet, an attempt to empty the heel of slurry to the centrifuge through the tank bottom was made, but the connection was blocked. The blockage was cleared but the heel was not emptied.
The tank was then filled with process water until the level reached the upper tangent line of the top head, as observed through a sightglass. At 1615 hours circulation was started and steam was turned on to the coil, with the objective of heating the contents to 70 degrees C and then allowing circulation of the hot water for a further 30 minutes. Soon after the steam flow was started the level indicator reading returned to normal, suggesting that the tank vent was at least partially open.
At 1640 hours the tank contents reached 40 degrees C, the upper limit of the installed temperature indicator. Subsequently, temperature measurements were made using a portable surface-reading pyrometer on the circulation pump suction piping. At 1740 the temperature was 55 degrees C and at 1835 it had reached 74 degrees C. Steam was then shut-off from the coil, the circulation was stopped, and an operator tried to empty the tank contents via a gravity drain line.
Draining was unsuccessful due to a blockage in the pipe, a flexible hose to a drain valve on the discharge of the pump. At 1910 hours draining was started via the hose to a floor drain. The operator looked through the tank sightglass to confirm that the level had started to decrease before returning to the control room.
At about 1920 hours two field operators responded to what sounded like a high pressure steam leak in the feed tank area of the plant. Almost immediately they came within view of the tank, at a distance of about 12 metres, it violently ruptured. They were blown backwards and sprayed with a black residue, but returned to the control room unaided and sustained only minor injuries.
The tank overpressurisation was caused by the steam pressure that was generated by the heat of chemical reactions. Initially the IBA started to decompose due to overheating during the cleaning operation. The hydrogen cyanide (HCN) formed then polymerised, significantly augmenting the heat evolution, and provided the heat essential for vessel rupture.
The chemical reactions were initiated by the use of a tank cleaning operation which was unsuitable for the process material, particularly in respect of heating medium, water quality and procedure.
[vent blocked, solids deposition]

Lessons

As a result of the investigation a series of preventative recommendations were made:
1. Reduction in IBA build-up.
Consider the impact of upstream equipment performance and operations on solids build-up in the feed tank.
Consider the installation of nozzle inserts in the feed tank entry and re-circulation piping to minimise splashing and run-down on the head.
Consider operating the feed tank through the bottom outlet only and decide on the need for a side outlet.
2. Reduction in IBA quantity at clean out.
Establish clear guidance on the planning and minimum frequency of feed tank clean outs.
Enssure that cleaning is carried out before the build-up is too large, and only after the feed tank is fully drained.
3. Reduction in temperature to safe level below IBA decomposition.
Enssure that steam is not used for cleaning the feed tank and for unblocking/decontaminating associated piping. Remove steam connections to the coil.
Develop a safe temperature controlled method for cleaning the feed tank and associated piping, provide the necessary facilities to support the method, and establish formal instructions for clean out.
Enssure that steam is not used for cleaning all other vessels where IBA is present and for unblocking/decontaminating associated piping. Provide for temperature controlled cleaning as above. Where steam heating is employed as part of normal operation, evaluate the use of tempered water or gain formal approval of continued use of steam.
4. Reduction in IBA exposure time to heat.
Provide for specified time limits as part of new cleaning procedures.
5. Prevention of contact with alkaline solutions.
Connect only non-basic pH controlled water to the feed tank.
Connect only non-basic pH controlled water to other vessels containing IBA and/or HCN .
6. Improvement in process instrumentation.
Provide an improved temperature measuring system on the feed tank to reliably monitor both normal and clean out temperature ranges.
Provide a high temperature alarm, high temperature interlock, and high rate of temperature rise interlock on the feedtank. Either interlock should discontinue cleaning operations and initiate corrective actions.
Provide a high temperature alarm, high temperature interlock, and high rate of temperature rise interlock on other vessels containing IBA and/or HCN. Either interlock to be discontinue normal operations and cleaning operations, and initiate corrective actions.
Provide an improved level measuring system on the feed tank to operate reliably independently of vessel pressure.
7. Improvement facilities in emergency.
Consider the provision of quench systems to terminate a reaction if started in the feed tank and other vessels containing IBA. Ensure that the feed tank and other vessels containing IBA are provided with vent systems of adequate size which can be monitored and maintained operational.
8. Improvement in process knowledge and documentation.
Enssure that all process documentation is updated to effectively emphasise the reactivity and thermal stability characteristics of IBA. Establish a procedure to review, incorporate and communicate changes or new information impacting process safety at least annually. Educate all personnel on the hazards of IBA reactivity, particularly in respect to the revised operating and cleaning procedures introduced.
9. Additional hazard assessment.
Conduct HAZOP studies on designated IBA/HCN containing vessels throughout the manufacturing process.

8727 1992

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

An aqueous solution was unloaded from a deck tank into tote bins. The deck tank was pressured with nitrogen to 20 psig and top loading of the bin was used. At the time of the incident, the unloading was nearly completed and nitrogen was flowing through the pipework. The operator noticed 6 inch sparks between the metal straps on the tote and the metal lid which holds the dip pipe and the vent.
The cause was the build up of static electricity on an unearthed vessel.
Generation took place while nitrogen was flowing with mist as normally a gas flow would not cause static. The static charge collected on the liquid and since the tote was lined with polyethylene it was not readily dissipated. The accumulation of charge on the inside of the tote induced a charge on the metal frame in contact with the liner. Since the frame was not well earthed it discharged to the pipeline.
[corrosive solution, processing, material transfer, loading, packaging equipment, tote, static discharge, unsafe condition, plant / property / equipment]

Lessons

Since the corrosive solution was not flammable the consequences were not serious. The easiest way to prevent static charges is to earth the pipeline, the tote and the weigh scale.

5502 07 December 1991

Source : RELEASE OF CHEMICALS, A REPORT OF THE INVESTIGATION BY THE HSE INTO CHEMICAL EMISSIONS ON 7 DECEMBER 1991
Location : , UK

Injured : 0 **Dead :** 0

Abstract

Three and a half tonnes of chemicals were released from a reaction vessel. The cloud of vapour was blown by the wind 4 km and affected 60 people. An unexpected chemical reaction occurred which overpressured the reactor. Substances involved: dimethyl aniline, dimethylamino benzoic acid and phosgene.
[unwanted chemical reaction, overpressurisation, reactors and reaction equipment]

Lessons

[None Reported]

5501 06 December 1991

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

3 to 4 explosions in a nylon intermediate scrubber caused ejection of polypropylene packing, most probably due to a buildup of static in the solvent containing areas of the scrubber.
[separation]

Lessons

[None Reported]

7502 06 September 1991

Source : LOSS PREVENTION BULLETIN, 119, 11.
Location : , DENMARK

Injured : 0 **Dead :** 0

Abstract

Ethyl acetate was transferred from a storage tank via a flameproof pump with a capacity of 800 litres per minute to a three-compartment stainless steel road tanker with a capacity of 22,600 litres. The tanker had previously carried a brine solution but had been washed out with hot water and was inspected and confirmed satisfactory before commencement of loading. The tanker was positioned at the loading point and the vehicle's electrical equipment isolated. An earthing cable was connected to the tanker and a proving unit confirmed that a good earth had been made. An aluminium loading lance with a 5 m length of hose was lowered through the open man-lid into the front compartment which had a capacity of 13,500 litres. The loading operation was started.
The tanker driver and the supervisor were present on the loading platform when they both heard a metallic clicking noise coming from the loading hose. They assumed that this noise came from rust/metal in the loading line. The supervisor checked and found that the earthing connection was still satisfactory. The supervisor came down from the gantry in response to his telephone pager and while he was passing the tanker he heard an explosion and saw flames coming from the man-lid into which the ethyl acetate was being loaded. The loading pump was stopped immediately and the fire quickly extinguished.
After investigation it was found:
1. 3420 litres of ethyl acetate had been loaded.
2. All electrical equipment was found satisfactory including the earthing point.
3. An internal inspection of the road tanker showed no evidence of the sparking or fire.
4. There was no evidence of any items on the gantry which could have caused the ignition. Personnel involved in the loading were wearing anti-static footwear.
5. The loading velocity was estimated at 6.5 m/s through the 5 cm loading lance.
6. The loading lance was 1.4 m long and was designed so that it would sit upon the man-lid and reach the bottom of the compartment of older elliptical tankers. However, the newer tanker was used for this loading which was circular in cross-section and the lance was 50 cm short of reaching the bottom of the compartment being loaded. The liquid level was estimated to have been 10 cm below the bottom of the lance at the time of the ignition.
7. There was no evidence of rust that could have given a thermite reaction with the aluminium lance. The tanker was stainless steel. It was concluded that there was an ignition between the earthed lance and static on the surface of the ethyl acetate.
[material transfer, fire - consequence]

Lessons

Splash loading of ethyl acetate can produce a static charge despite its high conductivityAluminium filling lance should be replaced by a stainless steel one.

1049306 September 1991

Source : ICHEME
Location : , DENMARK
Injured : 0 **Dead :** 0

Abstract

A fire occurred whilst ethyl acetate was being loaded into a road tanker at a distribution terminal.
The stainless steel tanker was positioned at the loading gantry, and an earth connection made and proved.
An inspection showed that the tanker was clean. An aluminium loading lance (connected to the ethyl acetate loading line via a 5 metre length of hose) was lowered into the front compartment of the tanker. The isolating valve in the ethyl acetate line was opened and the pump started. Loading started at a rate of about 800 litres/minute (6.5 metres/second through the 2 inch loading lance. During the initial loading period, the supervisor heard 'clicking' noises - he checked that there was still a good earth connection, but there appeared to be no problems.
After about 3,500 litres of ethyl acetate had been loaded, there was an explosion and fire at the open manlid of the tanker. The loading pump was stopped, isolation valve closed and the fire quickly extinguished. The temperature in the tanker was about 400 degrees C.
Electrical resistance checks on the loading lance, hose and road tanker were all satisfactory. There was no evidence of the presence of water (which can cause static generation). Personnel were all said to be wearing anti-static footwear.
The main problem which was identified was that the loading lance was designed for an older type of tanker, and was not long enough to reach the bottom of the new tanker compartments. (There was a gap of 50-75 cm to the tank bottom, and it was estimated that the level of ethyl acetate in the tank would have been about 10 cm below the end of the lance at the time of ignition). It is believed that the 'splash loading' of ethyl acetate generated a static discharge, causing ignition. It is also possible that rust or metal particles from the (recently commissioned) pipework may have contributed - perhaps by contact with the aluminium lance.
[road transportation, loading arm, fire - consequence, explosion / pressure release, loading]

Lessons

The following recommendations were made:
1. Aluminium lances should be replaced by stainless steel ones, and these should be designed to ensure that they reach the bottom of all designs of road tankers.
2. 'Step down' tank compartments should not be used for highly flammable liquids
3. Personnel should be retrained in the awareness of the dangers of splash filling
4. Consideration should be given to acid-washing the loading pipeline to eliminate rust/metal particles
5. The hose involved in the incident to be scrapped
6. Checks to be carried out on anti-static footwear

5361 20 June 1991

Source : LOSS PREVENTION BULLETIN, 129, 11; HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1991, AUG.; LLOYDS LIST, 1991, 21 JUN.
Location : Dhaka, BANGLADESH

Injured : 30 **Dead :** 7

Abstract

The failure of a welded joint between a carbon dioxide stripper and the main cylindrical body resulted in the release of high pressure gas, which consisted of ammonia, carbon dioxide, and carbamate liquids. Subsequent to the release, an explosion resulted which caused significant damage to this fertiliser plant. The source of ignition for this explosion is unknown. Fatality.
[weld failure, damage to equipment, injury, unidentified cause]

Lessons

[None Reported]

7906 21 April 1991

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

A tube burst in a hot oil heater resulting in a fire inside the heater at a refinery. The incident occurred during a start-up of the heater after a programmed electricity supply interruption to the area. The fire completely destroyed the heater coil with damage estimated at £750,000 (1991). There were no injuries sustained as a result of the incident. The loss of the heater caused a one week delay in bitumen deliveries.
A preliminary investigation was carried out on the day of the incident by the Operations Manager. A formal investigation team with written terms of reference was later set up by the Refinery Manager.
The Investigation Team found that the basic cause of the incident was that the heater burner was inadvertently put into operation.
Other causes which contributed to the incident were the bypassing of the protection systems and the absence of operating procedures for the heater burner.
[tube failure, fire - consequence]

Lessons

[None Reported]

5281 11 March 1991

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

An explosion and flash fire occurred in a wet cake screw conveyor. The pressure wave propagated into the drier. An explosion suppression system was activated and contained the explosion. The screw conveyor had been running for 30 hours without product and the cause was probably due to material being pulverised into a fine powder and ignition from static.
[fire - consequence, processing]

Lessons

[None Reported]

108991991

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A road transport incident. A tank truck catastrophically collapsed as it was unloading a hazardous liquid.
The 6,300 gallon tank on the trailer had a nameplate design pressure of 30 psig, and appeared to have been very well maintained before the incident.
The truck arrived about 09.00 hrs and was set up for unloading about 09.15 hrs. A 3 inch unloading hose was connected to an unloading pump by an operator and a three quarter inch nitrogen hose was connected to a manifold which was located just forward of the rear wheels on the trailer.
The operator opened the valves on the nitrogen supply line, both upstream and downstream of the pressure regulator to pad the truck. The truck manifold pressure gauge read the expected 20 psig. The operator opened the proper delivery valves and started the unloading pump.
At this point the unloading activity appeared normal. The truck driver checked the sight glass on the truck and informed the control room that the truck was empty. The busy operator passed by and observed that the unloading hose was still vibrating, which indicated that the tank truck was not quite empty.
About 10.05 hrs, people in the area reported hearing a loud rumbling noise, and they observed the collapse of the tank. There were no injuries, no leak of hazardous material, and no damage to the plant receiving the feedstock. Engineers determined that a nitrogen valve was open connected to the tank trailer manifold, but there was a failure to open the valve on top of the tank.
It seems that the driver misunderstood a nitrogen supply piping modification.
Investigators discovered a device which appeared to be a combination safety relief valve and vacuum breaker; however, it was subsequently established that the tank was not equipped to deal with vacuum.
[design or procedure error, implosion]

Lessons

[None Reported]

5180 25 November 1990

Source : LLOYDS LIST, 1990, 5 DEC., & 1991, 3 JAN.
Location : Denver; Colorado, USA

Injured : 0 **Dead :** 0

Abstract

A fire that burned for 55 hours at the fuel storage area for an airport destroyed or damaged 7 tanks and consumed more than 1.66 million gallons of jet fuel.
The fourth largest large-loss fire of 1990, it caused $30 million (1990) in damage. There were no reported injuries from the fire.
On Sunday morning, November 25, 1990, one of the fuel supply companies began pumping fuel to CAL Tank 7. The company's facilities were 5 miles away, and at a 100' elevation above the airport tank farm. Fuel to the CAL tank flowed through pipes adjacent to the UAL tanks.
Fuel was also being transferred from the UAL tanks to the airport. There were no personnel at the tank farm during these operations.
At about 09.20 hours the fuel supply company received a `no flow' indication in the pipeline.
About 5 minutes later, the pumps restarted, but only pumped about 4 barrels of fuel before the `no flow' indication recurred; and the company stopped operations at this time.
Personnel in the airport control tower spotted a column of black smoke and notified the airport fire department. At 09.22 hours, four aircraft rescue and fire fighting (ARFF) trucks and one rapid intervention vehicle were dispatched to the tank farm. This was quickly followed by pumpers, trucks, and a build-up of senior fire officers and fire crews.
The ARFF crews arrived within 4 minutes of dispatch and found a large pool fire in the valve pit. Two distinct streams of flaming fuel forming a "V" shape extending 25-30' into the air.
Investigators believe that the initial fuel involved an operating pump and that the ignition source may have been the same pump. Preliminary findings indicate that fuel from a second source - a cracked pipe flowing fuel to a CAL tank - was feeding the fire before fire fighters arrived.
[valve failure, fire - consequence, no flow, aviation fuel]

Lessons

1. Fire fighters were unable to stop the backflow of fuel from the flight line to this valve because there was no manual shut-off near the valve.
2. Fire department personnel attempted a dual agent attack on tank pipework fires, but were unsuccessful as they were unable to sustain AFFF streams for more than or 5 minutes.
3. Past Lessons not applied to Engineering Standards: A friction coupling opened releasing fuel from the tank. It is known that this type of coupling will not hold up under intense flame conditions.
4. Radiant heat on the shell or roof will create vapours which will accumulate under the roof and when pressure increases, flammable vapours will result.
5. In order to detect equipment deficiencies, it must be inspected regularly according to specified procedures.
6. There was insufficient knowledge on how to stop the flow of fuel.
7. Inadequate Training: Responding firefighting crews were not trained in handling 3-dimensional flammable liquid fires requiring unique suppression tactics and equipment.

10245November 1990

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

An explosion and fire occurred in the reactor section of an ethylene plant causing the olefins unit to be shutdown. The explosion sent a fireball and cloud of smoke about 50 feet over the plant. Fortunately there were no injuries and no evacuations.
The cause of the incident was due to heated, pressurised hydrocarbons which are used in the manufacture of alpha olefin, which is used to make detergents. The explosion occurred when hydrocarbons were ignited. Ignition source unknown.
It took less than an hour for workers to cut off all the valves feeding hydrocarbons to the damaged site. Hydrocarbons remaining in the blast area were released and burned in controlled flares.
[fire - consequence, reactors and reaction equipment, unidentified cause]

Lessons

[None Reported]

5104 29 August 1990

Source : LLOYDS LIST, 1990, 2 OCT.
Location : Chesapeake; Virginia, USA

Injured : 0 **Dead :** 0

Abstract

Transportation. A 12 inch oil pipeline was damaged two weeks earlier and ruptured when there was a pressure surge causing spillage of 67,000 gallons of diesel fuel.

Lessons

[None Reported]

5074 31 July 1990

Source : LOSS PREVENTION BULLETIN, 118, 14.
Location : Essex, UK

Injured : 0 **Dead :** 0

Abstract

A double compartment stainless steel road tanker was steam cleaned than loaded with fermentation ethanol. After unloading, the driver noticed a blue and yellow mark on the bottom of the tanker barrel below the manway. The matter was investigated and the most likely explanation for this incident was as follows:
The road tanker became charged with static operation (the driver carried out the steam cleaning and says that the tanker was not earthed during this operation). The road tanker was still highly charged when it arrived at the loading bay and it seems likely that the flexible loading hose was lowered into the tanker barrel before the earthing clamp was attached to the tanker. This could have led to a static discharge occurring between the bottom of the tanker barrel and the end of the flexible hose. It seems likely that the small amount of ethanol drainings left in the hose from a previous filling operation were ignited by the static discharge and caused the discoloration of the stainless steel tanker barrel.
[near miss]

Lessons

1. That tankers should always be earthed during steam cleaning operations.
2. That tankers should be earthed immediately on entering a flammable liquids loading bay prior to carrying out any other operation.

5062 23 July 1990

Source : THE CINCINNATI ENQUIRER, 1990, 20 JUL.; HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1990, SEP.; BUSINESS INSURANCE, 1990, 30 JUL.; LLOYDS LIST, 1990, 13 DEC.

Location : Cincinnati; Ohio, USA

Injured : 72 **Dead :** 1

Abstract

An explosion and fire destroyed 3 storey resin plant of coatings and ink division. Overpressure caused release of cleaning solvent vapours to leak from a chemical reactor to mixing equipment. Damage to plant and building extensive. Windows broken in quarter mile radius. Cost of accident $1.550m (1990). Fatality.

[gas / vapour release, overpressurisation, reactors and reaction equipment, damage to equipment]

Lessons

[None Reported]

5057 19 July 1990

Source : LENOIR E.M & DAVENPORT J.A, A SURVEY OF VAPOUR CLOUD EXPLOSIONS SECOND UPDATE, PROCESS SAFETY PROGRESS, 1993, 12, (1), 12-33.

Location : Cincinnati; Ohio, USA

Injured : 63+ **Dead :** 2

Abstract

An explosion and fire occurred at a coatings plant killing one worker, injuring approximately 70 other people and causing considerable damage to the neighbourhood. A reactor in the resin building was being cleaned with a solvent when a ruptured valve or pressure seal failure released the vapour cloud into the building. The exact cause of ignition is still unknown but could be due to the area being near a boiler room where gas generators, electrical switches could have created a spark. There was a build-up of pressure in the reaction as a result of the improper setting of a valve. The company fined $1.7 million for 133 safety and health violation.

The company criticised for not equipping kettles in the plant with alarm devices for excessive temperature and pressure, not furnishing kettles with automatic high temperatures and high-pressure shutdown devices, not requiring that an operator be present during kettle use and not having written instructions for kettle cleaning.

[unidentified cause, reactors and reaction equipment, gas / vapour release, damage to equipment, fatality, injury]

Lessons

[None Reported]

4961 15 April 1990

Source : SEDGWICK LOSS CONTROL NEWSLETTER, 2ND QUARTER, 1990.
Location : , MALAYSIA

Injured : 0 **Dead :** 0

Abstract

Internal overheating of an autothermal methanol reactor led to a rupture and 5 inch diameter hole in the reactor shell. Exterior synthesis gas fire rapidly extinguished.
[reactors and reaction equipment, fire - consequence]

Lessons

[None Reported]

8781 1990

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOIN RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 0 **Dead :** 0

Abstract

An incident occurred in a waste oil de-oiling tank where water was separated out by gravity and the remaining fuel used in soil treatment furnaces. The vapours displaced during transfer operations were passed through an active carbon filter. Due to self-overheating in this absorption unit, the vapours ignited; as no flame arrestors had been installed, flashback occurred to the de-oiling tank. The following explosion tore the roof partly loose from the sidewall and destroyed the cooling unit and foam chamber of the tank. The subsequent fire threatened also other storage tanks and boil-over danger existed. Cooling of the neighbouring tanks by means of their water-cooling rings and additional portable/mobile fire fighting equipment by the fire brigade started to prevent escalation, the tank was left burning until adequate foam concentrate and water pumping capacity were available to undertake a successful foam attack using monitors (a second foam unit was in stand-by to fight pitfires should a boil-over have occurred). Additional fire water had to be supplied by a fire fighting boat because one of the two fire water pumps of the installation failed. After the fire had been extinguished, the remaining tank content was cooled down and, several days later, fed to the furnaces.

Apart from damage to the tank construction, many electrical pumps were damaged due to flooding by cooling and fire fighting water.

[separation equipment, damage to equipment, fire - consequence]

Lessons

1. Monitoring the temperature of the absorption unit and install a fire extinguishing unit.
2. Installation of flame arrestors.
3. Installation of (semi) sub-surface foam application devices for these tanks instead of foam chambers.

8779 1990

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOIN RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 207 **Dead :** 0

Abstract

A rail transportation incident. During chlorine unloading from a rail car into the storage tank of the cellulose bleaching section of a plant, the steel-reinforced transfer hose burst, causing emission of chlorine to the environment. The storage tank was located in a closed building. Operators with suitable personnel protection suits closed the valves to stop the chlorine emission. The emitted chlorine was treated with caustic soda in the chlorine destroyer plant, and water curtains were used to wash out the chlorine. The population was warned and the rescue of injured persons was organised.
[storage tanks, gas / vapour release, overheating, design inadequate]

Lessons

1. Installation of quick-action isolation valves on loading/unloading parts of existing installations for toxic gases.
2. More frequent inspections of similar installations by Authorities and experts.
3. Use of hydrogen peroxide instead of chlorine for cellulose bleaching.
4. Development of additional safety requirements for storage installations of liquefied toxic gases.

4820 1990

Source : CONCAWE REPORT 4/91
Location : , WESTERN EUROPE

Injured : 0 **Dead :** 0

Abstract

Transportation. The accidental closure by a pipeline workman of a main line valve at a pump station caused a scraper-pig trap at an upstream facility to be over-pressurized. A spillage of 252 cubic metres gross of jet fuel occurred. The pipeline was out of service for two days while the trap installation was modified. There was no significant pollution.
[overpressurisation, operator error]

Lessons

[None Reported]

12127November 1989

Source : ICHEME

Location : Southampton, UK

Injured : 0 **Dead :** 0

Abstract

A marine transportation incident. A port in the South of England was closed after a gas leak occurred on a marine tanker berthed at a refinery jetty.
The 280,000 tonnes dwt tanker almost completed its cargo of crude oil when tow of its midships tanks, one containing oil and the other ballast water were damage by a sudden overpressurisation. No one was injured.
Everyone except the ship's essential personnel were evacuated from the ship.
Other tankers at the refinery jetties were moved off as a precaution.
An investigation into the incident was carried out into the cause of the leak and it was concluded that the cause was due to overpressurisation, the a confirmation that there had been a risk of ignition of crude oil vapour.
High winds prevented towing the damaged tanker off its berth immediately and it was decided to tow the ship out to sea, transfer the cargo to another tanker and then to tow away for repair.
[evacuation]

Lessons

[None Reported]

4744 12 October 1989

Source : LLOYDS LIST, 1989, 24 OCT.; HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1990, MAR.
Location : Tobolsk, USSR

Injured : 0   **Dead :** 0

Abstract

During the high pressure water test of a gas pipeline to 3 times normal pressure, the pipeline ruptured and released a large quantity of gas which was then burnt off. Many evacuated for controlled explosion.
[testing, overpressurisation, evacuation]

Lessons

[None Reported]

4740 06 October 1989

Source : LLOYDS WEEKLY CASUALTY REPORTS; LLOYDS LIST, 1989, 7 OCT.
Location : Rainhill; Merseyside, UK

Injured : 0 **Dead :** 0

Abstract

A cloud of fumes was released from a plant when a storage tank containing chemicals overheated and caught fire. Fumes believed to contain hydrogen cyanide. Residents warned to stay indoors.
[overheating, fire - consequence]

Lessons

[None Reported]

4700 05 September 1989

Source : LOSS PREVENTION BULLETIN, 099, 3; SAN FRANCISCO CHRONICLE, 1989, 6 SEP.; LLOYDS LIST, 1989, 7 SEP.; HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1989, OCT.

Location : Martinez; California, USA

Injured : 2 **Dead :** 0

Abstract

An explosion or fire occurred in a hydrotreater unit which was processing FCC (Fluid Catalytic Cracking) feedstock. A failure occurred in a pipe downstream from a separator, resulting in the release of hydrogen and hydrocarbons in the unit area. The cause of line failure is unknown.
[cracking equipment, pipeline failure, unidentified cause, injury]

Lessons

[None Reported]

1064319 August 1989

Source : DAILY TELEGRAPH, AUG 21, 1989, AUG 22, 1989,; LLOYDS LIST 22/08/89, 23/08/89, 24/08/89 AND 25/08/89.
Location : , UK

Injured : 0 **Dead :** 0

Abstract

One hundred and fifty tonnes of crude oil escaped from a 12 inch pipeline under the river. The pipeline carried crude oil from the terminal to a refinery. The spill caused pollution and ecological damage along a 50 km stretch of the estuary, threatening the breeding grounds of tens of thousands of birds. The clean-up costs and likely damages payments were expected to reach about £1m (1989).
The company was criticised for delays in providing clean-up equipment. The leak was the third involving different pipelines in the estuary during the previous 3 years.
[transportation, pipeline failure, unidentified cause]

Lessons

An independent committee was set up to study the impact of the leak and identify lessons for future spillages.

12091 28 July 1989

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

An explosion occurred when a tank ruptured at the roof/shell joint. At the time of the incident the tank was receiving product from a bitumen oxidiser. The tank was 66% full at a temperature of 208 degrees C.
Fortunately, no personnel were near the tank at the time of the explosion and no injuries were sustained. Bitumen fumes did escape from the rupture but no spillage or fire occurred.
An investigation found the roof vent was blocked with coke.
[material transfer, gas / vapour release, vent blocked]

Lessons

The following recommendations were made:
1. Regular inspection of tank vent nozzles to monitor rate of coke deposition, weekly initially was suggested. To assist in this it is suggested that the vents be modified by incorporating a hinge and locking mechanism at the flange so that the vent does not have to be removed to inspect the nozzle.
2. A trial to be carried out to compare coke build up rate between a cowl vent and a refitted original goose neck vent.
3. Trails to be carried out to determine the effects of vent insulation on the amount of liquid condensing, in conjunction with attempting to improve fume extraction.
4. The 35 pen storage tank temperatures to be as low as feasible to reduce thermal cracking.
5. To continue to sample and analyse tank vapour spaces for volatile spaces for volatile hydrocarbons.
6. Possible incorporation of high integrity pressure raise warning devices and pressure relief on the tank roofs. A weighted door or flap, similar to that often designed into bitumen blowing towers was considered a possibility, providing this could be designed so as not to allow air to be drawn through it across the roof to the existing central vent.

3872 11 July 1989

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

Failure of a tank roof. The incident occurred during a temporary shutdown of the distillate hydrotreater.
The crude oil distillation units main column overhead product was pumped to a gasoline storage tank via the straight run gasoline rundown line. When restarting the distillate hydrotreater, a valve in the start-up line to the high pressure separator branching off the crude oil distillation unit main column overhead product line was opened before the line to tankage was closed.
Hydrogen gas at a pressure of 30 bars consequently reached the tank, overpressured it and caused substantial damage. The tank shell was lifted upwards by approximately 110mm.
No one was injured in the incident and there was no leakage of liquid product.
[overpressurisation, damage to equipment]

Lessons

The reports recommendations were:
Consider training of operators for routes by which storage tanks can erroneously receive unwanted pressure and ensure that facilities and/or procedures procedures prohibit this as far as possible.
A second important lesson to be learnt from this incident is that the pressure of volatile hydrocarbons must always be considered as a possibility in any refinery storage tanks until shown to be otherwise. This is very important when considering dipping and sampling procedures (e.g., adequate relaxation time to dissipate static charge), and when giving clearance for tank entry and repair work.

4628 03 July 1989

Source : HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1989, AUG.
Location : Decatur; Alabama, USA

Injured : 2   **Dead :** 3

Abstract

An explosion of a chemical mixing vat. Fatality
[unknown chemicals, unidentified cause, injury]

Lessons

[None Reported]

4587 27 May 1989

Source : LLOYDS LIST, 1989, 30 MAY.
Location : Thatcham; Berkshire, UK

Injured : 0 **Dead :** 0

Abstract

A fire occurred at a plastics factory which led to fears that chemicals would get into drainage system.
[fire - consequence, drains & sewers, unknown chemicals, unidentified cause]

Lessons

[None Reported]

1313619 May 1989

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

Reaction products for an agrochemical product were charged to a 2,000 litre glass lined batch reactor one Friday evening. According to the process instructions, the reaction should have been started only after the addition of caustic soda on Monday morning. The reactants were left in the vessel at ambient temperature, without agitation or supervision, over the weekend. The thermal behaviour of the reaction mixture (without caustic soda) had not been investigated.

Contrary to previous weekends when a similar procedure had been followed, the reactants started to self-heat and a runaway reaction occurred after about 45 hours. Part of the batch was blown out of the reactor.

[batch reaction, storage, product loss, gas / vapour release, safety procedures inadequate, reactors and reaction equipment, uncontrolled reaction, overheating]

Lessons

Laboratory analysis revealed a high reaction and decomposition energy (potential adiabatic temperature rise 700 degrees C). Simulations based on this data showed a 'temperature runaway curve' similar to that shown in the incident, for a starting temperature of 28 degrees C - roughly in line with the ambient temperature over that weekend. Ambient temperatures for previous batches left in this way without overheating had been somewhat lower.

The following recommendations were made:

1. Process instructions must indicate at which steps the process may be interrupted without risk
2. Thermal behaviour of the reaction mixture must be measured and hazard analysis carried out.

1304509 May 1989

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

Reaction products for an agrochemical product were charged to a 2,000 litre glass lined batch reactor one Friday evening. According to the process instructions, the reaction should have been started only after the addition of caustic soda on Monday morning. The reactants were left in the vessel at ambient temperature, without agitation or supervision, over the weekend. The thermal behaviour of the reaction mixture (without caustic soda) had not been investigated.
Contrary to previous weekends when a similar procedure had been followed, the reactants started to self-heat and a runaway reaction occurred after about 45 hours. Part of the batch was blown out of the reactor.
[batch reaction, storage, product loss, gas / vapour release, safety procedures inadequate, uncontrolled reaction, overheating, batch reactor]

Lessons

Laboratory analysis revealed a high reaction and decomposition energy (potential adiabatic temperature rise 700 degrees C). Simulations based on this data showed a 'temperature runaway curve' similar to that shown in the incident, for a starting temperature of 28 degrees C - roughly in line with the ambient temperature over that weekend. Ambient temperatures for previous batches left in this way without overheating had been somewhat lower.
It was recommended that:
1. Process instructions must indicate at which steps the process may be interrupted without risk.
2. Thermal behaviour of the reaction mixture must be measured and hazard analysis carried out.

4557 25 April 1989

Source : HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1989, JUN.; LLOYDS WEEKLY CASUALTY REPORTS
Location : Altonia; Melbourne, AUSTRALIA

Injured : 0   **Dead :** 0

Abstract

Transportation. 100,000 litres of gasoline escaped from burst pipeline near residential area. Rupture occurred when there was a sudden increase in pressure. Gasoline leaked into creek.
[pressure surge, spill]

Lessons

[None Reported]

4515 24 March 1989

Source : HAZARDOUS CARGO BULLETIN, 1989, MAY,; LLOYDS LIST, 1989, 29 MAR.
Location : Porvoo, FINLAND

Injured : 0 **Dead :** 0

Abstract

A fire occurred in 25000 cubic metre storage tank of isohexane in the floating roof. Fire extinguished but reignited an hour later when foam was being applied. The reignition occurred as a result of static when reapplying the foam. The tank was 52 m diameter by 14 m high with a capacity of 30 000 cum. The fire lasted nearly 32 hours.
[fire - consequence]

Lessons

[None Reported]

4505 20 March 1989

Source : LOSS PREVENTION BULLETIN, 107,
11-15; LLOYDS LIST, 1989, 23 MAR.; HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1989, MAY.

Location : Ionava; Lithuania, USSR

Injured : 57 **Dead :** 7

Abstract

Refrigerated storage tank of ammonia ruptured without warning spilling 7000 tonnes of liquid ammonia. The vapour ignited and the resultant fire involved 35 000 tonnes of fertilisers. Evacuation of 30,000 people. The tank was displaced by the force of the escape and broke the holding straps and the reinforced concrete wall. Official cause attributed to rollover.
[fire - consequence, fatality]

Lessons

[None Reported]

4489 03 March 1989

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A flange leak led to a vapour release on this production platform.
[gas / vapour release, offshore]

Lessons

[None Reported]

1161401 February 1989

Source : ICHEME
Location : Hull, UK

Injured : 0 **Dead :** 0

Abstract

A fire occurred in a dust collecting bag. No details were reported of injuries or damage. The process involving lime transfer generated lime dust which was considered a potential source of fire.
Four possible areas of electrostatic accumulation and subsequent discharge were identified and discounted as possible sources of ignition. Other potential sources of electrostatic charge generation were identified which could be eliminated by changes to equipment and procedures.
No definitive cause of the fire was identified. However, the polyethylene dust collecting bag was found to have high surface resistivity such that charging to potential of 5kV could occur by the action of installing the bag.
[fire - consequence, material transfer, container]

Lessons

1. Ignition could not be caused by electrical discharge caused by lime dust charge in the pneumatic conveying system because lime was not introduced into the process vessel until after the bag had caught fire.
2. Lime should always be introduced into the slurry vessel below the liquid surface to minimise dust generation.
3. The filter unit was not handling an amount of dust sufficient to generate a hazardous level of charge.
4. The polythene dust collecting bag had a surface resistivity in excess of 10E14 ohms per square metre, which could readily be charged to potential of 5kV by the action of installation.
5. A metal buckle on the leather strap used to attach the dust collecting bag was an isolated conductor. The strap should be earthed.
6. Potential sources of electrostatic charge generation may be identified by competent inspection of plant. Some sources may be readily eliminated.

4436 10 January 1989

Source : HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1989. APR.

Location : Houston; Texas, USA

Injured : 0 **Dead :** 0

Abstract

A marine transportation incident. Six cargo tanks on a chemical tanker ruptured by explosion due to overpressurisation with nitrogen.

Lessons

[None Reported]

2762 1989

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOIN RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 0 **Dead :** 0

Abstract

Production of PVC proceeded without adequate ammonia addition. Hence, the excess of HCl produced caused coagulation of the latex. The mixer failed but there was no indication of it. Consequently, a local overheating was caused since steam of 165-175 degrees C was used (latex starts decomposition at 140 degrees C), but this was not detected. An expansion of coagulated latex clogged all the piping including the inlet to the safety valve. Not compensated HCl started to react with the reactor material. Though the steam supply had been stopped and external cooling started, the vessel burst because the wall thickness had been reduced from 9.8 mm to 2 mm. Activation of the sprinkler system enhanced reactor cooling and diluted HCl vapours.
[mixing, runaway reaction, design or procedure error, damage to equipment]

Lessons

1. A substitution of the plasticising agent and use of steam with a maximum temperature of 127 degrees C (latex starts decomposing at 140 degrees C).
2. Installation of a double signalling device on the mixer for the detection of malfunctions.
3. Interlock of the steam supply to the mixer so that steam supply will be automatically shut off in the case of agitator failure.
4. Installation of 2 independent temperature sensors. The steam supply will be automatically shut off in case any of the sensors indicates a temperature above 100 degrees C or when there is a substantial difference in the indications of the 2 sensors.
5. Installation of a level switch which will automatically shut down the steam supply when a high level in the reactor is reached.
6. All these steam shut-off actions will be coupled to an alarm indication in the control room. Batch control on quality, pH and persulphate content will be introduced.
7. During the process the pH will be monitored through regular sampling; the possibility of continuous pH-monitoring will be investigated.

8774 1989

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOIN RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A storage tank for aqueous ammonia solutions was up for maintenance (replacement of the bottom part). After mechanical completion of the replacement work, a trial had been undertaken to fill the tank up, but overpressure was registered and the flange connecting the feeding line to the tank leaked. The problems were reported to the maintenance department, the flange connection was repaired and the pressure relief line checked, the trial to fill the tank was not reported to the shift supervisor. The next day a safe work-permit was issued to the mechanics to disconnect the piping associated with this tank for further repair. The repair work proceeded and during the grinding of a disconnected pipe, a mechanic noticed a whistling sound and hid, together with the other mechanics, behind a concrete tankfarm wall. Soon afterwards the tank exploded. The top of the tank was blown over an adjacent building and the office buildings, and bumped into another office building (approximately 60 m away), which was empty. The explosion is believed to be caused by the ignition of ammonia vapour caused by the repair works. Also the pressure relief line failed to perform as expected.
[storage tanks, overpressurisation, maintenance inadequate, damage to equipment, design inadequate]

Lessons

1. Improvement of procedures.
2. Improvement of communication.
3. Improvement of training of personnel.
4. Re-design of vapour relief lines.

8777 1989

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOIN RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A lightning stroke caused voltage fluctuation in the control unit of the nitric acid plant which, in turn, led to the shut-down of the plant. Due to incomplete depressurisation of the unit during repeated start-up trials, a back flow of process gas containing nitrogen oxides occurred in the suction line of the secondary air compressor, resulting in nitrogen oxide emission within the plant at ground level.
After this accident, it has been decided that a one-way valve will be fitted to the suction line of the compressor to prevent unintentional backflow of the process gas to the environment.
[gas / vapour release]

Lessons

[None Reported]

123851989

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

An explosion occurred during mixing in a vessel.
The incident occurred whilst making a solution of a metal organic compound in toluene; the powder was manually added to a stirred vessel that was partly filled with toluene. During this manual operation, a slight under-pressure was maintained to avoid dust nuisance for the operator. Approximately 15 minutes after closure of the manhole the explosion occurred.
The report stated the investigations into the cause that found:
A source of flammable atmosphere.
The toluene at 20 degrees C was well above its flash point and, with the sucked-in air, would have produced a flammable atmosphere in the vessel.
Chargeable material.
The conductivity of toluene is typically in the order of 10 pS/m. At this low level, vigorous stirring of two-phase systems may generate hazardous potentials.
Electric charge generation.
During the dissolving process there is a stage at which material is in suspension.
Stirring such a two-phase mixture can generate charge.
Tests showed it reaching a maximum potential some 10 minutes after the start of adding a powder.
At that moment a discharge can occur from the charged suspension to the stirrers, to the tank wall or to inserts, such as instruments.
[mixer, static]

Lessons

The report stated the following precautions for preventing recurrence:
There are two basic methods for avoiding explosions caused by static electricity discharges in this type of dissolving operation:
Prevent the formation of a flammable atmosphere by inerting the system.
Prevent the build-up of hazardous potentials.
This can be achieved by:
Avoiding vigorous stirring by limiting the power for agitation, and/or
Raising the conductivity of the solvent by adding anti-static additive.

4418 1989

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

Damage to refinery crude distillation plant due to water slug.
[damage to equipment, refining]

Lessons

[None Reported]

8330 1989

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

Cracked Fluid Catalytic Cracker Unit (FCCU) reactor vapour line at a refining company. During start-up of the FCCU, and shortly after the introduction of feed, vapour was noticed to be coming from the insulation around the reactor vapour pipeline and support hanger. There was product loss and damage to equipment. Failure of the line was due to thermal fatigue. A contributing factor was inadequate insulation that allowed plates to remain cool and not expand with the line, acting as a restraint. Insufficient maintenance of insulation around the line in recent years was the cause of this incident, in addition to inadequate design of support section.
[maintenance inadequate, design inadequate, fluid cracker]

Lessons

Particular care is needed in regular inspection and necessary repair of plant which is the subject of significant temperature cycles with possibilities of thermal fatigue.

4380 11 December 1988

Source : HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1989, FEB.
Location : Karachi, PAKISTAN

Injured : 0 **Dead :** 0

Abstract

A fire occurred at a bonded warehouse containing chemicals and cotton waste.
[warehousing, fire - consequence, unknown chemicals, unidentified cause]

Lessons

[None Reported]

4355 21 November 1988

Source : CLAYTON W E, GRIFFIN M L, CATASTROPHIC FAILURE OF A LIQUID CARBON DIOXIDE STORAGE VESSEL, AICHE 28TH LOSS PREVENTION SYMPOSIUM, ATLANTA, 21 APRIL 1994,; LOSS PREVENTION BULLETIN, 125, 3-10.

Location : Worms; Frankfurt, GERMANMY

Injured : 10 **Dead :** 3

Abstract

A catastrophic failure of a liquid carbon dioxide storage vessel in a citrus process caused 3 fatalities and $20 million (1988) in property damage. An investigation showed that the vessel had been overpressured due to ice formation in the safety relief valve and heater failure in the heating on mode. A list of other carbon dioxide vessel ruptures is given. Fatality.

[safety relief valve failure, overpressurisation, storage tanks, mechanical equipment failure, vessel failure, damage to equipment]

Lessons

1. Elimination of the use of carbon dioxide in many non-critical applications.
2. Leased or rented equipment must be to the same standard of safety as owned equipment.
3. Carbon dioxide storage tanks should not be heated with an internal heater.
4. Development and adoption of specific company design requirements for liquid carbon dioxide storage systems into standard practice.

9444 18 September 1988

Source : HAZARDOUS CARGO BULLETIN, JAN, 1989.
Location : , SINGAPORE

Injured : 0 **Dead :** 0

Abstract

A marine transport incident. For reasons unknown, a ship began to capsize during loading operations. The cargo included plywood, drilling mud, drilling equipment, general cargo containers and other containers laden with cyanide. A deck crane on the edge of the jetty prevented the ship from rolling over. Fortunately there were no injuries.
Within a few hours, a heavy lift crane was being prepared to come to the aid of the stricken vessel.
Fortunately, the floating crane was already close by and by the afternoon of the same day it had arrived at the scene.
The crane, which has a 1,000 tonnes maximum lift capacity, supported the vessel and gave full control as operations began to pump out the flooded engine room and steering gear space.
Water in the flooded hold was sampled and found to be contaminated with cyanide.
[near miss, contamination, cyanide product, unidentified cause]

Lessons

1. Cyanides are toxic if swallowed, by skin contact or dust inhalation. On contact with water cyanide may form a weak hydrogen cyanide solution.
2. Cyanides must be stowed away from acids with which they react, giving off highly toxic and flammable cyanide gas.

4269 31 August 1988

Source : HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1988, NOV.; HAZARDOUS CARGO BULLETIN, 1989, 77-78.
Location : Long Island Sound, USA

Injured : 0 **Dead :** 1

Abstract

A marine transportation incident. An explosion occurred in the cargo tank of a marine tanker of fuel oil when a static charge ignited vapours. The static charge was released from a steam leak as an ungrounded temperature probe was removed from the tank. Fatality.

Lessons

[None Reported]

4247 06 August 1988

Source : HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1988, OCT.
Location : Elsberry; Missouri, USA

Injured : 0 **Dead :** 0

Abstract

A rail transportation derailment at a storage depot. 14 rail tanker cars derailed and caused damage to fuel tanks of diesel and gasoline, a grain silo and an ammonia tank resulting in fire. Cause of derailment was probably an overheated wheel bearing.
[fire - consequence, rail incidents, overheating]

Lessons

[None Reported]

4230 17 July 1988

Source : HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1988, OCT; LLOYDS WEEKLY CASUALTY REPORTS; FIRE PREVENTION, 1989, MAR.
Location : Massa, ITALY

Injured : 20 **Dead :** 0

Abstract

An explosion of a 40 million cum (cubic metres) storage tank containing 45% solution of insecticide occurred releasing a toxic cloud causing pollution of the area. At around 0600 hours workers noticed that the tank's cooling system was losing nitrogen and the chemicals were overheating. Explosion minutes later. 3 smaller explosions. A little later fire followed. Plant permanently closed. 12 tonnes of pesticide released into atmosphere. 60,000 holiday makers had their holidays moved.
[fire - consequence]

Lessons

[None Reported]

4198 21 June 1988

Source : FIRE PREVENTION,NO. 211; PURDY G & SMITH E.J, THE LESSONS LEARNT FROM EMERGENCIES IN THE U.K. INVOLVING HAZARDOUS CHEMICALS, EMERGENCY PLANNING 91, SYMPOSIUM, SEP,1991,; HAZARDOUS CARGO BULLETIN, JAN, 1989.

Location : Poole; Dorset, UK

Injured : 14 **Dead :** 0

Abstract

A fire and explosion involving drums of unknown chemicals occurred in a main chemical warehouse at a chemical factory. Five of the drums of solvents that were blown into the air, landed close by. The majority of drums fell back within the storage area.
Nearby buildings were damaged by the blast.
An investigation into the incident found that lack of segregation in the storage of a vast range of chemicals led to the extremely rapid and violent spread of the fire.
[warehousing, fire - consequence, unidentified cause, injury]

Lessons

The following recommendation was made:
Ensure that segregation policy for chemicals is clearly set out and fully impemented, especially in the respect of off-specification or waste materials.

7635 18 June 1988

Source : ICHEME
Location : ,

Injured : 1 **Dead :** 0

Abstract

Following drying operations on a regenerator and reactor refractories a 30 inch isolation spade to the down stream unit had to be removed.
The work was recognised as high risk and therefore precautionary measures and established procedures were applied, including having fire fighting and safety services personnel standing by.
At the time of the incident the liquid level in the tower was below the minimum indication on the level gauge. The liquid temperature was 170 degrees C and the flash zone pressure was 8 mb. There was a small amount of snuffing steam going to the purge points near the spade.
When the spade was removed the fitters noticed that the vapours coming from the tower side were drawn across to the other side towards the 10" vent line.
It is reasonable to assume that air was also drawn in.
A fire broke out inside the transfer line on the tower side. Safety personnel in attendance partially extinguished the fire but, unfortunately it flared up again.
One of the operators on the platform attempted to reach the snuffing steam valve near the location of the fire.
Unfortunately at the same time another operator opened the steam injection to the base of the tower and caused a sudden increase in the flow of hydrocarbons, thereby increasing the intensity of the fire. The operator on the platform received serious burns to the face.
Subsequently steam to the tower base was stopped, nitrogen was introduced and steam spray to the reactor was started. These measures, together with fire water spray, eventually extinguished the fire.
The investigation team concluded that the open 10 inch vent line, was the primary cause of the fire. Vapours from the column were drawn by the vent line's chimney effect.
The source of ignition was not identified but the team have suggested static electricity, pyropheric material or incandescent material (the refractories had been dried at 53 degrees C) as possible causes.
Damage was estimated at £115,000 (1988).
[reactors and reaction equipment, fire - consequence, damage to equipment, maintenance, blind/spade/slip plate]

Lessons

The following recommendations were made:
1. Rewrite the procedure for turning spades of this type.
2. Totally empty the tower base.
3. Purge tower with nitrogen prior to turning spade, but remember the hazards that nitrogen use poses.
4. Use more protective clothing.
5. Consider modifications to improve platform access.
6. Hydraulic spreader required for separating the 30 inch flange.

4194 15 June 1988

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

Overpressurisation of a column on an aniline plant led to explosion and fire.
[processing, fire - consequence]

Lessons

[None Reported]

9988 15 April 1988

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

As a result of a safety relief valve failure during the start-up/ commissioning of a second naphtha cracking furnace, "cracked gas condensate" (light hydrocarbons) was able reverse flow through the overpressure relief system, and leak out through an expansion joint. The leaking liquid spilled over a furnace and was ignited. The fire consequences were substantial, involving plant shutdown and major damage to equipment. Although the main fire was extinguished after about 20 minutes, several smaller fires ensued and it was about 1 hour before they were under control. There were no injuries.
[fire - consequence, training inadequate]

Lessons

An inquiry team reported that reverse flow through the relief valves was well known, as there had been a previous incident. The reason why four methods for detecting this relief valve leak had not been carried out was attributed to training inadequate. The procedures were to be revised.

4137 07 April 1988

Source : LENOIR E.M & DAVENPORT J.A, A SURVEY OF VAPOUR CLOUD EXPLOSIONS SECOND UPDATE, PROCESS SAFETY PROGRESS, 1993, 12, (1), 12-33; HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1988, JUN.

Location : Beek; Geleen, NETHERLANDS

Injured : 0 **Dead :** 0

Abstract

During start-up of a high pressure polyethylene plant, the rupture disc opened due to overpressurisation. The discharge line failed and ethylene was released in partially confined compressor shed. The ethylene ignited and damaged the compressor shed.
[overpressure relief, damage to equipment, processing, gas / vapour release, reactors and reaction equipment]

Lessons

[None Reported]

1272829 March 1988

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

An incident occurred when a manhole cover on an underground drainage system lifted. On investigation it was found that there was a high level in the drain sump, which was hot and steaming and local ground drains had back-flowed.
The area was roped off and water lines put into the quench water outfall. This had an immediate cooling affect. Soon after the conditions of the drains were back to normal.
The drains and downstream drains levels and temperatures were later checked and found to be normal.
The report stated the following conclusions:
The design of the oily drains system is such that a 100-200mm layer of hydrocarbons is always present in the sump drains. Hot water from the quench vessel vaporised light hydrocarbons in the drain system.
The resultant overpressure pushed liquid back up the sumps, lifting the manhole covers.
The water from the quench vessel was hotter that normal due to a dip in the raw water supply pressure.
[drainage system, overpressurisation, draining]

Lessons

The report stated the following recommendations:
1. Fit a pressure gauge to the quench vessel raw water supply to monitor fluctuations in supply pressure during reactor regeneration. Consider fitting a temperature alarm to the outfall.
2. Check all vents on the gas separation drains system.
3. Remove accumulated hydrocarbons from the gas separation drain sumps.
4. Check drain sumps for solid debris and remove. Consider need to clean main drain runs at shutdown.

9437 01 March 1988

Source : ICHEME
Location : , FRANCE

Injured : 1 **Dead :** 0

Abstract

A polyethylene powder flash fire occurred on a polyethylene plant in the area of the outlet pipework from the prepolymer catalyst injection vessel.
As a result of this incident one operator suffered serious burns, there was significant plant and equipment damage and loss in product.
An investigation into the incident revealed:
1. The incident occurred whilst two plant operators were checking to see whether an outlet line of the prepolymer vessel was free from blockage.
2. The operators had fitted a large plastic bag over the outlet of the outer valve to contain any powder spillage.
[dust explosion, damage to equipment, processing, reaction, compressor, reactors and reaction equipment, process causes, static, hydrogen, nitrogen, management system inadequate]

Lessons

The plant was modified to ensure all such operations to verify that such pipework was clear of blockages would be completed in a closed vessel under a nitrogen atmosphere.

1021026 February 1988

Source : ICHEME
Location : Dorsey, USA

Injured : 2 **Dead :** 0

Abstract

An explosion occured at a water - proofing company when a mixture of two chemicals was transferred from one 55 gallon drum to another. The highly flammable vapours were ignited by static electricity.
[material transfer, drums, static, burns]

Lessons

[None Reported]

1211101 February 1988

Source : ICHEME
Location : , USSR

Injured : 55 **Dead :** 0

Abstract

A rail transportation incident. A train carry unknown chemicals derailed causing the release of triethylamine.
The incident occurred when the goods train unexpectedly left the rails on approach to a bridge over a river. The train derailed 150 m from the river bank, two goods wagons and three tank cars left the track causing one to rupture. Approximately 740 l of triethylamine was released. Three thousand people were evacuated from their homes.
Fifty five people were taken to hospital for treatment. The spillage did not reach the river.
[derailment - consequence, gas / vapour release, unidentified cause, injury]

Lessons

[None Reported]

7702 16 January 1988

Source : SAFER PIPING, ICHEME, SAFETY TRAINING PACKAGE, 012, 4.47.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A small leak was noticed on the bonnet of a 300 mm (12 inch) block valve together with a leaking flange gasket on the adjacent, closed 300 mm (12 inch) block valve in the suction of P-112B in the propylene unit. The leaking flange was on an unused tie-in between the propylene splitter overhead and the inter tower system that had not been used for several years at least. The shift foreman and an operator assessed the leak as minor and took immediate action to isolate and depressurise the affected portion of the line.
[flange leak]

Lessons

The following conclusions were made:
1. Flange connections can be very complex system. If parts of the connecting system have to be modified, the integrity of the whole system may be affected.
2. If systems fail, the real cause of their failure should be found before modifying or changing the system.
3. Even good experience with modified connecting systems, gaskets for instance, in some sections of the plant does not mean that the modified system is appropriate for all other applications.
4. Deviations from standards, the increase in thickness of the asbestos layer of the grooved gasket for example, may be justified in some cases but should not be applied as a solution for all applications. Surface quality of the flange faces, eveness of flanges and additional stresses on flange connections can all play important roles in the integrity of the connection and should be regarded as such during design and operation.
5. The changing of gaskets and other elements of the flange connection should be discussed and decided on by experts.
6. The design of flange connections should include all operating conditions including the maximum valves e.g. external forces on pipes and extensions.
7. Both grooved and spiroflex gaskets are reliable if the specific requirements of the type of a gasket are considered.

9910 14 January 1988

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

An ethylene gas compressor on line feeding the ethanol plant suddenly failed. Immediate investigation showed that the south cylinder and interspace chamber had become detached from the crosshead housing; 8 bolts holding the flanges together had failed. Damage to the compressor, and associated equipment, resulted in a release of 0.5 tonne of ethylene gas over a period of about 2 minutes. Gas was present in the atmosphere of the compressor house when 7 personnel were effecting shutdown, but there were no injuries.
Investigation showed that the bolting on the crosshead of the south cylinder failed in fatigue, due to loss of bolt pre-tension. The pre-tension was probably lost in two stages:
1. During a liquid ethylene ingestion at the south cylinder, and
2. During an overheating incident affecting both north and south cylinders.
The overheating was probably the more significant event, producing fatigue failure in 385 operating hours as opposed to a predicted 563 hours to failure, possibly due to the loss of pre-tension.
[bolt failure, gas / vapour release]

Lessons

The compressor manufacturer's recommendations on the re-tightening of bolting at given intervals had not been adhered to at routine overhauls. The incident was dealt with very efficiently by the operating team. An ethylene feed low temperature alarm modification had not been finalised at the time of the incident.

7269 1988

Source : LOSS PREVENTION BULLETIN, 084, 19-21.
Location : ,

Injured : 5 **Dead :** 0

Abstract

A serious fire broke out in a chemicals store at a plant.
Substantial damage was caused by the fire to materials stored in the oxidising bay but by examination of records, questioning staff and analysis of what remained it proved possible to obtain a break down of the materials stored in the oxidising store on the day of the fire which was adequate for the purpose of the investigation.
During the investigation it became clear that incompatible materials had been placed too close to each other inside the stores building, despite the works original intention to segregate chemicals on the basis adopted for transportation purpose by international codes. In particular the system appears to have been overloaded by the scheme adopted for sorting returned and off specification materials for disposal. As a result, the fire spread extremely rapidly and violently. Within minutes the fire, had penetrated the exterior walls of the oxidising materials store and involved the drums of flammable liquids stored in the open area outside, despite the practice for storing drums of non-flammable materials adjacent to the store building.
[fire - consequence, storage, damage to equipment, unknown chemicals, unidentified cause, injury]

Lessons

The following recommendations were made:
1. The decision to co-locate the oxidising materials section of the production stores building and the drum storage area for flammable liquids was flawed in that the end wall of the store was not capable of preventing fire breaking through to the drum storage area. The building met the building regulations in force at the time.
2. The storage practices adopted, failed to cope with the problems created by the need to store, sort and dispose of the vast range of chemicals returned by customers, manufactured off specification or otherwise for disposal.
3. A number of chemical routes to ignition in the event of leakage or spillage or exothermic reactions were present in the oxidising store on the day of the fire. The precise route to ignition cannot be identified with certainty.
4. Once the ignition had occurred fire spread was inevitably rapid because of the lack of segregation within the building and the lack of adequate thermal barriers between the oxidising store and the drum storage area.
5. The smooth handling of the incident by the emergency services, local council and works, demonstrated the importance of good emergency planning.

8770 1988

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOIN RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 1 **Dead :** 0

Abstract

During charging operations, an operator added a wet powder, using a metal scoop, to the hot drier when an explosion with subsequent flash fire occurred at the charge chute. The automatic sprinkler was automatically activated by the flash fire but was not needed. The powder was damped with toluene. Apparently, an electrostatic discharge ignited the toluene vapours. The operator had superficial burns on hands and face. Nitrogen purging is recommended to be carried out before charging the drier.

[safety procedures inadequate, fire - consequence, charging reactor]

Lessons

[None Reported]

8772 1988

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOIN RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A crystalline finished product was spinning in a batch centrifuge when an explosion occurred. The product had been refrigerated to minus 7 degrees C before it was separated from a methanol/isopropanol mixture. It was subsequently washed with isopropanol pre-cooled to 9 degrees C. The mixture was spinning for about 5 minutes when the explosion occurred in the centrifuge. The lid of the centrifuge was blown off by the force of the explosion. The overpressure shattered nearby glass pipelines and windows inside the process area (up to 20 m away) but nearby plants were not damaged. As no operator was in the vicinity at the time of the explosion, no one was injured. No nitrogen inerting was used and enough time had elapsed to ensure that sufficient air could have been drawn into the machine to create a flammable atmosphere. Sufficient heat could also have been generated by friction to raise the temperature of the solvent medium above its flash point. The ignition of the flammable mixture could also have been caused by metal-to-metal contact between the basket and the bottom outlet chute of the centrifuge, leading to a fraction spark, since the Teflon coating on the centrifuge basked was worn away, or by a static discharge (continuity checks failed to eliminate this latter possibility).
[overpressurisation, safety procedures inadequate, batch reaction, separation]

Lessons

[None Reported]

4064 1988

Source : HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1989, JUL.
Location : , USA

Injured : 0 **Dead :** 0

Abstract

A river transport incident. A river barge used on ammonium hydroxide duty was overpressured while being loaded resulting in severe buckling of main deck. Cause was the corrosion of the pv valve which contained bronze components resulting in seizure of the valve.
[loading, valve failure, overpressurisation]

Lessons

[None Reported]

8771 1988

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOIN RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A technician had tested a drier on a number of occasions. He closed the manway, put the drier under vacuum and started rotation. A few minutes later an explosion and flash fire occurred which was self-extinguished. No one was injured. Investigations revealed that after the last testing, the drier manway was not fully fastened. Air must have entered the rotating drier at the manway gasket after sampling. The ignition source could probably be an electrostatic discharge (the Teflon coating on the internal lining of the drier could have built up a charge). No nitrogen inerting was used.
[testing, fire - consequence]

Lessons

1. Nitrogen purging must be carried out before charging/testing the drier.
2. If the vacuum falls to -0.7 bar, rotation must stop and a nitrogen purge must automatically start. An audible alarm must ring.
3. The company is presently compiling a computer program for the drying process to ensure that these functions are carried out.

7943 01 December 1987

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

An operator noticed smoke and flames at the top of the bitumen unit HTO system reservoir (above the HTO circulating pumps). Two other operators arrived at this time and the Fire Station was telephoned to ask that a fire hose be sent down to the unit as the equipment sited there was not capable of reaching that height. The Fire Station instructed that the fire siren should be sounded and one of the operators proceeded to call the emergency number.
At this stage the HTO reservoir disgorged oil out of the top of the header tank. The spilt oil spread to the area around the base of the reservoir and ignited. The operators present used dry chemical extinguishers to prevent the fire reaching the bitumen unit charge pump and air blower. A short time later the Fire Brigade arrived and put out the remainder of the fire at the reservoir base, followed by that at the top of the reservoir.
The incident was investigated fully but the reason for the fire remains unknown. There was no evidence to indicate the oil in the system as anything other than what it should have been or that there was any scale in the area of the fire that could have spontaneously ignited.
[spill, fire - consequence, unidentified cause]

Lessons

This incident highlights a number of points on the philosophy and procedures for fire-fighting:
1. At a minimum there should be hand held equipment eg. 12kg dry chemical extinguishers, on elevated platforms if there is a potential risk of fire.
The type of equipment to be located at the operating unit will depend on the fire-fighting philosophy adopted by the installation. Hoses and monitors should be provided at a unit to meet the need for a first aid attack and it is expected that the operators will be trained in their proper use.
2. In the case of fire the emergency procedures should require that an emergency call is made immediately by the accepted means of communication to the designated centre giving the necessary information. The designated centre will in turn arrange despatch of the emergency teams with the appropriate equipment. Even in the case of a small fire which an operator is confident can be extinguished immediately with a hand held extinguisher then the call to the designated centre should still be made before attempting to extinguish the fire.
3. The sounding of a siren or alarm will depend on the installation and the level of the emergency.
4. It is imperative that all persons on site are aware of the various alarms/signals and the emergency procedures.

3992 05 October 1987

Source : THE EVENING SUN, 1987, 6 OCT.
Location : Howard County; Baltimore, USA

Injured : 0 **Dead :** 1

Abstract

An explosion in a road tanker blew a worker who was sitting on the top of the tanker into the air. Possible ignition sources were static or friction. Fatality.

Lessons

[None Reported]

3976 27 September 1987

Source : THE INDEPENDENT, 1987, 28 SEP.
Location : Wolverhampton, UK

Injured : 38   **Dead :** 0

Abstract

Gas cloud released from factory affected policemen, firemen and ambulance men. Vat of caustic soda was overheated.
[overheating, gas / vapour release]

Lessons

[None Reported]

3967 30 August 1987

Source : ICHEME
Location : , NEW ZEALAND

Injured : 0 **Dead :** 0

Abstract

A fire occurred involving a furnace at a petrochemical gasoline plant caused by loss of flow.
[fire - consequence, no flow]

Lessons

[None Reported]

3939 03 July 1987

Source : MELLIN B, ETHYLENE OXIDE EXPLOSION, LOSS PREVENTION BULLETIN, 100, 13-19; LENOIR E.M & DAVENPORT J.A, A SURVEY OF VAPOUR CLOUD EXPLOSIONS SECOND UPDATE, PROCESS SAFETY PROGRESS, 1993, 12, (1), 12-33.

Location : Antwerp, BELGIUM

Injured : 14 **Dead :** 0

Abstract

The ethylene oxide unit was commissioned in 1969. The process involved in the oxidation of ethylene with oxygen over a silver catalyst in multi-tubular reactors at pressures between 15-20 bar.

In June prior to the incident, the ethylene oxide unit had undergone a planned three week shut down to allow a routine planned maintenance programme. The unit was re-commissioned on 24 June. All operating data indicated normal conditions up to the time the column suddenly exploded.

Following a very long and exhaustive investigation, it was concluded that the final purification column had failed on being subjected to a rapid over-pressure caused by the decomposition of the ethylene oxide in the bottom section of the column. That is ignition of the ethylene oxide in the base section of the column led to a decomposition reaction resulting in a deflagration which rapidly over pressured the column causing its failure.

The most likely source of ignition was found to be an ethylene oxide leak on one of the insulated large flanges on the base of the column which had been opened up during the shutdown period. The escaping ethylene oxide trapped in the "free space" beneath the mineral wool insulation reacted with the "active material" in the lagging. The resulting "adiabatic" heating from the subsequent reaction ignited the escaping ethylene oxide. The subsequent heat from the under lagging fire raised the metal temperature to a temperature sufficiently high to decompose the ethylene oxide in the tower. The flange most likely to have started this sequence of events was the 610mm manhole cover as this had been opened up during the shutdown period and had been insulated prior to start up. It was reported that positioning of the gaskets had indeed posed some problems.

[separation equipment]

Lessons

Some of the main lessons learned from this incident are as follows:

1. Mineral wool, which is commonly used as fire insulating material, can be a potential source of hazard where it is used on insulating equipment on ethylene oxide because it has a high surface area and can absorb a lot of moisture. Minor leaks of ethylene oxide, if undetected, may well react with water contained in open cell structure type insulation such as mineral wool. If near adiabatic conditions exist than a hot spot can build up in the lagging that may well be sufficient to ignite the escaping ethylene oxide.
2. The accumulation of rust in quiescent areas of the column, e.g. nozzles, manways or other dead zones etc., particularly those located in un-wetted areas must be avoided at all costs.
3. Materials of construction of equipment and associated pipework must be such as to minimise the generation of rust, or be kept substantially rust free.
4. The practice of insulating large flanges on ethylene oxide duty can increase the overall fire and explosion hazard on account of their leak potential and the possibility that small leaks may remain undetected.
5. High leak potential areas, i.e. flanges, nozzles and small diameter piping on ethylene oxide installation, which contain gaseous ethylene oxide and where the internal flow is insufficient to provide adequate cooling are particularly susceptible to a potential explosion hazard in the event of fire.
6. Those parts of equipment which are identified as having high leak potential, i.e. flanges, should be subject to a comprehensive leak checking programme commensurate with the potential hazards.

1100018 June 1987

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

Diketene in a pump manifold and acid egg decomposed, giving off a release of heat.
The incident occurred whilst trying to purge the diketene from the acid egg the relief valve lifted, releasing process material to the atmosphere. This incident happened shortly after the commissioning of a new liquid ring pump system.
The conclusions of the investigation were that the presence of the diketene was due to carryover from the liquid ring pump separator by a gas lift system, which had occurred when the pump tripped out. The liquid trap in the pump suction pipework probably contributed to the gas lift mechanism.
This system had been HAZOP-ed before installation, but had not covered the possibility of two phase flow, giving suck back of liquid despite the presence of a U seal in the pipework.
[decomposition, gas / vapour release, backflow, purging]

Lessons

Design alterations were recommended for the suction pipework and trip systems and the cause of electrical faults causing pump trips were investigated.
The type of seal fluid to be used was reviewed and operating instructions were updated to cover the potential hazards of priming the weak acid seals. Other users of liquid ring pumps were advised to review their systems to prevent backflow and the HAZOP guidewords were revised to ensure they covered this type of event.

3902 May 1987

Source : SEDGWICK LOSS CONTROL NEWSLETTER, 1987.
Location : , SINGAPORE

Injured : 0 **Dead :** 0

Abstract

A refinery incident. Flange leak fire on powerformer unit had knock on effects and fire engulfed stabiliser.
[fire - consequence, refining]

Lessons

[None Reported]

3881 29 March 1987

Source : TORONTO GLOBE AND MAIL, 1987, 31 MAR.
Location : Calgary, CANADA

Injured : 12 **Dead :** 0

Abstract

Gas cloud of unknown origin.
[gas / vapour release, injury, unidentified cause]

Lessons

[None Reported]

3877 22 March 1987

Source : THE HEALTH & SAFETY EXECUTIVE REPORT; LOSS PREVENTION BULLETIN, 089, 13-17.; PURDY G & SMITH E.J, THE LESSONS LEARNT FROM EMERGENCIES IN THE U.K. INVOLVING HAZARDOUS CHEMICALS, EMERGENCY PLANNING 91, SYMPOSIUM, SEP.,1991

Location : Grangemouth; Scotland, UK

Injured : 0 **Dead :** 1

Abstract

A major explosion occurred on a hydrocracker unit. This seriously damaged plant and equipment, completely disintegrating the low pressure (LP) separator vessel with debris being widely scattered.
Flames from the ensuing fire reached a height of over 90 m (300 ft) and caused extensive damage to the hydrocracker unit.
The hydrocracker unit had been shutdown for maintenance and the day before the accident, the unit was being prepared for recommissioning. Immediately prior to the incident the unit reactor section was on gas circulation at 140 bar (2030 lb/in2).
At 07.00 the explosion occurred.
The inquiry team concluded that the incident resulted from severe overpressure of the LP separator designed to operate at 10 bar g 140 lb/in2, which caused the vessel to disintegrate and the contents, primarily hydrogen, to be released.
A vapour cloud quickly ignited in the form of a fire ball and produced a serious explosion. Although the source of ignition cannot be identified with certainty the three primary considerations are sparks caused by the impact of flying debris, electric wires, light fittings, or ignition of the gas by friction during the failure of the vessel.
Inquiries carried out by the refinery and authorities agreed that disconnection of the trip system had placed too much reliance on operators for safe control of the high pressure/low pressure (HP/LP) interface. Without extra low level protection in the HP separator, the LP vessel was at risk of being overpressured at any time through human error or level control system failure. The plant was most vulnerable when the level control valve was held on "manual".
Regular testing during start up of alarms and trips was practised on the plant but some, including the HP separator extra low level trip switches were not included on the check list. These systems had been inoperative for some time and were presumed by some operators and maintained staff to be no longer required. Training of new operators by those sharing this belief helped to perpetuate this misconception. Fatality.
[fire - consequence, damage to equipment, overpressurisation, human causes, cracking]

Lessons

There are three main lessons to be leaned from this tragic and costly accident.
1. Disconnection of trip switches for whatever reasons should only take place after full evaluation of the safety implications as part of standard procedures for reviewing proposed modifications to the process plant. Such changes should be documented and formally brought to the attention of the operations and maintenance.
2. The usefulness of hazard and operability studies (HAZOP) to help identify hazards analyse the causes and effects, assess the risk and make a decision on what action is required is well proven. HAZOP is just as applicable to existing systems as to new plants.
3. The importance of adequate surface drainage on sites. The massive firefighting operation carried out on this occasion produced vast quantities of water which the system could not cope with and resulted in extensive surface flooding. Where it is not feasible to increase existing drainage systems, consideration should be given to directing the flow of excess water to less hazardous areas and the provision of mobile pumps to remove excess water.

1113019 March 1987

Source : ICHEME
Location : , UK

Injured : 1 **Dead :** 0

Abstract

Operator received chemical burns to face and eyes. At the time of the incident an operator was adding imidaziline from a drum to a product blend tank. This operation was carried out using a diaphragm pump and flexible hoses on both the pump suction and delivery. Following failure of the pump, the operator closed a valve on a permanently piped section of the discharge pipework.
Upon removal of the quick release coupling at the delivery connection of the pump, the operator was sprayed in the face with imidaziline. The operator was wearing safety spectacles at the time of the incident.
The accident investigation revealed that a build up of pressure in the discharge line may have been the result of an air pocket that was pressurised by the static head of the discharge line following pump failure and trapped upon closure of the manual valve. No means of venting the flexible hoses existed at the time of the incident.
[drums, overpressurisation, material transfer, unknown chemicals, injury]

Lessons

The following observations/recommendations were made after the incident:
1. Means of venting all flexible hoses were to be installed.
2. Increased emphasis on the need for plant personnel to wear visors or goggles where contact with corrosive chemicals is possible.
3. Further training and awareness of how pressure can build up in diaphragm pumps was to be given.

7263 17 February 1987

Source : LOSS PREVENTION BULLETIN, 080, 21.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Two contractors were working inside the skirt of a butadiene plant distillation column. They were installing a clamp on a leaking process line flange. An entry permit had been issued and the men were wearing breathing apparatus supplied by a works trolley set.
The men came out of the confined space claiming that they were receiving an inadequate air supply. A replacement set was supplied and on this occasion the reduction in air supply occurred suddenly, such that the air masks had to be removed and evacuation took place immediately. The job was completed satisfactorily using a further trolley set.
After investigation the findings were as follows:
1. The sintered metal air filters in the air pressure regulators were blocked with debris, consisting of metal filings from the component fittings and slivers of teflon tape used on the component threads.
2. The filters were clearly old and appeared to be partially blocked with fine dust. There was no procedure for regular, periodic changing of the filters. Similarly there was no procedure for checking the air flow using a rotameter on each occasion prior to issue.
As a result of this incident, procedures have been revised to ensure that the filters are changed annually and that proper records are maintained. Also to insure that a rotameter test is carried out on each occasion prior to issue of the equipment and the result recorded in as issue book.
[entry into confined space, maintenance, flange leak, testing inadequate]

Lessons

Excess tape was a factor in the blockage of the air filter.

8008 08 January 1987

Source : ICHEME
Location : , HOLLAND
Injured : 0 **Dead :** 0

Abstract

A slops oil tank was found to be severely damaged. The fixed cone roof had lifted apart from the shell over an approximately 15 m length, and the tank shell and bottoms were severely buckled.
The tank was immediately taken out of service and subsequently repaired at a cost of approximately £80,000 (1987).
There were no injuries to personnel.
The day before the incident, tank filling operations were commenced i.e. recovered oil from the refinery separator being pumped into the tank. The steam coils were commissioned on manual control on account of the unreliability of the tank temperature control system.
Water drainage operations were started.
Filling operations were stopped two hours later but the water drainage operations continued until 12.00 hrs when the tank contents were reported as water free. The tank inventory level was recorded at 7.40m at a temperature of 18 degrees C.
Pump out operations of water-free recovered oil from the tank to the crude tank were also started at this time. However due to the slow pump out rate it was necessary to clean out the filters on the transfer pumps. This activity was carried out for five hours on the day of the incident and required the temporary suspension of the material transfer operations.
On recommencing the transfer operations the tank inventory level was reported as 5.4m at a temperature of 65 degrees C. Pumping operations continued throughout that afternoon and early evening until the time of the incident at 21.05 hrs.
The last recorded readings on the tank at 20.00 hrs had showed a level of 2533mm and a temperature of
97.5 degrees C.
An investigation into the incident concluded that the tank failure was due to an overpressure situation. Inadequate control of the steam supply to the steam coils had resulted in the tank contents being overheated to such an extent that it ultimately caused vaporisation, leading to overpressure of the tank and its eventual rupture.
[overpressurisation, overheating, damage to equipment, cone roof tank]

Lessons

1. Review of procedures and instructions associated with the operation of tankage containing heated oil-water mixtures.
2. Ensure all personnel associated with the operation of such tankage are acquainted with and have been trained in the application of these procedures. In addition it is essential that all operating personnel are fully aware of the hazards associated with such an operation and recognise the importance of adhering to established procedures and working practices.
3. Review the installations of tankage designed to store heated oil-water mixtures to ensure that the control systems associated with the heating processes are operated and maintained to the appropriate acceptable standards commensurate with such a hazardous operation.

1889 1987

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOIN RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 0 **Dead :** 0

Abstract

From the hydrocracked liquids, hydrogen gas is removed firstly in a HP separator vessel at 130 bar and then further in a LP separator vessel at 9 bar. A control valve between the HP and LP separators was opened manually to allow the liquid to drain. High-pressure hydrogen passed uncontrolled into the closed LP separator, which had limited pressure relief capacity. The operator failed to notice the unsafe condition and the safety trips and alarm were overriden. The overpressurisation led to the rupture of the LP separator at an estimated pressure of 50 bar. The explosion disintegrated the separator and produced also severe damage to other vessels and pipes. The site emergency procedure was set in motion. Nonessential personnel was evacuated. The fire fighting system was quickly brought into use. The local major incident control committee (police, fire brigade, representative from major companies in the area) was called into operation. Road blocks were set up. Difficulties in fighting the fire arose because waxy material from ruptured pipework blocked drains, causing the fire water to accumulate. Leaking petroleum spirit spread over an area of 35,000 m2, increasing the risk of flash-over. 5 hours after the explosion a serious flash-over did occur, enveloping neighbouring process units in flames. It was not necessary to evacuate any housing.
[damage to equipment, evacuation, fire - consequence, cracking]

Lessons

1. The rebuilding of the hydrocracker will include a full pressure relief on the LP separator, as well as improved instrumentation and fail-safe shut-off valves in series with level control valves.
2. Rigorous procedures will be adopted in order to drain the HP separator of liquid at shutdown.
3. The systems for reporting plant defects, for testing interlocks and trips, for authorising equipment changes and for training operators have been tightened up.
4. Routine audits will now be carried out rigorously.

3824 28 December 1986

Source : NEW YORK TIMES, 1986, 29 DEC.
Location : New York, USA

Injured : 2 **Dead :** 0

Abstract

A river transportation incident. Gasoline being offloaded from a river barge spilled into the street following overfilling of storage tank. Fire.
[fire - consequence, offloading, overflow, storage tanks]

Lessons

[None Reported]

3825 28 December 1986

Source : LLOYDS LIST, 1987, 2 JAN.
Location : Shropshire, UK

Injured : 0 **Dead :** 0

Abstract

A fire and chemical hazard alert at an electronics factory.
[fire - consequence, unknown chemicals, unidentified cause]

Lessons

[None Reported]

3821 27 December 1986

Source : NEUHOFF S, EXPERIENCE GAINED FROM RECENT MAJOR ACCIDENTS IN THE FEDERAL REPUBLIC OF GERMANY, IN: GOW H.B.F & KAY R.W (EDS), EMERGENCY PLANNING FOR INDUSTRIAL HAZARDS, PROCEEDINGS OF THE EUROPEAN CONFERENCE ON EMERGENCY PLANNING, VARESE, ITALY, 4-6 NOV., 1987, ELSEVIER, 1988, 243-249.

Location : Garmisch; Partenkirchen, GERMANY

Injured : 8 **Dead :** 11

Abstract

A hotel was heated by a gas fired boiler from a 64 m3 LPG tank. On the day of the incident a relief valve lifted when the tank was 54% full. 15 minutes later the gas cloud ignited. Gas in the basement ignited to give explosion and this ignited the gas from the relief valve. The tank overpressured due to a hot water heating system for the tank which could cause it to overpressure. Fatality.
[vapour cloud explosion, overpressurisation]

Lessons

The following remark was made. There is no technical need for a heating system for liquefied gas tanks, as increased amounts of gas can be removed through an evaporator.

3823 27 December 1986

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

An fire occurred involving a furnace at an ethylene plant which was caused by overheating.
[fire - consequence]

Lessons

[None Reported]

8009 21 December 1986

Source : ICHEME
Location : , HOLLAND

Injured : 0 **Dead :** 0

Abstract

A fire occurred on a stripper reboiler on a No. 2 Hydrofiner. Gas leaking from a flange on the reboiler ignited. The fire lasted for approximately two hours until the leakage of gas ceased.
There were no injuries arising from the incident and there was no loss of production. The damage was estimated at approximately £100,000 (1986).
As the operating conditions were steady at the time of the incident operational causes were ruled out.
An examination of the reboiler joints (shell/tubesheet and tubesheet/channel) was carried out after the fire with the following results:
1. A maximum distortion of 0.35mm was found on one of the flange faces and it was remachined. All other flange faces were within acceptable tolerances.
2. The gaskets on both sides of the tubesheet were an envelope type, asbestos filled, of 13mm thickness. They were found to be in poor condition although they had been replaced during a recent shutdown.
3. The asbestos filled gaskets have now been replaced by solid metal gaskets and no further problems experienced.
[flange leak, fire - consequence]

Lessons

[None Reported]

3773 01 November 1986

Source : LOSS PREVENTION BULLETIN, 075, 11-17; EUROPEAN CHEMICAL NEWS, 1986, 24 NOV.;FIRE PREVENTION, NO.196, 1987, JAN./FEB.; LLOYDS LIST, 1986, 3 NOV.NUMEROUS;11-1986

Location : Basle, SWITZERLAND

Injured : 0 **Dead :** 0

Abstract

A warehouse fire. The warehouse originally built for storing machinery and equipment, was officially approved for use as a warehouse for products and chemicals having a flash point higher than 21 degrees C, including agrochemicals, phosphoric esters and mercaptans. From that time on, it was used for this purpose. Only four days before the fire, an officially authorised fire prevention expert made an inspection of the works and found everything in order.
On the morning of the accident the fire alarm was raised almost simultaneously by a police patrol and the works safety personnel. The fire in the warehouse spread with extreme rapidity, so rapid that the 10 fire brigades with 160 men could only concentrate on ensuring that it did not engulf neighbouring warehouses and production buildings.
Attempts to extinguish the fire with foam alone proved ineffective and water had to be used. Enormous amounts were required to prevent the fire from spreading further. Which would have had really catastrophic consequences. Roughly 10000 m3 of fire water drained into the nearby river, and with it about 30 metric tonnes of the chemicals stored in the warehouse. Among the chemicals were an estimated 150 kg of highly toxic mercury compounds dissolved in aqueous concentrates. The gases and vapours produced by the fire caused a pungent, offensive odour in parts of the surrounding area. Complaints such as headaches, nausea, burning eyes and respiratory irritations were reported. The fire water contaminated with chemicals passed directly into the river causing severe ecological damage over a length of about 250 km. A great number of fish, principally eels, died, along with part of the micro -organisms on which they feed. On the other hand, considerable amounts of the river's vegetation survived. Unidentified cause.
[fire - consequence, warehousing, spill, mercaptan]

Lessons

Recommendations were made immediately after the fire and the corresponding measures were taken.
The works:
1. Already by the end of 1986, the product of insecticides had been reduced by over 60%.
2. The stocks of agrochemicals are being cut by one-third, or 2300 metric tonnes.
3. The manufacture of all substances which require the use of phosgene has been discontinued. No phosgene had been stored at the works since the beginning of December 1986.
4. The production and sale of all products containing mercury was discontinued world-wide as from 1st January 1987.
5. All agrochemicals manufactured and/or stored at the works are being reviewed as to whether they are to be retained in the product range or withdrawn.
The most important criteria in this study are: agricultural, utility, profitability , toxicity and combustion properties.
Groupwide, the safety regulations for storing toxic and flammable substances have been re-defined. These regulations take into account:
1. The characteristics of buildings and their equipment.
2. Storage density, storage volume and storage procedures.
3. Packaging materials and storage records.
4. Retention of the fire extinguishing water in case of fire.
On longer duration and of greater seriousness than the material damage are the psychological consequences of the disaster. A major fire developed into an ecological disaster. This also caused the loss of confidence in the population in the and around the vicinity of the works.
The company therefore feel obligated to re-think and re-evaluate their priorities to keep the public informed about the results of their evaluation and its consequences, to regain and maintain the people's trust.

3768 November 1986

Source : SEDGWICK LOSS CONTROL NEWSLETTER, 1986
Location : , SWITZERLAND

Injured : 0 **Dead :** 0

Abstract

Human error caused overpressurisation of resin reactor leading to release of phenol. Leak.
[human causes, reactors and reaction equipment]

Lessons

[None Reported]

9494 14 October 1986

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

During the manufacture of an organic compound in a batch reactor, the temperature rose from a control level of 80 degrees C to an actual level of 120 degrees C.
It was known that the reactor contents would ignite in the presence of oxygen at elevated temperatures. The reactor was fitted with a nitrogen purge system (including an in-line oxygen analyser for the off-gas). In order to control the situation, the supervisor increased purge rates and this led to odour complaints from local residents. The reactor was brought under control without further incident.
Subsequent internal examination of the reactor and product showed no signs of smouldering or combustion.
[batch reaction, unidentified cause, gas / vapour release, chemical - organic]

Lessons

The conflicting evidence prevented a clear analysis of the problem. Improvements in monitoring off-gas temperature and composition were suggested. Off-gas scrubbing was also improved.

9493 20 September 1986

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

Operators lost control of a batch polymerisation reactor when the temperature was (intentionally) raised from 37 degrees C to 38 degrees C. The bursting disc blew and relief valve lifted, discharging the reactor contents to a salvage tank. No other damage was sustained.
Similar incidents had occurred with this grade of polymer on 4 or 5 previous occasions over a period of 10 years. The grade of latex being made had an unusually high monomer content and was known to be difficult to control.
[reactors and reaction equipment, exothermic reaction, overheating, instrumentation failure, overpressure, gas / vapour release, product loss, batch reaction]

Lessons

Investigation showed that the temperature controller terms were poorly set up (integral time of 2 seconds instead of 1 minute).
Longer term, improved methods of catalyst control were recommended.

3723 08 September 1986

Source : DAILY TELEGRAPH, 1986, 8 SEP.
Location : Doncaster, UK

Injured : 0   **Dead :** 0

Abstract

Residents told to stay indoors. Fear of a leak of hydrogen sulphide. In fact overheating additive oil.

Lessons

[None Reported]

7928 31 July 1986

Source : ICHEME

Location : ,

Injured : 1 **Dead :** 0

Abstract

A marine transport incident. A marine tanker barge exploded and sank whilst loading gasoline. A tankerman aboard the barge was thrown into the water. He suffered numerous burns to his face, arms and back but managed to make his way to the shore.
The previous cargo which the barge had carried was gasoline and diesel fuel. No tank cleaning was carried out before loading where unleaded gasoline and diesel fuel were to be loaded. The same cargo tanks were used for the two parcels on both loadings.
The loading of the diesel fuel into the aftermost tanks had been completed without any mishaps.
Prior to commencing to load the unleaded gasoline the tanks were inspected and apart from puddles at the after end were dry. The inspection was made through open hatches which were then closed and secured and flame screens were placed over the ullage openings.
Loading of the gasoline then commenced. The tankerman checked that the cargo was entering the tanks by removing the flame screen from the ullage opening and looking into the tank using an explosion proof torch. When satisfied it was entering all the tanks he advised the jetty operator to increase to maximum loading rate. He followed this with another inspection and noted that the cargo was flowing into the tanks with "violent bubbling" indicating to him that the loading rate had increased. He then turned away from the tanks being loaded and commenced walking aft. As he did there was an explosion which threw him into the water. The explosion was immediately followed by fire which spread to cargo which had been released into the harbour. The jetty operator activated the emergency shut-down system, stopped the flow of products to the jetty and notified refinery officials. He then activated the water and foam fire monitors on the jetty and directed them towards the barge. Within 5 to 6 minutes the refinery's firefighting team was on scene and started to fight the fire. The fire spread under the jetty rupturing pipelines and engulfing the shore end of the jetty in flames.
The barge sank alongside the pier and was declared a constructive total loss. It was valued at £500,000 (1986). Damage to the terminal facilities was estimated to be
£4.5 million (1986).
The investigation ruled out an external ignition source. The tankerman on the barge had an explosion proof torch in his hand and a radio in his back pocket. However he did not use the radio before the explosion. Also as he was walking away before the explosion occurred it suggests his actions did not initiate the explosion. Adverse weather conditions, such as lightning were not a factor.
Since the explosion occurred minutes after the loading rate had been increased it was determined that the probable cause of the explosion was the initial high loading rate of the highly volatile low conductivity gasoline which resulted in the generation and discharge of an electrostatic charge in the flammable atmosphere of the barge's cargo tanks. Contributing to the severity of the damage was the ineffectiveness of the foam monitors which prevented the terminal's response team from containing the fire on the barge before it spread to the jetty.
[fire - consequence]

Lessons

[None Reported]

3685 31 July 1986

Source : MARINE ACCIDENT REPORT, EXPLOSION ABOARD THE U.S. TANK BARGE...,NATIONAL TRANSPORTATION SAFETY BOARD, WASHINGTON D.C, USA, REPORT NUMBER NTSB/MAR-87/05, 1987.

Location : Pascagoula; Mississippi, USA

Injured : 0 **Dead :** 0

Abstract

A marine transportation incident. An explosion occurred while loading gasoline into a tank barge. The barge was partly filled with diesel, burnt, sank and spilled fuel into the bay. The fire spread under the pier rupturing pipelines. The cause of the first explosion was the high initial loading rate of the highly volatile and low conductivity gasoline which generated a static charge.

[fire - consequence, sinking]

Lessons

[None Reported]

7513 04 July 1986

Source : LOSS PREVENTION BULLETIN, 121, 18-19; BOND J, CASE STUDIES ON UNSTABLE SUBSTANCES, ICHEME SYMPOSIUM SERIES, NO.102.
Location : , UK

Injured : 0 **Dead :** 0

Abstract

As a result of over pressure there was a rupture of a 1.8m3 feed hopper containing a hydrazide blowing agent. The hopper had been designed for handling a flammable powder delivered in sacks. The bag was placed on the trap door and slit open with a knife. The trap door was then shut and the powder would fall into the hopper while the bag was retained on the door. The hopper was provided with a small vent which was connected to a dust extraction system and bag filter. To cater for a possible dust explosion three explosion suppression bottles containing a halon were provided. At the base of the silo there were two slowly rotating anti-bridging scrolls and a screw auger into a weigh hopper.
The rupture of the hopper caused extensive damage to the bag slitting device which was torn from the silo and displaced several feet. Cladding panels on the roof and side of the building were blown off. The explosion suppression device had been operated by a rise in temperature.
Investigation showed that there had not been a dust explosion. This was determined by the lack of halon pyrolysis products typically present after such an event. The 250 kg of powder in the hopper had been loaded one hour previously and there had been no further movement. Just prior to the rupture of the silo the auger had been started to weight out a batch.
The hydrazide product had a decomposition temperature of about 150 degrees C. On decomposition it gave off vast quantities of nitrogen and water. The decomposition reaction was exothermic. If there had been no venting of the hopper, the decomposition reaction would have generated a pressure of about 10 bar. The decomposition temperature was reduced by traces of other hydrazide products used in the hopper.
It was established that a decomposition of the hydrazide product had occurred, possibly initiated by friction of the auger against the wall of the tube to the weight hopper. The decomposition was exothermic and initiated the explosion suppression system, which added to the volume of gas and caused the rupture of the hopper.
[silo/hopper, overpressurisation, storage, high temperature]

Lessons

[None Reported]

1152003 July 1986

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A release of ethylenediamine occurred while a ro-ro ferry was being unloaded. This was caused by a leak on a container tank valve. In one report this was attributed to overheating of the tank. The spillage was dispersed by hosing with water. Two and a half hours working time were lost on the ferry while this done. Adjacent berths were not affected and there were no injuries.
[unloading, marine transport]

Lessons

[None Reported]

11103July 1986

Source : PETROLEUM REVIEW, JULY 1986.
Location : ,

Injured : 1 **Dead :** 2

Abstract

Two employees working for a company producing sour crude were overcome by hydrogen sulphide gas. Despite attempts at resuscitation, both died. Existing wells were being connected to a new satellite system. Line depressurising led to hydrate blockage so the line was excavated to expose it, giving a 2m deep pit.
Methanol was pumped into the cut line and drained to a road tanker. The hose came off the cut line, in the pit, and two people entered the pit and were overcome by fumes. The second person had tried (unprotected) to help the first. Both victims were dead on arrival at hospital. A third victim lost consciousness but recovered.
[no flow, excavation, asphyxiation, fatality]

Lessons

1. All persons who could be exposed to hydrogen sulphide should be trained in the specific health hazards. All should be examined on the relevant procedures, and receive regular training.
2. Planned entry into pits that could contain hydrogen sulphide must only be done under an entry permit.
3. The entry permit to include: wearing of respiratory equipment, definition of communications, use of the co-workers outside the pit, use of ropes tied to all people entering the pit, co-worker to wear respiratory protection equipment (this can be unconnected), no entry without respiratory equipment even in an emergency.

3651 25 June 1986

Source : ICHEME
Location : ,

Injured : 0   **Dead :** 0

Abstract

An explosion ocurred due to overpressurisation at a petrochemical chlorine plant.

Lessons

[None Reported]

3644 16 June 1986

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

The flow of polyethylene powder from a bin to an extruder slowed down and pellet was added to the silo to assist the flow. Shortly after starting the airflow taking in the pellets to the bin there was a small explosion which caused damage to the vent bag filter of the silo. It was concluded that a dust explosion had occurred in the vent bag filter ignited by static. The system was not fitted with explosion venting. Design inadequate.
[silo/hopper, design or procedure error, damage to equipment]

Lessons

Recommendations.
With respect to this particular incident:
1. The powder should be conveyed and stored under nitrogen.
2. Air transfers into powder storage bins or storage bins contaminated by powder should be via inlet cyclones or other means designed to minimise internal dust creation.
3. Pellets should not be added to powder bins which contain or are contaminated with powder.
4. Redundant vent bag filter housings on powder bins should be removed.
5. Routine monitoring of earth continuity of equipment attached to powder bins should be instituted.
In general
1. Bins or other equipment which may contain High Density Polyethylene (HDPE) powder should be provided with adequate safeguards against dust explosion risks (e.g. inerting or suppression or relief devices).
2. A systematic programme of work to assess the dust explosion hazards of different grades should be undertaken to supplement data available. Urgent attention should be paid to new or recently introduced grades to confirm, as soon as possible, that they may continue to be conveyed and stored in air. Acquisition of in-house explosion testing facilities should be considered.
3. Electrical equipment contained in powder bins should be checked for its suitability for operation in flammable dust clouds.

1159516 June 1986

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A small fire occurred in an extruder feeder bin after a powder explosion.
Powder had stopped flowing freely from the feeder bin onto a weighfeeder. Operators added material, in pellet form, to the feeder to push the powder out.
Pellets were transferred to the bin after air had been commissioned from a 'pellet transfer' blower to the bin.
Between ten and fifteen seconds after starting the pellet flow, flames were seen coming from the feeder bin and a 'bang' was heard. The pellet transfer was stopped and the Fire Station was alerted.
Equipment in the vicinity of the incident was shut down.
The fire in the bin was extinguished and damage to equipment was minor. Up to three tonnes of product had been lost.
An enquiry team identified the probable cause of the explosion as an electrostatic discharge occurring in the bin and igniting a flammable dust cloud. The dust cloud formed by the action of transfer air and pellets entering the bin.
[fire - consequence, material transfer, product loss, dust explosion]

Lessons

The enquiry team made a number of recommendations. These were 'Specific' and 'General'. The 'General' recommendations included:
1. Bins where dust explosion exists should be safeguarded e.g. inerting, suppression, relief devices.
2. Assessment of the explosion hazards associated with different grades of powder should be undertaken.
3. Electrical equipment, contained in powder bins, should be checked for suitability.

3642 09 June 1986

Source : WASHINGTON TIMES, 1986, 10 JUN.
Location : Fairfax; Virginia, USA

Injured : 0   **Dead :** 0

Abstract

Release of hydrogen from overheated electrical storage batteries. Leak.
[overheating]

Lessons

[None Reported]

3621 15 May 1986

Source : ICHEME
Location : , UK

Injured : 1 **Dead :** 0

Abstract

Ethylene oxide liquid released under pressure when the top of a non-return valve on a rail tanker was removed for inspection. Line under pressure and not isolated. 8 tonnes released but no igniotion. Leak.
[overpressurisation]

Lessons

[None Reported]

3589 13 April 1986

Source : LLOYDS LIST, 1986, 15 APR.
Location : Guatemala City, GUATEMALA

Injured : 0 **Dead :** 0

Abstract

A fire occurred in a warehouse included fertilisers, plastics, propane gas, paper and unknown chemicals. Damage estimated at $2 million (1986).
[fire - consequence, warehousing, unidentified cause]

Lessons

[None Reported]

8007 30 March 1986

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A crude oil tank failed mechanically to such an extent that its contents of 12,900 tonnes of material were emptied into its bunded area within an estimated 5 minute period.
Some 12,400 tonnes of the material were recovered from the surface area, whilst the remaining 500 tonnes that had migrated into the water table, was slowly recovered with the groundwater hydrocarbon recovery pumps throughout the refinery.
No personnel were injured as a result of the incident, and no unplanned shutdown of processing equipment was necessary. The storage tank was isolated, drained and removed from service for repair.
An investigation into the cause of the incident was immediately set up.
The subsequent metallurgical and geo-technical investigations concluded that the failure was due to undersized fillet welds being overstressed due to the high stresses generated by greater than normal tank heating conditions. The sequence of events believed to have occurred over a very short period of time which led to this failure is as follows:
1. Immediately prior to the failure, the tank was being heated to the required average temperature of 60 degrees C. It appears that the base of the tank was well above this temperature, possibly in excess of 80 degrees C.
2. The thermal stresses generated by the high temperatures in the bottom of the tank, probably in conjunction with stresses built in and stresses due to some differential settlement, caused rupture of the undersized welds. This resulted in one or more leaks close to the sump near the edge of the tank. The fillet weld at the point of initiation was typically 40% undersized and up to 88% undersized.
3. The hot tank contents were then in direct contact with the sand under a high hydrostatic pressure, which initiated hydraulic fracturing of the sand and the opening up of fissures and quickly eroded the sand.
4. Once this had occurred, loss of support to the tank floor would have occurred, inducing stresses in the floor plates.
With undersized and already weakened welds, propagation of a crack along a weld is envisaged which resulted in high flows of product which in turn accentuated the sand erosion, etc.
[spill, overheating, weld failure, tank failure]

Lessons

1. A detailed analysis of the effects of tank heating on the structural integrity of storage tank floor to be initiated.
2. Local temperature indicators to be installed adjacent to the tank floors in heated tanks to measure temperatures close to the floor plates.
3. More stringent examination of floor plate fillet welds to be introduced.
4. Because of the rapidity of failure due to the cohensionless nature of the underlying sand it is recommended that for future tanks on foundations consideration be given to placing a layer of stabilised sand.
5. Precautionary measures to be taken to protect all existing storage tanks similar to the tank e.g. chemical grouting beneath the tank.
6. Tank settlement surveys should be carried out on a regular basis.

1272917 March 1986

Source : MANCHESTER EVENING NEWS, MARCH 18, 1986.
Location : Lancashire, UK

Injured : - **Dead :** 0

Abstract

A fire occurred at a chemical plant releasing a hydrochloric acid cloud over a residential area forcing the evacuation of residents.
Half the building was destroyed in the fire and an investigation into the cause is underway.
[fire - consequence, gas / vapour release, unidentified cause]

Lessons

[None Reported]

3558 27 February 1986

Source : HAZARDOUS CARGO BULLETIN, 1986, APR., 43,; HAZARDOUS CARGO BULLETIN, APRIL 1996.
Location : Alaska, USA

Injured : 0 **Dead :** 0

Abstract

A rail transportation incident. A tank car left in a railway siding to await onward transfer was found to be leaking foul smelling fumes from the relief valve and a manhole cover. Residents were evacuated from the area. At one point the fumes were jetting to a height of several hundred feet. Although the tank contained urea-formaldehyde (25% urea, 1% methanol and 74% water), it was wrongly labeled formaldehyde. The guidelines supplied to the authorities for emergency response were thus for the wrong chemical, however luckily these were not acted upon. Had the guidelines been acted on, the tank-car could have ruptured. The cause of the incident was overheating; the tanks contents had gelled due to cold weather conditions en route to the rail yard, then been steam heated to 150 degrees F, to reverse the gelling. Then the tank car had been heated again by mistake to 200 degrees F before leaving the rail-yard. A chemical reaction had then developed within the tank-car resulting in the emission of fumes. The tank-car temperature measured at the siding was 206 degrees F. The tank-car was eventually taken from the siding to a remote spot for the chemical reaction to run its course.
[overheating, heating equipment, evacuation]

Lessons

[None Reported]

1161231 January 1986

Source : ICHEME
Location : , FRANCE
Injured : 0 **Dead :** 0

Abstract

During the loading of clean condensate the centre tank of a marine tanker suffered structural damage due to overpressurisation.
Loading was immediately stopped and the vessel was moved from the berth. Cargo was transferred to other tanks and the damaged tank was gas-freed and inspected. Weld cracks upto 1.25m were found, along with associated 6cm to 10cm cracks. No obvious bulging of deck or bulkheads was present but there had been some movement of grating/pipe supports.
[damage to equipment]

Lessons

1. Permanent repairs were required that included cropping out of the deck plate and fitting a welded insert of dimensions 2000mm by 800mm by 15mm. Also welding of all other cracks and repair epoxy coatings.
2. No.5 centre tank to remain in ballast in the short term.

7947 07 January 1986

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 1

Abstract

Hot work was being carried out on the ground at the foot of a 100 tonne cutback tank, from which 40 tonnes of bitumen had been taken out, and the tank just refilled. The hot work ignited oil soaked lagging. As the fire spread upwards on the lagging, the workman followed with an extinguisher, and was blown off the top of the tank and killed by an internal explosion which lifted the tank roof.
Charring of the lagging in the vicinity of the manlid was evident. The work permit details were inadequate. Fatality.
[fire - consequence]

Lessons

There is probably no margin of safety on the recommended IP maximum storage temperature of 230 degrees C, so to be able to avoid having to inert tanks for the higher storage temperature grades a tighter control of bitumen operations will be necessary to avoid incidents for example:

1. Frequent calibration of temperature measuring instruments.
2. Avoid unnecessary excessive blowing and storage temperatures.
3. Care in rate of transfer from blowers to storage, especially where there is no intermediate heat exchange.
4. Care with hotwork, especially with cut back bitumen tanks.
5. Do not have manholes/hatches open on two sides of a tank.
6. More regular cleaning and checking of bitumen tanks.
7. Avoid dipping/sampling at tank tops during thunderstorms or periods of high natural electrical activity.
8. Remove and replace bitumen soaked lagging.
9. Do not expose heating coils.

3502 04 January 1986

Source : NEW YORK TIMES, 1986, 10 JAN.; HAZARDOUS MATERIALS INTELLIGENCE REPORT, 1986, 10 JAN.

WALL STREET JOURNAL, 1986, 17 MAR.

Location : Gore; Oklahoma, USA

Injured : 90 **Dead :** 1

Abstract

A steel cylindrical tank containing approximately 29 500 pounds of uranium hexafluoride ruptured, due to overpressure, at a uranium processing plant. A release of uranyl fluoride and hydrogen fluoride occurred. On the day of the accident the cylinder was not weighed correctly and was overfilled by approximately 2 000 pounds. The uranium hexafluoride is first introduced into the cylinder as a liquid but solidifies in the tank. The operators realised that the tank had been overfilled and applied steam heat to liquefy the contents so that the excess could be removed. This was against company procedure. A three-foot split occurred in the wall of the cylinder during this heating process. Training inadequate. Fatality.
[overpressurisation]

Lessons

[None Reported]

3493 January 1986

Source : SEDGWICK LOSS CONTROL NEWSLETTER
Location : , SOUTH AMERICA

Injured : 0 **Dead :** 0

Abstract

Motor overheating or gas leak caused massive fire destroying main section of offshore flow station which collapsed when pile work fractured.
[fire - consequence]

Lessons

[None Reported]

123141986

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

A fire occurred during an operation to clear a blocked condensate line in a gas processing plant.
The incident occurred when a blockage developed in the liquid line linking a high-pressure separator with a low-pressure degasser. An operator attempted to clear the blockage by isolating the line from the separtor, and flowing condensate back from the degasser to atmosphere through a drain point. The discharge condensate and some liquid impurities were collected in a plastic bucket with a metal handle.
The procedure did not completely free the line, so the operator applied higher pressure from the separator. A violent discharge of condensate occurred which spontaneously ignited after a few seconds. As the high-pressure flow had splashed condensate over a wide area, which also caught fire, the operator was forced to retreat. The fire burned for five minutes until being extinguished by prompt action.
An investigation into the cause of the incident revealed that an electrostatic spark was the cause of the ignition. During high velocity discharges of liquids or two-phase gas-liquid mixtures, sufficient static charge may be generated to cause the high potentials necessary for the generation of incendiary sparks.
[fire - consequence, flow restriction, cleaning, design or procedure error]

Lessons

The following recommendations were stated in the report:
1. Draining to atmosphere of liquids from equipment under higher than atmospheric pressure to be avoided.
2. Venting of gases, which contain entrained or condensed liquid to be avoided.
3. Such gases to be passed through a knock out facility at atmopheric pressure before being emitted in a controlled manner at a suitable location.

9893 1986

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A valve on the inlet to a fluid catalytic cracking unit main fractionator was closed during start-up and than had to be opened to bring the unit into operation. The procedure was reversed during shutdown . The thermal shock of the change-over caused persistent flange leaks. The position was improved by better gasketting but it was only finally resolved by a change in operating procedures which avoided the need to use this valve.
[hydrocarbon, start-up, flange, blowout, fire - consequence, design inadequate, thermal expansion, joint leak]

Lessons

Procedures for start-up, shutdown or other changes in operation should be planned to minimise abrupt changes of temperature on equipment.

8725 1986

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOIN RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 0 **Dead :** 0

Abstract

The storehouse of chemical fertilisers was a hangar subdivided into 8 compartments, divided one from the other by wooden walls. The different compartments contained composed fertilisers of different types and ammonium nitrate. In one of the compartments, where several hundred tonnes of composed fertilisers were stored, a fire occurred at 5 a.m. The cause of the fire is still unknown. The rapid intervention of the fire brigade limited the fire to this compartment. The smoke produced took some hours to disperse. Fortunately, due to the wind direction, it was not necessary to evacuate the population.
[fire - consequence, storage, unidentified cause]

Lessons

[None Reported]

3481 1986

Source : ENVIRONMENTAL EMERGENCIES: A REVIEW OF EMERGENCIES AND DISASTERS INVOLVING HAZARDOUS SUBSTANCES OVER THE PAST TEN YEARS, UNITED NATIONS CENTRE FOR URGENT ENVIRONMENTAL ASSISTANCE, UNITED NATIONS ENVIRONMENT PROGRAMME, 1993

Location : , TADZHIKSTAN

Injured : 0 **Dead :** 0

Abstract

An unknown amount of chlorine was released from an electrochemical plant, causing extremely high air pollution up to 1.5 km from the plant, damaging human health and agricultural land.
[gas / vapour release, pollution, unidentified cause]

Lessons

[None Reported]

8738 1986

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOIN RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 1 **Dead :** 0

Abstract

A marine transport incident. The accident occurred after the loading of a ship tank with benzene. During the let-down of the sampling equipment, the explosion occurred. The walls of the tank were deformed. The person charged with the sampling was injured. Burning of benzene followed. Several tens of tonnes of benzene ended up in the river. Shortly afterwards there was the explosion of an empty benzene tank on land. The primary cause is unknown.
[spill, pollution, damage to equipment, injury, unidentified cause]

Lessons

[None Reported]

3475 21 December 1985

Source : LOSS PREVENTION BULLETIN, 099, 22; THE TIMES, 1985, 23 DEC.; LLOYDS LIST, 1985, 23 DEC.
Location : Naples, ITALY

Injured : 150+ **Dead :** 4

Abstract

An explosion and subsequent fire at a fuel storage terminal and depot, resulted in four deaths, over one hundred and fifty injured, the entire evacuation of the residential zone around the plant, and a 15 kilometre cordon around the area. The plant extended over an area of 99,000 sqm., had a capacity of 107,000 cum.in 39 bulk vessels plus oil pipelines; and at the time of the incident had in storage on the site 41,000 cum. of product. The resultant fire burned for more than 48 hours, and the damage is estimated to amount to about $24million (1984).
The initial view about the cause of the explosion was to attribute it to the work of terrorist saboteurs. It is believed that the sophisticated safety and fire protection systems on the plant were out of action at the time of the explosion.
[fire - consequence, overflow, offloading, vapour cloud explosion, damage to equipment, fatality, sabotage, injury]

Lessons

The necessity of appropriate security precautions against terrorist action, and adequate separation of adjacent populations from hazardous installations.

7974 10 December 1985

Source : ICHEME
Location : ,
Injured : 0 **Dead :** 0

Abstract

A fire occurred in a crude oil heater after it had been shutdown to remove a redundant section of pipework on a relief valve manifold.
The fire was extinguished within ten minutes, and there were no injuries to personnel. Damage to the heater consisted of a split heater tube.
During the afternoon of the previous day, the coil outlet pipework to be worked on was spade isolated and the line was steam purged. At 03.30 hrs on the day of the incident an increase in production demand necessitated the recommissioning of the gas turbine set. Prior to start up of the turbine the operators checked the status of the inlet and bypass dampers on the heater but did not check the position of the heater outlet damper. In addition they did not check the status of the heater coil but assumed that it was either full of water or empty.
Later on during the day, the control operator recorded the following temperatures on the heater system 154 degrees C for the coil tube skin 72 degrees C for the heater arch 159 degrees C for the crude oil outlet from the coil 425 degrees C for the heater flue gas stack temperature.
Both the crude oil outlet temperature and the flue gas stack temperatures were to be expected since one indicated the steam purging temperature in the coil outlet pipework and the latter showed the temperature of the flue gas in the flue gas outlet duct downstream of the bypass connections. The inside operator did not realise the significance of the high heater arch temperature nor the high tube skin temperature in relation to the shut down heater and therefore did not prompt any investigation.
At 15.30 hrs on the same day, yellow/brown smoke was seen coming from the common heater stack. This was reported to the control room and immediately checks were carried out on all on- line burners for any upset condition - none were found. The smoke continued to emit from the stack but had turned black in colour, a recheck was carried out on all heaters. As a result of these checks a pool of burning liquid was discovered inside the firebox of the shut down crude heater.
Snuffing steam was immediately introduced into the firebox, the outlet damper shut and the gas turbine taken off-line.
The fire was extinguished within ten minutes.
Subsequent inspection of the heater revealed that a tube had burst.
Cause of the Incident:
Oil was released into the firebox following the rupture of an overpressured heater tube. The fire resulted from ignition of hydrocarbons by hot turbine gases.
[fire - consequence, tube failure, overpressurisation, damage to equipment]

Lessons

Several important lessons can be learned from this incident:
1. That prior to embarking on a planned unusual or unfamiliar mode of operation for whatever reason, it is essential that a critical analysis and a feasibility study of the operating mode to be undertaken is carried out. All operating procedures, monitoring procedures, control procedures and communication systems to be employed must be thoroughly examined to ensure that satisfactory measures have been taken to maintain the integrity of the unit throughout the planned work programme.
2. The shutting down of a crude oil heater and its preparation for maintenance is a complex operation that demands care and attention throughout all stages. It is essential that well structured and comprehensive shut down procedures, systems and check lists are provided to ensure that the numerous complex tasks associated with such an operation are completed in a safe, efficient manner to maintain the plant integrity. This would have been particularly beneficial had it been applied to the operations associated with taking the crude oil heater off-line and preparing it for maintenance.
3. It is equally important that the operating workforce, including supervision are made fully aware and understand the particular hazards associated with the work involved. It is imperative that they appreciate the significance of maintaining good effective control at all stages, in order that all potential problems are recognised and identified as early as possible, so that their relative significance to the overall safety of the unit can be assessed and corrective measures taken if required. No deviation from the procedures are to be permitted unless authorised through a modification procedure.
4. Similarly, the success of such an operation depends on the installation and use, by all parties (supervisors and workforce), of an effective formal communications system (i.e. written and verbal). This ensures that any deviations from plan, for whatever reason, are immediately communicated formally to the appropriate level of authority for consideration and action.
5. In this incident the communications between the operating workforce and their supervision were far from ideal and were a major contributory factor leading to the incident.
6. The success of any work programme such as that undertaken above, depends on the effectiveness of the isolation of equipment from all process streams. In the case of this incident it is evident that the isolation procedures adopted were inadequate in that they failed to positively isolate the unit from all its process streams. Had systems been set up to check and monitor the effectiveness of the isolation carried out on the unit following its shut down, then the problem of the passing inlet flue gas damper would have been discovered at an early stage and alternative isolation methods could have been adopted.
7. The attention of refineries is drawn to the problems associated with having the tube skin temperature alarm of a heater coil being set so high that it fails to alert operating personnel sufficiently early of a potential problem, similar to that experienced in this incident which led to the rupture of the tube. Refineries, with similar installations, are advised to review their equipment in relation to adjusting the tube skin temperature alarms to avoid a similar incident.

7966 05 November 1985

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A blockage in the common relief valve discharge header from a treating tower and the extract pressure tower was found on attempting to restream a unit following a production shutdown.
The tailpipes from the relief valves on the treating tower and the extract pressure tower are collected in a common relief valve discharge header and routed via a loop seal to the sump drum.
In addition to servicing the pressure safety valves on these two towers, the sump drum collects furfural rich drainings from the plant.
Summary of incident and short term corrective action taken:
On attempting to restream the unit following a production shutdown, a fault on the level controller and pressure transmitter on the extract pressure tower resulted in that tower being filled and overpressured. The unit start-up was aborted and checks initiated to determine why the relief valves on the extract pressure tower failed to relieve the pressure.
Following injection of pressured flue gas and subsequently steam into the 3/4" vent valve on the relief valve discharge line from the treating tower, the inlet elbow to the sump drum was found to be blocked solid with carbonaceous scale. This section of pipework was removed for cleaning.
On recommissioning steam, an unsatisfactory flow was obtained. The flange on the horizontal 6' line from the treating tower was broken and proved to be clear. The flange was remade, no improvement in steam flow was apparent. The section of 6' pipework which constitutes part of the loop seal on the inlet to the sump drum was removed and found to be blocked with carbonaceous scale. The relief valve discharge headers to both the extract pressure tower and treating tower were then both proved to be clear by steaming.
Following clearing and boxing up of all lines on the common relief valve discharge header and instrument attention to the faulty level controller on the extract pressure tower the unit was restreamed three days later.
[instrumentation failure, overpressurisation, flow restriction]

Lessons

The blockage in the common relief valve discharge header was most severe at the loop seal and inlet line to the sump drum. Due to the waxy nature of any material likely to be relieved from the treating tower on a unit upset, this line is steam traced.
The accumulation of material, waxy and with a high furfural content in the lower sections of the loop seal coupled with localised overheating because of the steam tracing, would over a period of time, cause degradation and lead to carbonisation and eventual blocking of the line. The build up of further liquid from subsequent unit upsets would exacerbate the situation.
As the sump drum is blanketed with an inert gas purge, a project has been raised to remove the loop seal at the inlet to the sump drum and reinstall pipework which directs the common relief valve discharge directly into the sump drum sloping in at an angle of about thirty degrees.
As an additional safeguard, use an inert gas or steam on a routine basis to ensure the relief line is clear.

3184 November 1985

Source : PHOSGENE TOXICITY. ICHEME
Location : Hebron; Ohio, USA

Injured : - **Dead :** 0

Abstract

A series of explosions and fires occurred at a chemical solvent plant. Toxic smoke produced by the fires forced the evacuation of nearby residents.
The incident occurred as workers were transferring leaking material spirits into a holding tank.
A spark is thought to have caused the first explosion, which triggered more explosions and a severe fire. Approximately 30 large storage tanks were destroyed in the fire.
Company chemists decided to allow the fire to burn out as the fumes presented a lesser risk than the chemicals would if mixed with water and allowed to run into the ground.
The chemicals involved included, trichloroethylene, 1-1-1 trichlorethylene, nitromethane, cyclohexaneoxide, 1-4 dioxane and perchloroethylene.
It was believed that the intense heat created large amounts of phosgene.
[fire - consequence, overheating]

Lessons

[None Reported]

3364 August 1985

Source : SEDGWICK LOSS CONTROL NEWSLETTER
Location : Birkenhead, AUSTRALIA

Injured : 0   **Dead :** 0

Abstract

A fire occurred at a refulling bay. Five road tankers and a the refuelling bay were destroyed by the fire.
It is though that the cause of the incident was due to build-up of static electricity.
[fire - consequence, gasoline]

Lessons

[None Reported]

1108319 July 1985

Source : LLOYDS LIST, 20, 22, 26, 27, JUL, 1995, TIMES 22, 23, 25, JUL, 1985, GUARDIAN 24, 25, JUL 1985.
Location : Stava, ITALY

Injured : - **Dead :** 222

Abstract

Two earthwork dams which formed part of a fluorite mining complex at the top of a valley collapsed, burying a village and four hotels under 17.5 million cubic feet of mud, silt and water. The reservoirs were used for cleaning mineral ore from the mine, and it is believed that one or both of the dames may have failed due to the accumulated weight of the deposits, or have been weakened by rain or underground streams. Although the dams should have been checked by provincial authorities every three months, no checks had been made in the nine months preceding the disaster. The owners of the mine and several local and national officials responsible for mining regulations were subsequently charged with criminal negligence.
[overpressurisation, fatality, people, design or procedure error]

Lessons

Government arrangement and facilities for checking the stability of artificial basins and their surrounding terrain were inadequate. Local administrators lacked the resources and expertise to do this themselves. The hydrological and geological risks of such area to be closely checked and regularly reassessed.

1163310 July 1985

Source : ICHEME
Location : , UK

Injured : 1 **Dead :** 0

Abstract

This incident occurred on a P2S5 plant which produced a range of zinc thiophosphate derivatives (which are used as oxidation inhibitors). To make this particular product, phosphorus pentasulphide was fed into a reactor containing a mixture of an alkyl phenol and lube oil. The plant was fed from a tote bin to the reactor via a screw conveyor, inspection box, flexible sleeve and a train of 3 power operated valves. Due to the hazardous nature of the materials, the tote bin and feed system were nitrogen purged.
During the powder feeding operation it was noticed that the flexible sleeve was distended, indicating a blockage in the valve train. Rodding was carried out through an inspection door and appeared to clear the blockage. However, shortly afterwards molten or burning P2S5 was ejected from the inspection door casing minor facial burns to an operator.
The Works and local fire brigades successfully extinguished resulting small fires.
A thorough investigation showed that the most likely cause of the incident was that, when rodding was carried out, air was drawn through the inspection box and valve train into the reactor (which was under a slight vacuum). Moisture from the air reacted with the P2S5, forming hydrogen sulphide (which has a very low ignition energy). The source of ignition could have been an electrostatic discharge generated by the flow of air and P2S5 dust.
[charging reactor, reactors and reaction equipment, injury, fire - consequence, air leaking into system, static, unwanted chemical reaction, injury]

Lessons

The main recommendations made were as follows:
1. Minimise exposure to air of P2S5 powder by maintaining an effective nitrogen purge, by maintaining the door seal in good condition and by avoiding opening of the door.
2. If the door must be opened, ensure that the other valves are closed to avoid drawing in air.
3. Write specific instructions for dealing with blockages.

3345 06 July 1985

Source : LLOYDS LIST, 1985, 8 JUL.; CHEMICAL WEEK, 1985, 17 JUL.; FERTILIZER INTERNATIONAL NO.207, 1985, 18 JUL.
Location : Heroya; Oslo, NORWAY

Injured : 2 **Dead :** 1

Abstract

An explosion occurred involving an ammonia unit at an ammonia factory when an overheated hydrogen pump burst and ignited leaking hydrogen gas.
[overheating, fatality, burns, fire - consequence]

Lessons

[None Reported]

3343 04 July 1985

Source : LLOYDS LIST, 1985, 12 JUL.
Location : Melbourne, AUSTRALIA

Injured : 0 **Dead :** 0

Abstract

A chemical fire occurred in a vehicle maintenance workshop.
[fire - consequence, unknown chemicals, unidentified cause]

Lessons

[None Reported]

3339 July 1985

Source : ICHEME
Location : , FRANCE

Injured : 0 **Dead :** 0

Abstract

Two explosions followed by a fire in a peroxide storage cell.
The storage facility, for reaction initiators were made up of six separate refrigerated cells. Each cell was separated from the adjacent cell 10m away by a fire wall. The facility was surrounded by a fire wall higher than the top of the cells. The wall on the fire-wall side of each cell is a partition forming a pressure-resistant valve. The incriminated cell contained 5 tonnes of peroxides. The fire, preceded by two explosions was extinguished. The refrigeration and ventilation system as a whole was operating but this was stopped by an electrician. Two possible hypotheses as to the origin of the fire:
1. Inside the cell, spontaneous ignition of the peroxides for an as yet unknown reason.
2. Outside the cell, the power ventilator unit is suspected.
[fire - consequence, refrigerated storage tank, unidentified cause]

Lessons

[None Reported]

3325 31 May 1985

Source : ICHEME
Location : , AUSTRALIA

Injured : 3 **Dead :** 0

Abstract

A fire occurred on an ethylene cracker causing damage to electrical and instrument cabling. Prior to the accident there was considerable voltage cycling which got worse, causing compressors to surge etc. Eventually the furnace tripped. On restoration of power, the furnace could not be restarted due to a microswitch on a damper being closed. This was not realised and it was thought that the fault was due to a programmable logic controller. While this was being sorted out, cracked gas was being wrought across to the cracker to prevent shutdown of the acetylene converter. There was a space velocity of 1/10 of the previous flow and the gas was rich in hydrogen. The temperature in the acetylene converter want off scale, the outlet line heated up causing a leak at a flange. This ignited and impinged on pipework under pressure and ruptured. The catalyst did not fuse but carbon was present downstream.
[electrical equipment failure, fire - consequence, flange leak, cracking]

Lessons

[None Reported]

9686 23 April 1985

Source : ICHEME
Location : , BELGIUM

Injured : 0 **Dead :** 0

Abstract

An overheated offsites fuel oil pump, jammed and finally disintegrated, causing a large leakage of oil in a semi-closed pumphouse.
The leak ignited and the subsequent fire, which was difficult to reach, caused some £276,000 (1985) damage.
[overheating, fire - consequence, damage to equipment]

Lessons

[None Reported]

3251 07 March 1985

Source : HAZARDOUS MATERIALS INTELLIGENCE REPORT, 1985, 22 MAR.
Location : South Charleston; West Virginia, USA

Injured : 8 **Dead :** 0

Abstract

A release of 5400 lb of acetone and mesityl oxide occurred at a plant.
The gas escaped when too much steam was injected into the mesityl oxide-acetone separation tower. The excess steam overheated the tower and caused the release through a vent line. Eight workers were affected by the incident.
[overheating, overpressurisation]

Lessons

[None Reported]

3240 25 February 1985

Source : EDINBURGH EVENING NEWS, 1985, 25 FEB.
Location : Grangemouth; Stirlingshire, UK

Injured : 0 **Dead :** 0

Abstract

Release of gas when unloading. Leak. Spill.

Lessons

[None Reported]

3225 04 February 1985

Source : ICHEME
Location : , USA

Injured : 1 **Dead :** 0

Abstract

A river barge containing styrene was unloading when an operator opened a manhole lid to the 3000 cum tank. There was an immediate explosion. The styrene was normally blanketted with methane during storage and dissolved natural gas came out of solution during transit forming a flammable mixture.

Lessons

[None Reported]

7959 21 January 1985

Source : ICHEME
Location : ,
Injured : 0 **Dead :** 0

Abstract

A leak developed from an eductor pressure gauge during a tetramethyl lead (TML)/gasoline blending operation.
Investigation of the shutdown system, revealed that the leak resulted from hairline cracking on the bourdon tube of the pressure gauge.
Two technicians were assigned to the TML blending operation at 0300 hrs. The operating steps taken were correctly carried out according to detailed instructions.
Vibrations of the eductor and associated piping/gauges had been observed at every TML blending when throttling down the bypass valve of the eductor. This is because of cavitation in the gasoline stream which caused rapid pressure fluctuations leading to the mechanical vibrations.
At 0555 hrs., one of the technicians returned to the TML blending area. He did not notice or smell anything abnormal initially because he had a cold, however, he subsequently saw a leaking pressure gauge downstream of the eductor. He radioed control room about the leakage and hurriedly left the area.
On instructions from the Acting Supervisor, two technicians, carrying canister respirators from the control room, returned to the site, and proceeded to shut down the system.
Under cover of water spray protection and using canister respirators, the two technicians isolated the ball valve of the leaking pressure gauge. They continued washing the piping, valves, surroundings, etc. with water for the next 20-30 minutes. The spillage was confined within the bunded area of the TML Meter Package Unit and flushed to the leaded slop pit.
The Shift Superintendent was informed and the Acting Supervisor came to the site. He detected the smell from a distance and did not go nearer.
By 0630 hrs., the situation was under control. The three personnel at the scene of leakage were advised by the Shift Superintendent to have medical check ups.
Cause of Incident:
Dye penetrant checks on both failed bourdon tubes revealed hairline cracks at similar locations with similar configurations. Subsequently, one of them was sent for metallurgical examination, and this pointed to stress corrosion cracking characteristic of austenitic stainless steel.,
Based on this information, the most likely theoretical cause of the stress corrosion cracking is the presence of moisture and organic chlorides environment.
The moisture most probably came from the gasoline circulation line while the organic chlorides are present in TML as 18.8% of EDC.
The secondary contributing factor is the mechanical vibration and pressure surge of the gasoline which aggravate the stress on the bourdon tubes.
[pressure meter/control, excessive vibration, tube failure, incorrect material of construction, processing]

Lessons

The following recommendations were made:
1. Modifications to be made to drain as much water from the blending components as possible.
2. The original specification of phosphor bronze bourdon tube pressure gauge to be reinstated. If for any reason not possible, then monel, inconel or ferritic stainless steel tubes can be used to avoid stress corrosion.
3. To reduce vibration, separate the gauge mounting from the eductor mounting using an impulse line with one or two anti-vibration loops. The material used will be compatible with the piping and gauge.
4. Compressed air breathing apparatus will be provided to deal with leakage, because the duration of leakage and concentration of the toxic leaded vapours is not predetermined and canister masks can be saturated even in an open ventilated area.
5. Whenever possible a technician should stay at site during the additive blending operations. If not possible, regular checks to be made of the area, to ensure the earliest warning is obtained should an emergency arise.
6. At least two complete sets of protective equipment to be readily available kept in UNLO.

3209 20 January 1985

Source : INSTITUTE OF INSURERS
Location : Jackson; Mississippi, USA

Injured : 0 **Dead :** 0

Abstract

Due to abnormal cold weather operating controls for a boiler failed due to freezing. They indicated a false water level in the boiler. Thus the boiler suffered from severe overheating and damage in the form of tube rupture and severe warping.
[material of construction failure, damage to equipment]

Lessons

[None Reported]

3206 16 January 1985

Source : LOSS PREVENTION BULLETIN 069, 29-32.; WHITE B.J ET AL., REPORT ON A STUDY OF CHEMICAL TANKER VENTING AND GAS FREEING ARRANGEMENTS, SCOTTISH ENERGY CENTRE, 1988, P70.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A tank was loaded with benzene, at a temperature of 20 degrees C, a further amount was offloaded from a marine tanker. The temperature in the tank was 24 degrees C whereas the outside temperature was 10 degrees C. The tank farm operator went to the tank to take a sample and discovered a leak. Immediate inspection showed that at the top the wall steelplates were indented. At the bottom wall connection, the tank was tilted up from its foundation. Examination of the four P/V valves and flame arresters showed that the benzene vapour had condensed and completely blocked all four flame arresters. Consequently the tank ruptured at the designed weak screen weld at the top of the tank wall.
[loading, unloading]

Lessons

[None Reported]

3193 02 January 1985

Source : DAILY TELEGRAPH, 1985, 3 JAN.
Location : Bootle; Merseyside, UK

Injured : 8 **Dead :** 0

Abstract

Eignt people taken to hospital after a potassium cyanide storage tank overheated giving off ammonia fumes.
[overheating]

Lessons

[None Reported]

8747 1985

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOIN RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 0 **Dead :** 1

Abstract

An ignition of gas coming from a leaking flange initiated a jet fire which caused the blast of the fractionating column and the explosion of 3 tanks containing ethylene, propylene and LPG. The explosions were very powerful, but it was not necessary to evacuate the zone. One person was found dead outside the establishment.
Although the fire was under control it continued for many days. Jet fires were not extinguished to avoid the formation of explosive clouds. A flare connected to various points of the plant was set up to accelerate the exhaustion of the fire. Various fires in a radius of 60 m were extinguished. Fatality.
[fire - consequence, flange leak, processing]

Lessons

[None Reported]

8769 1985

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, MAJOR ACCIDENT REPORTING SYSTEM LESSONS LEARNT FROM ACCIDENTS NOTIFIED, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS, COMMISSION OF THE EUROPEAN COMMUNITIES JOIN RESEARCH CENTRE, 1991, ISBN 9282622894.

Location : ,

Injured : 0 **Dead :** 0

Abstract

During the addition of phthalic anhydride to a varnish kettle which contained a mixture of soya bean oil, glycerol and caustic at 200 degrees C, an explosion occurred at the charging hatch. The operator was blown back by the force and broke his arm as he fell to the ground. Two other operators standing nearby were not injured. The charging chute was also propelled upwards and damaged the kettle agitator motor. The content of the vessel was unaffected. The bursting disc in the kettle pressure relief line did not rupture. The steel charging chute was not bonded to the reactor because of the presence of a non-conducting gasket in between, hence the most likely cause of the explosion is the ignition of phthalic anhydride dust by a static discharge from the unbonded chute.
Since this accident, the company was required to check that all equipment used to transfer phthalic anhydride powder is bonded to earth and to amend the operating procedures and ensure that the dangers associated with phthalic anhydride are highlighted.
[safety procedures inadequate, charging reactor]

Lessons

[None Reported]

1112420 December 1984

Source : FIRE PREVENTION, JUL, AUG, 1985,; PRESS ASSOCIATION,; THE GUARDIAN, 21, 28, DEC, 1984, 9 FEB 1985; THE TIMES, 21, 28, DEC, 1984.
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A rail transportation incident. A goods train comprising a diesel locomotive and 13 rail tankers each carrying 70 tonnes of petroleum spirit was derailed as the result of a failed axle due to an overheated axle box, cause unknown, in a 2885 yards long tunnel. Petroleum leaking from the derailed railcars ignited, and the resultant fire burned with great ferocity over several days, presenting the emergency services, particularly the fire-fighters, with severe difficulties. There was intense heat at the seat of the fire, which caused the bricks of the tunnel to fuse with a glass-like appearance. The tunnel was out of commission for several months to allow remedial rebuilding work to take place, but the damage was not beyond economic repair, as had been initially feared. Forensic calculations assessed the temperature in the centre of the fire at around 1300 degrees C.
[derailment - consequence, overheating, fire - consequence, damage to equipment]

Lessons

The value of advance emergency planning was confirmed (contingency plans for such an incident had been prepared several years before the incident and practice exercises had taken place).

3166 17 December 1984

Source : NEW YORK TIMES, 1984, 19 DEC. HAZARDOUS CARGO BULLETIN, 1985, JAN.
Location : Matamoros, MEXICO

Injured : 182 **Dead :** 0

Abstract

Flexible hose used to offload ammonia from rail tanker car ruptured under high pressure causing release of 8000 usg and forming a gas cloud. 3,000 people were evacuated.
[offloading, spill, unloading, evacuation]

Lessons

[None Reported]

3161 13 December 1984

Source : THE TIMES, 1984, 14 DEC.; LLOYDS LIST, 1984, 15 DEC.
Location : , PAKISTAN

Injured : 11   **Dead :** 16

Abstract

Transportation. 16 in diameter natural gas pipeline explosion caused by overpressure. Fatality.
[overpressurisation]

Lessons

[None Reported]

1100528 November 1984

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A fire was discovered in the communal bathroom and toilet of a block of guest flats. The fire was caused by the extractor fan overheating and setting light to the plastic cover. This caused the fan unit to fall out of its housing and into the bath. Damage was caused to the bathroom and nearby corridor.
All the guests were safely evacuated from the building.The smoke emitted by the fire was noxious and could have caused harm to the residents. There was no smoke detection equipment in place.
[evacuation, gas / vapour release, fire - consequence, damage to equipment]

Lessons

Smoke detectors were fitted and signs displayed explaining that time delay in the lights and fans switching off. Fire Instructions in the rooms and on the landing were updated and the booking forms included information on the Fire Procedures.

3145 20 November 1984

Source : THE TIMES, 1984, 21 NOV.; THE TIMES, 1985, 23 JAN.; GUARDIAN, 1985, 23 JAN.; HAZARDOUS CARGO BULLETIN, 1985, FEB.
Location : Slaithwaite; Yorkshire, UK

Injured : 16 **Dead :** 0

Abstract

A road transportation incident. A road tanker of ferric chloride incorrectly labelled as sodium hypochlorite was unloaded into a tank of sodium hypochlorite causing the release of chlorine.
[offloading, spill, unloading, labelling incorrect]

Lessons

[None Reported]

3138 15 November 1984

Source : TORONTO GLOBE & MAIL, 1984, 7 DEC.
Location : Ontario, CANADA

Injured : 0 **Dead :** 0

Abstract

Overheated chlorine pipeline caused the steel to burn and rupture with the release of chlorine from a pulp mill. The entire town of 9000 people was evacuated.
[spill, evacuation, processing, overheating]

Lessons

[None Reported]

1264617 October 1984

Source : LLOYDS LIST, OCTOBER 19, 1984.

Location : ,

Injured : - **Dead :** 3

Abstract

A marine transportation incident. An explosion occurred onboard a 50,975 tonnes deadweight marine tanker causing a fire and the eventual sinking of the tanker. It is not known what caused the explosion.
[fire - consequence, fatality, unidentified cause]

Lessons

[None Reported]

3116 06 October 1984

Source : CHEMICAL AND ENGINEERING NEWS, 1984, 15 OCT.; LLOYDS WEEKLY CASUALTY REPORTS, 1984, 23 OCT.
Location : Linden; New Jersey, USA

Injured : 161 **Dead :** 0

Abstract

A 12,000 gallon tank ruptured at a pesticide plant and released a toxic cloud. More than two dozen crewmembers of a nearby ship were slightly injured when they inhaled the fumes and at least 16 other people reported breathing problems, nausea and skin irritations. The outdoor tank overheated causing a steel cover to blow off. The contained malathion, a commonly used pesticide described as extremely dangerous when inhaled in its pure form. Residents in a 20 mile radius were advised to stay indoors with windows shut until the chemical dissipated. The leak was plugged half an hour after the incident occurred.
[storage tanks, overheating, gas / vapour release, injury]

Lessons

[None Reported]

3098 06 September 1984

Source : NUNETON EVENING TELEGRAPH, 1984, 6 SEPT.
Location : Hinkley; Nuneton, UK

Injured : 42 **Dead :** 0

Abstract

Two chemicals were mixed and caused release of chlorine at swimming pool when road tanker offloading sodium chlorite was mixed with hydrochloric acid.
[mixing, gas / vapour release]

Lessons

[None Reported]

3084 25 August 1984

Source : INSTITUTE OF INSURERS

Location : Kafue, ZAMBIA

Injured : 0 **Dead :** 0

Abstract

Explosion during start-up of a gasifier furnace of a carbon monoxide unit caused by flameout. Oxygen and steam feed continued.

Lessons

[None Reported]

3072 09 August 1984

Source : ICHEME
Location : , UK

Injured : 0   **Dead :** 0

Abstract

A fatty acid followed by pentaerythritol had been added to a reactor the previous day and left stirring overnight. On the following day it was heated to 110 degrees C and 4 bags of phthalic anhydride added via a screw feed. The screw became blocked and while roddin it out there was a small explosion in the reactor. Solvent left in a return loop of the condenser was the source of the flammable mixture and static possibly came from the operator.
[reactors and reaction equipment, charging reactor]

Lessons

The following recommendations were made:
1. Use of antistatic footwear.
2. Provide a removable bobbin piece at the solids addition point so that any blockage could be cleared off the plant.

3066 August 1984

Source : JOURNAL OF THE ASSOCIATION FOR PETROLEUM AND EXPLOSIVES

Location : Grange Lane North; Scunthorpe, UK

Injured : 0 **Dead :** 1

Abstract

Driver suffered fatal burns when discharging diesel fuel at depot and it caught fire. Probable ignition was static. Possible low flash material in vapour after a hot weekend. Fatality.
[hot weather, unloading, fire - consequence]

Lessons

[None Reported]

3049 15 July 1984

Source : ICHEME
Location : , NETHERLANDS

Injured : 1 **Dead :** 0

Abstract

A river transportation incident. Loading a river barge with gasoline an operator opened a small manlid and there was a small ignition. The operator was burnt on the hands and face. Cause of the ignition unknown but static or pyrophoric blasting sources being considered. Iron grit found in lid opening from previous shot.
[fire - consequence, burns]

Lessons

[None Reported]

1145806 July 1984

Source : ICHEME
Location : , AUSTRALIA

Injured : 1 **Dead :** 0

Abstract

A fire occurred, in the propellant cutting section, at an explosives factory.
It was reported that an operator placed his arm into a plastic collection bucket to routinely sample the propellant and experienced an electric shock to his hand. The propellant powder in the bucket was then ignited.
The cutting operation was undertaken in an atmosphere of air and ether vapour. Extensive measurement of electrostatic charge generation and dissipation, showed that, at the time of the fire, the electrostatic charge on the cut propellant could have been more than sixty times that which would be required to ignite the ether vapour.
Investigations also showed that metal labyrinths in the cut propellant flow as well as employing collection buckets made from other materials (to reduce the charge accumulation) would successfully reduce the electrostatic energy to below the vapour's ignition level.
[fire - consequence, static, gas / vapour release, explosive]

Lessons

A coating on so-called "anti-static" plastic buckets appeared to be removed when exposed to ether. A recommendation is made in the data not to use these buckets.

3039 29 June 1984

Source : HAZARDOUS CARGO BULLETIN, 1984, NOV.
Location : Buenos Aires, ARGENTINA

Injured : 0 **Dead :** 6

Abstract

A marine transportation incident. Explosion occurred in a marine tanker while offloading oil. Fatality.

Lessons

[None Reported]

3037 27 June 1984

Source : HAZARDOUS CARGO BULLETIN, 1984, NOV.
Location : Port Arthur; Texas, USA

Injured : 0   **Dead :** 0

Abstract

A marine transportation incident. A marine tanker was disturbed while berthed and offloading crude oil causing mooring lines to break and loading arms to rupture. Spillage of 8 te of oil ignited by spark from equipment falling onto jetty. Fire damaged dock loading arms and fenders.
[fire - consequence]

Lessons

[None Reported]

1154907 June 1984

Source : LLOYDS LIST, 8 JUNE, 1984, 12 JUNE, 1984.
Location : Cilacap, JAVA

Injured : 11 **Dead :** 5

Abstract

Five people were killed and eleven others injured when a petrol storage tank exploded at a refinery. The fire began for unknown reasons and was brought under control without spreading to other storage tanks.
[storage tanks, explosion, fire - consequence, fatality, gasoline, injury, unidentified cause]

Lessons

[None Reported]

3008 28 May 1984

Source : ICHEME

Location : , UK

Injured : 0 **Dead :** 0

Abstract

Mild explosion in marine tanker 7 hours after offloading methanol.
[unloading]

Lessons

[None Reported]

2985 30 April 1984

Source : HAZARDOUS CARGO BULLETIN, 1984, NOV.
Location : Manaus, BRAZIL

Injured : 0 **Dead :** 0

Abstract

A marine transportation incident. Fire in pump room of marine tanker when offloading kerosene due to rupture of flexible coupling. A spark from the pump ignited the leaking cargo.
[coupling failure]

Lessons

[None Reported]

2979 18 April 1984

Source : INSTITUTE OF INSURERS
Location : Algeciras, SPAIN

Injured : 0 **Dead :** 0

Abstract

Implosion while the vacuum distillation column was stopped.

Lessons

[None Reported]

2972 10 April 1984

Source : RAILROAD ACCIDENT REPORT, SEABOARD SYSTEM RAILROAD FREIGHT TRAIN DERAILMENT AND FIRE, NATIONAL TRANSPORTATION SAFETY BOARD, WASHINGTON D.C, USA, REPORT NUMBER NTSB RAR-85/05, 1985; HAZARDOUS MATERIALS INTELLIGENCE REPORT, 1984, 20 APR.

Location : Marshville; Bostic; North Carolina, USA

Injured : 0 **Dead :** 0

Abstract

A rail transportation incident. A wheel axle overheated causing derailment of 4 rail tanker cars of methanol, spillage ignited from 2 rail tanker cars, fire. 2100 people evacuated within 1 mile radius. 3 buildings and 4 automobile cars were destroyed. The probable cause was failure of the train crew to apply correctly the information about overheated journal provided by inspector and wayside hotbox detector.
[wheel broken, overheating, human causes, evacuation]

Lessons

[None Reported]

2961 30 March 1984

Source : ICHEME
Location : , SAUDI ARABIA

Injured : 0 **Dead :** 0

Abstract

Damage to a tank caused by overpressure at a refinery storage.
[overpressurisation, refining, damage to equipment]

Lessons

[None Reported]

2958 28 March 1984

Source : ICHEME
Location : , FRANCE

Injured : 0 **Dead :** 0

Abstract

A violent explosion occurred in the extrusion building of number 4 polyethylene line reactor. A fire occurred and damaged the building. A plug in the vent system led to manual draining of the knock-out pot. The drain valve was left open and about 150 kg of ethylene escaped into the building and ignited probably by static.
[reactors and reaction equipment, leak]

Lessons

[None Reported]

1141718 March 1984

Source : LLOYDS LIST, 23, 24, MAR, 1984.
Location : , INDONESIA

Injured : 0 **Dead :** 0

Abstract

A fire started in the chemical store of an oil drilling barge working offshore. The fire was confined to the store itself. However, large quantities of toxic fumes produced from the fire necessitated evacuation of the eighty crew members by helicopter.
The fire could not be extinguished by conventional means and assistance of an international fire fighting specialist was enlisted.
Cause of the fire is unknown.
[fire - consequence, exploration, storage, marine transport, unidentified cause]

Lessons

[None Reported]

2939 06 March 1984

Source : INSTITUTE OF INSURERS
Location : Grimsby, UK

Injured : 0 **Dead :** 0

Abstract

Incombustible gas extinguished flame in heater then fuel gas entered causing explosion.
[flameout]

Lessons

[None Reported]

2927 26 February 1984

Source : NATIONAL TRANSPORTATION SAFETY BOARD, WASHINGTON D.C, USA, REPORT NUMBER, NTSB-MAR-85-06; HAZARDOUS CARGO BULLETIN, 1984, NOV.

Location : , GULF OF MEXICO

Injured : 0 **Dead :** 8

Abstract

An eductor driven with steam blew air into a plastic sleeve which was put into a tank on a marine tanker. An explosion occurred possibly due to static discharge from eductor to earth. A second explosion occurred many days later. Fatality. Substance involved: gasoline.

Lessons

[None Reported]

2908 04 February 1984

Source : INSTITUTE OF INSURERS
Location : Corpus Christi: Texas, USA

Injured : 0 **Dead :** 1

Abstract

An explosion occurred in a tank containing xylene. The cause was a spark which was caused by static when taking a sample. Fatality.

Lessons

[None Reported]

2891 17 January 1984

Source : ICHEME
Location : , QATAR

Injured : 0 **Dead :** 0

Abstract

Mechanical equipment failure due to overspeed on a compressor at a petrochemical ethylene plant

Lessons

[None Reported]

2887 15 January 1984

Source : INSTITUTE OF INSURERS
Location : Cressier, SWITZERLAND

Injured : 0 **Dead :** 0

Abstract

Rupture of gasket in crude feed oil line due to sudden pressure changes. Spraying oil ignited. Refinery shutdown for 1 week.
[fire - consequence, pressure surge, refining]

Lessons

[None Reported]

2884 10 January 1984

Source : INSTITUTE OF INSURERS
Location : , UK

Injured : 0 **Dead :** 0

Abstract

Spontaneous ignition of waste gases within empty bitumen tank following failure of thermostat. Subsequent overheating by heating elements.
[autoignition, mechanical equipment failure]

Lessons

[None Reported]

2880 06 January 1984

Source : ICHEME
Location : , SOUTH AFRICA

Injured : 0   **Dead :** 0

Abstract

An explosion occurred on an oxygen pipeline caused by a flange leak. Source of ignition was hot surface.

Lessons

[None Reported]

2837 19 December 1983

Source : INSTITUTE OF INSURERS
Location : Kaduna, NIGERIA

Injured : 0 **Dead :** 0

Abstract

Damage to crude catalytic reforming unit due to overheating after re-ignition of burners during shutdown.
[damage to equipment]

Lessons

[None Reported]

2825 01 December 1983

Source : GUARDIAN, 1983, 2 DEC.; LLOYDS LIST, 1983, 3 DEC.; FIRE PREVENTION NO.172, 46.
Location : Billingham, UK

Injured : 11 **Dead :** 0

Abstract

This fire began in an aromatics processing plant. One of the oil pumps failed, lost suction, became overheated damaging a seal. When suction was restored liquid leaked through the seal and was ignited on a hot surface. Pump failure.
[fire - consequence, overheating]

Lessons

[None Reported]

2820 December 1983

Source : SEDGWICK LOSS CONTROL NEWSLETTER
Location : , NICARAGUA

Injured : 0 **Dead :** 0

Abstract

Failure of flexible hose at jetty while offloading caused explosion.
[hose failure]

Lessons

[None Reported]

1163728 October 1983

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A failure of the let down gas pressure regulator, caused a blockage on the low pressure side of the regulator. The operators saw that the regulator body was iced up and they started to play live steam on it. This resulted in a leak of boron triflouride from the treaded valve. This leak was prolonged because of the lack of suitable breathing apparatus. The regulator had failed a week before.
[overpressurisation, spill, flow restriction, pressure raising/reducing equipment, safety equipment failure, maintenance, spill]

Lessons

Need for replacement of regulators after leakage or failure in test or operational conditions. Ample Breathing apparatus should be provided.

2778 24 October 1983

Source : WALLACE D.P, FAILURE OF TWO CO_2 REGENERATOR TOWERS, AMMONIA PLANT SAFETY, AICHE, VOL 32, 1991, 158-162.
Location : , UK

Injured : 0 **Dead :** 0

Abstract

The top section of both CO_2 regenerator towers, on an ammonia plant, failed due to vacuum being formed inside the tower during a short plant breakdown to repair a leaking reformer tube exit pigtail. The conditions for vacuum formation were established as a result of abnormal operating conditions and actions, and maintained due to failure of the nitrogen blanket protection system.
[maintenance, vacuum]

Lessons

[None Reported]

7514 24 October 1983

Source : LOSS PREVENTION BULLETIN, 122, 11-17.

Location : ,

Injured : 0 **Dead :** 0

Abstract

Collapse of the top sections of two carbon dioxide regenerator towers on a ammonia plant occurred. The collapse was due to the formation of an internal vacuum.
One contributory factor leading to the vacuum formation in the towers was due to operator error to open a valve to allow air into the system because the operator was worried about allowing a flammable gas/air mixture to occur. A quantified hazard analysis was therefore carried out to assess the risk of explosion if air was allowed into the towers.
[separation equipment]

Lessons

[None Reported]

2773 20 October 1983

Source : INSTITUTE OF INSURERS
Location : Ingolstadt, GERMANY

Injured : 0 **Dead :** 0

Abstract

Spillage of crude oil from a storage tank due to gasket leak.
[storage tanks]

Lessons

[None Reported]

2774 20 October 1983

Source : INSTITUTE OF INSURERS
Location : Kaduna, NIGERIA

Injured : 0 **Dead :** 0

Abstract

Overheating of gearbox caused sparks and ignition of lubricating oil.

Lessons

[None Reported]

2754 01 October 1983

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

An implosion occurred in a cone roof tank involving bitumen on an asphalt plant, due to a blocked vent. Damage to equipment.
[storage tanks]

Lessons

[None Reported]

13052October 1983

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

An 8000-litre batch reactor had been charged with a raw material and solvent when a fault on the refrigeration plant caused an interruption of the process for several days. The allegedly non-reactive chemicals remained in the reactor without supervision and with the agitator running. This had been the practice several times in the case of delays.
After 6 days, smoke was seen coming from the reactor. The temperature had risen from
60 degrees C to 160 degrees C and was still rising. Although full cooling was now applied, tar-like material was thrown out of the manhole and after a very short time the reactor exploded, although the 450mm manhole was fully open.
[storage, batch reaction, stirrer, explosion, spill, auto decomposition, safety procedures inadequate, overheating, thermal degradation, batch reactor, agitator]

Lessons

The investigation showed that the contents of the reactor had been at the solvent boiling point of 116 degrees C for 3 to 4 days. Causes for the first step of the temperature rise were probably the energy input from the stirrer with insufficient jacket cooling and a leaking steam valve on the jacket.
The second part of the temperature rise to 160 degrees C was caused by the autocatalytic decomposition of the mixture.

13143October 1983

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

An 8000-litre batch reactor had been charged with a raw material and solvent: then a fault on the refrigeration plant caused an interruption of the process for several days. The allegedly non-reactive chemicals remained in the reactor without supervision and with the agitator running. This had been the practice several times in the case of delays.
After 6 days, smoke was seen coming from the reactor. The temperature had risen from 60 degrees C to 160 degrees C and was still rising. Although full cooling was now applied, tar-like material was thrown out of the manhole and after a very short time the reactor exploded, although the 450mm manhole was fully open.
[storage, batch reaction, stirrer, explosion, spill, auto decomposition, safety procedures inadequate, overheating, thermal degradation]

Lessons

The investigation showed that the contents of the reactor had been at the solvent boiling point of 116 degrees C for 3 to 4 days. Causes for the first step of the temperature rise were probably the energy input from the stirrer with insufficient jacket cooling and a leaking steam valve on the jacket.
The second part of the temperature rise to 160 degrees C was caused by the autocatalytic decomposition of the mixture.

2675 31 July 1983

Source : HAZARDOUS MATERIALS INTELLIGENCE REPORT, 1983, 5 AUG.
Location : New York, USA

Injured : 0 **Dead :** 0

Abstract

Heat from a fire in a dumpster caused approximately 70 drums containing a total of more than 3000 gallons of toluene and methyl ethyl ketone, and other chemicals to explode and burn at a warehouse. Some chemicals spilled from the exploded drums into a storm sewer and pumps were used to remove the spill.
[fire - consequence, warehousing, explosion, overheating]

Lessons

[None Reported]

2667 22 July 1983

Source : HAZARDOUS MATERIALS INTELLIGENCE REPORT, 1983, 29 JUL.

Location : Baton Rouge, USA

Injured : 0 **Dead :** 0

Abstract

A road transportation incident. A road tanker of styrene overpressured and lifted the relief valve to release styrene vapour. Polymerisation occurred. [overpressurisation]

Lessons

[None Reported]

2645 July 1983

Source : CHEMICAL WEEK, 1983, 20 JUL.
Location : Reserve; Louisiana, USA

Injured : 20 **Dead :** 0

Abstract

Explosion occurred when a storage tank of chloroprene by-product, a main intermediate in the synthesis of neoprene, clogged and overheated.
[overheating, storage tanks, flow restriction]

Lessons

[None Reported]

2634 16 June 1983

Source : ICHEME
Location : , SAUDI ARABIA

Injured : 0 **Dead :** 0

Abstract

Damage to a refinery loading area involving a meter which was caused by overpressure.
[high pressure, refining, damage to equipment, overpressurisation]

Lessons

[None Reported]

2614 30 May 1983

Source : ICHEME
Location : , NETHERLANDS

Injured : 0 **Dead :** 3

Abstract

An explosion occurred at igniter factory. Three employees were repacking dried, centre-core igniters with propellant when two explosions occurred. The centre-core igniter was a tubular product, made of a very porous propellant. The propellant was dried in cylindrical aluminium containers into which heated air was blown. On the morning of the explosion the drying process, which usually took some days, was terminated. Over an hour later the aluminium containers with propellant were moved to a production room for repacking. Present in the production room was a mushroom mixer. The first explosion was initiated by a propellant fire in the mixer which was followed by a deflagration of propellant in one of the aluminium containers, which stood in front of the mixer. The second explosion occurred when propellant in another aluminium container was detonated. From the investigation into the electrostatic charging of the centre-core igniters and the subsequent discharging the conclusion can be drawn that during the actual drying process the centre-core igniters were strongly charged by the air flow, and that the discharge after termination of the drying process was extremely slow. Therefore the igniters still contained a great deal of charge at the moment when repacking started. As no special measures with respect to electrostatic charging of personnel had taken place, the employees were also charged. A transfer of charge in the form of a spark could, therefore, take place. The energy released in these sparks is by no means sufficient to ignite the centre-core igniters, but is sufficient to ignite propellant dust, which was dispersed in the production room whenever the mixer was used. Therefore the most probable cause of the explosion was the electrostatic charging of the centre-core igniters followed by a transmission of the charge to one of the employees and arc discharge from this employee to a conductor. The mixer was the most probable source of spark discharge, igniting propellant remains. The resulting jet of flame ignited the propellant in front of the mixer, causing the container to explode. The propellant in the remaining container ignited later. Fatality.
[static, explosive]

Lessons

[None Reported]

9982 04 May 1983

Source : ICHEME
Location : , UK

Injured : 1 **Dead :** 0

Abstract

The cleaning of a pipeline for maintenance was being undertaken by steam purging. There was high pressure created behind an isolation plug as a result of inadequate venting. The plug was ejected and a fitter suffered injury by scalding.
[cleaning procedure incorrect]

Lessons

[None Reported]

1047827 April 1983

Source : ICHEME
Location : , USA

Injured : 5 **Dead :** 2

Abstract

A spontaneous decomposition reaction of cumene hydroperoxide (CHP) took place in a 70 gallon head tank (which fed shot tanks, in turn feeding reactors). The decomposition caused an explosion killing 2 people and burning a further 5. CHP is an intermediate in the manufacture of phenol from benzene.
The plant had been re-started some 6 weeks previously after a shutdown period of about 3 years. The head tank had not been drained, cleaned or totally isolated from the CHP supply system during the shutdown. Prior to start-up, some black sludge had been found in the head tank: this had been flushed out. However, the bottom outlet line from the tank was a stand-pipe extending several inches up into the tank, thus creating a stagnant pool which would not drain. CHP is evidently a highly reactive material, and it its thought that the presence of sludge catalysed the rapid decomposition. However, there was no proof that this could occur at room temperature.
There had also been some problems with the CHP feed system to the head tank, and it is possible that the feed pump had become hot, and thus fed hot CHP to the head tank.
[processing, charging reactor, reactors and reaction equipment, fatality, contamination, cleaning inadequate, overheating]

Lessons

No firm conclusions were reached about the precise mechanism which triggered the decomposition. However it may well have been a combination of catalysis by impurities (sludge) and a hot feed stream due to pumping problems.

1050627 April 1983

Source : ICHEME
Location : , USA

Injured : 5 **Dead :** 2

Abstract

An 80 gallon head tank, containing 82% cumene hydroperoxide (CHP), exploded violently, causing two fatalities and five injuries. The incident appeared to have been caused by overheating of a transfer pump, used to transfer CHP from storage to the head tank. This may have resulted in the filing of the head tanks with hot (over 100 degrees C) CHP. At such temperatures, CHP thermally decomposes. There may have been a catalytic effect from powdered iron, as rust, from the carbon steel of the head tank.
[explosion, fatality, material transfer, rusting, injury]

Lessons

[None Reported]

5258 20 April 1983

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

An explosion was reported in the vicinity of the Fluid Catalytic Cracker Unit (FCCU) substation. Power to the FCCU failed, as both sides of the main power supply board tripped out. The FCCU, however, continued to operate on internally generated emergency power, supplying instrument power and lighting and steam turbine drives. No injuries were reported to have resulted.

On inspection it was revealed that the substation was full of highly astringent fumes and smoke.

The north end of the power supply board had overheated and one of the pump starter cubicles burned to destruction.

Investigation revealed that a flash-over had occurred within this starter, the stabs having been welded to the bus-bar, and the surrounding bus-bars badly charred. The fault was cleared by overcurrent protective relays in the feeder substation. The faulty section of bus-bar was isolated and the healthy south section was re-energised to restore as much power to the FCCU as possible whilst repairs were carried out on the north section.

After cutting away damaged sections of the bus-bar, insulation testing revealed resistances generally below 50 K ohms. Closer inspection revealed that the internals were covered with a dirty aqueous slime which proved to be mostly hydrochloric acid with a pH of 1, i.e. highly acidic. A total stripdown of the north section of the board was carried out for cleaning and dry-out as there was a high probability of further damage if the slime was not effectively removed.

When the north section had been reassembled and re-energised the same exercise was carried out on the south section where more of the acidic slime was found. Both sections of the board were back in service nine days after the original incident.

Several power cables running from the sub-station to individual pump motors were found to have some damage with one being completely unserviceable.

Investigation revealed that about 30 cables were overheated and burned, some severely, part-way along the sand filled common cable trench. It is surmised that this overheating was due to a combination of factors:

1. The trench was too full, cables were laid five or six deep.
2. Locally available sand with low thermal conductivity was used to fill the trench.
3. A steam trap discharging into the ground warmed the sand around the cables up to 38 degrees C.

[power supply failure, overheating, damage to equipment]

Lessons

[None Reported]

2546 24 March 1983

Source : LLOYD LIST, 1983, 26, 30, MAR.; HAZARDOUS CARGO BULLETIN, 1983, APR., 28; HAZARDOUS MATERIALS INTELLIGENCE REPORT, 1983, 8 APR.

Location : Cebu Island, PHILIPPINES

Injured : 40 **Dead :** 6

Abstract

An explosion occurred when ammonia was being discharged from a liquefied petroleum gas (LPG) carrier. 1,397 tonnes gross was being discharged at the time of the incident. The cause was due to the rupture of the cargo hose which led to the release of ammonia.
[unloading, fatality]

Lessons

[None Reported]

2540 22 March 1983

Source : INSTITUTE OF INSURERS
Location : Sidi Kacem, Morocco, NORTH AFRICA

Injured : 0 **Dead :** 0

Abstract

Short interuption in flow to burners of furnace resulted in flame going out and when flow restarted an explosion occurred.
[flameout, no flow]

Lessons

[None Reported]

2531 13 March 1983

Source : ICHEME
Location : , ISRAEL

Injured : 0 **Dead :** 0

Abstract

Fire occurred on a refinery hydrotreater plant involving an exchanger. The incident was caused by a flange leak.
Substance involved, gas oil.
[fire - consequence, refining]

Lessons

[None Reported]

2443 1983

Source : SAFETY PRACTITIONER, 1983, DEC, 28-29.
Location : , UK

Injured : 0 **Dead :** 3

Abstract

During cleaning of oil storage tanks an explosion occurred which ruptured the roof of the tank. Kerosene was being used to clean the tank. The source of the ignition could have been a non-flameproof floodlight or static generated on either the clothing being worn or on the hose pipe used. Fatality.
[cleaning]

Lessons

[None Reported]

2424 11 December 1982

Source : THE FIRE AND EXPLOSION, 11 DECEMBER 1982, HSE REPORT, HMSO,1983, ISBN 011883715X.
Location : Stalybridge; Manchester, UK

Injured : 0 **Dead :** 0

Abstract

Fracture of a glassware plant led to release of toluene and ignition causing explosion and fire. Breakage of the glass was either vibration of an agitator or pressure in a reactor forcing glassware upwards. The ignition source was probably static collected on an insulated flange.
[fire - consequence, reactors and reaction equipment, excessive vibration, high pressure]

Lessons

The following recommendations were made:
1. All plant and equipment to be installed in accordance with the designers' and manufacturers' instructions and then inspected and maintained to that standard.
2. Staff engaged on maintenance to receive adequate training and have their attention directed to any components which are particularly important if the plant is to be operated safely.
3. Earthing of metalwork close to valves, pipe-joints etc. on glass or other insulated pipework to prevent the accumulation of a static charge.

1015513 October 1982

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

An incident occurred at the refinery involving a 125,000 barrel floating roof tank - Tank A. It has a single deck design which consists of a pontoon ring with 24 compartments. The roof is designed to hold 10 to 12 inch of water without sinking.
On 11 October, Tank A was on its high legs with approximately 4 and a half feet when it received a barge load of crude oil. The crude was off-loaded into the tank at 3,000 BPH and after about 30 hours, a pumper noticed that the roof was sinking. Oil was coming out of the roof drain and all but one or two pontoons were submerged. When the roof sank, all of the hatch covers came off and all pontoons with the exception of one or two that stayed out of the liquid filled with oil. The level was slowly pumped out to 10-12 feet and then an air driven pump was lowered into each pontoon and pumped them out one at a time allowing the roof to level out. The roof was creased from SW-NE with major apparent damage to the centre skin. The SW quadrant was damaged the worst due to the collapse of the legs. 600 barrels of crude oil was lost.
[spill, product loss, loading, storage, unidentified cause]

Lessons

A definite primary case is unknown. A possible opinion is that the roof hung up during filling and oil was able to fill one compartment at a time until the roof sank. It was also noticed previously that during rain, a water puddle forms causing the roof to tilt.
To prevent a recurrence, an inlet distribution nozzle to limit incoming velocity to 3 feet per second as a precautionary measure was installed and the new roof was floated to the top on water and the clearances throughout the test before recommissioning the tank were measured.

2386 20 August 1982

Source : EXPLOSION OF CHEMICAL PLANT DUE TO RUNAWAY REACTION, HSE TRANSLATION 10780
Location : Sakai City, JAPAN

Injured : 20 **Dead :** 6

Abstract

An agitator started to fail in a resin plant due to a burnt out magnetic switch. The power source was cut off and an effort was made to supply cooling water and agitation to the other autoclaves. The temperature rose and steam flowed into the odour control duct. The first explosion occurred. See 21st August, record 2387, for second explosion. Fatality.
[overheating]

Lessons

[None Reported]

1065401 August 1982

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

A break in a 300 mm pipeline resulted in a spill of about 250,000 gallons (6,000 barrels) of crude oil.
The oil was carried down irrigation canals into a nearby river and reservoir. Preliminary reports indicated that neither wildlife nor farmlands were seriously affected.
The cause of the rupture was not known at the time of this report.
[pollution, ecological damage, unidentified cause, pipeline failure]

Lessons

[None Reported]

2377 01 July 1982

Source : ICHEME
Location : , PHILIPPINES

Injured : 0 **Dead :** 0

Abstract

The roof of a floating roof tank sank at a storage plant which was caused by a blocked vent.
[vent blocked]

Lessons

[None Reported]

2374 27 June 1982

Source : HSE REPORT
Location : Stavely; Derbyshire, UK

Injured : 0   **Dead :** 0

Abstract

Two explosions took place at the premises of a chemicals. Large clouds of white sulphuric acid fumes were emitted, which travelled off-site causing local alarm, reducing visibility on roads and damaging vegetation. Explosions continued for 24 hours. There were no injuries or property damage. The source of the explosion was a pit containing drums of redundant oleum and sulphur trioxide chemicals. The cause was reaction of these materials with ground water. This caused a rapid temperature rise and drum failures. The chemicals had been in storage for 10 years at the time of the incident.
[gas / vapour release, contamination, leak]

Lessons

1. A repeat of this incident is unlikely as these materials are now handled in bulk containers. This is why these drums were redundant.
2. Chemical suppliers should have a well documented procedure for the safe treatment/disposal of returned redundant chemicals.
3. The chemical industry should consider the problems that long-term storage of substances in commercial use might present.
4. Companies handling chemicals should review their responsibilities under Section 2 of the Health and Safety at Work Act.

1062522 June 1982

Source : CHEMOSPHERE, VOL.15, NO. 9-12, PP 1305-1311, 1986.
Location : , USA

Injured : - **Dead :** 0

Abstract

A transformer overheating. At a private school, the main power transformer in a basement transformer vault became pressurised due to internal arcing. About 50 gallons of the transformer coolant was released as a mist over a period of approximately two hours. The coolant comprised a commercial mixture of 45% polychlorinated biphenyls (PCBs), and 55% of mixed trichlorinated and tetrachlorinated benzene. Contamination of some areas of the building resulted from the release of coolant.
About 20% of the individuals at the scene reported skin irritation, unusual tiredness and headaches.
[gas / vapour release, fire - consequence]

Lessons

An environmental assessment of both surface and airborne contamination was undertaken to determine the extent of contamination in the school.
Blood and urine samples were collected within 48 hours from all potentially exposed individuals and analysed to determine exposure. Repeat samples were collected 4 weeks after the incident.
Serum PCB levels and mean values for blood and urine tests were within normal ranges.

2364 16 May 1982

Source : ICHEME
Location : , UK

Injured : 1 **Dead :** 0

Abstract

Polyethylene powder was being taken from a drier into drums due to a process upset using a polyethylene sock. There was a fire as the powder was being taken out. Investigation showed that there was some residual hydrocarbon present and that ignition was by static as the drum was not earthed contrary to instructions. The procedure for this operation was not detailed.
[fire - consequence, design or procedure error, lack of earthing, material transfer]

Lessons

[None Reported]

2363 12 May 1982

Source : LLOYDS LIST, 1982, 15 MAY.
Location : Shuaiba, KUWAIT

Injured : 0 **Dead :** 0

Abstract

Leak of fuel oil in cooling system ignited in refinery hydrocracker plant. Source of ignition was autoignition. Flange leak.
[fire - consequence, refining, cracking]

Lessons

[None Reported]

2361 06 May 1982

Source : HAZARDOUS MATERIALS INTELLIGENCE REPORT, 1982 21 MAY.
Location : Duluth; Minnesota, USA

Injured : 8 **Dead :** 0

Abstract

An explosion and fire at a chemicals plant forced the evacuation of 3 800 people. It was suggested that static electricity may have ignited fumaric acid dust in the packaging area of the plant. Although it was also suggested that the ignition spark probably came form a machine.
[fire - consequence]

Lessons

[None Reported]

7627 May 1982

Source : LOSS PREVENTION BULLETIN, 131, 3-5.
Location : ,

Injured : 1 **Dead :** 0

Abstract

A fire on a loop purge conveyor on a polyethylene plant resulted in the plant being shut down. The fire occurred when the unit was being prepared for maintenance.
During the drum filling operation a fire occurred in the area around the drum filling equipment. Flames were funnelled up the chute and out through a gap, and burned the process operator. As a result the operation was immediately shutdown, the fire extinguished by plant personnel and the fire service.
An investigation into the incident concluded:
1. The most probable cause of ignition for the fire was static discharge which occurred in the area around the drum on the base of the polythene chute.
2. Inadequate electrical earthing of equipment together with the use of non-conducting materials were contributory factors.
3. Hydrocarbons present in the polymer being dumped facilitated the ignition and contributed to the subsequent fire.
4. Hydrocarbons were present due to the inadequacy of the purging operations in the polymer drier.
5. Investigation found that this problem arose from a combination of a blocked balance line between drier and the flash tank and the flood-feeding of material into the drier.
[fire - consequence, plant shutdown, lack of earthing, burns]

Lessons

The following recommendations were made:
1. Modifications to equipment to ensure filling chutes could be correctly fitted to pipework and filling drums.
2. Chutes to be fabricated from suitable conducting material and should be earthed.
3. Modification to balance lines between polymer driers and flash tank to minimise likelihood of powder blockages and to facilitate early detection of possible restrictions.
4. Fundamental review of operations, including further Hazop work. Upgraded operating procedures, instructions and documentation to ensure safe operations.
5. All operators received training in lessons learned and new operational requirements.
6. Upgraded earthing continuity checks.
7. Instructions/procedures require the sampling of the atmosphere above powder to ascertain hydrocarbon contents prior to dumping. Also certain criteria are established prior to the commencement of dumping operations.
8. Follow-up audit and review to be carried out after three months to ensure compliance.

9432 19 April 1982

Source : ICHEME
Location : , UK

Injured : 2 **Dead :** 0

Abstract

A fire occurred whilst an operator was attempting to withdraw 10L of methyl ethyl ketone from the line feeding the drum filling machines. This material was required to top up a drum which was deficient in contents. Soon after the valve was opened there was an ignition followed by fire. The fire was contained and extinguished by the operators, the damage was not extensive.
An investigation was carried out and it was concluded that the ignition probably resulted from a static charge generated on the vessel that was being filled. The fact that the vessel was unearthed and conditions were conductive to the formation of a spray both probably contributed to the incident.
Considering the magnitude of the fire the structural damage was small. There was loss of products, some cans were damaged but may be salvageable.
[fire - consequence, loading, damage to equipment]

Lessons

The fire resulted from a static discharge between the jug the operator was holding and the hose connection. The static arose from spray filling of a non-earthed vesselRecommendations were:
1. The use of a jug and liquid from a main product line must stop.
2. The general rule requiring the use of earthing wires when filling containers should encompass transfer or draing into metal jugs and cans.
3. Samples or small quantities of flammable materials should not be withdrawn from lines under pressure except via properly designed sample points which could minimise the flow in the event of an accident.
4. The practice of transferring products from drum to drum and the topping up of part filled drums should be reviewed to ensure satisfactory safety standards.

1243831 March 1982

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

An explosion occurred in the cell of a plant. Two operators investigated the explosion and found the cell to be full of smoke.
Further investigation found that a joint on a one-inch run off line had ruptured. The valve on the end of the line was closed and the valve at the run off end of the line was also closed. This caused pressure in the line causing the joint to burst.
No injuries or further damage occurred.
[mechanical equipment failure, overpressurisation]

Lessons

[None Reported]

1055821 March 1982

Source : THE TIMES, MAR 29, 1982.
Location : Edinburgh, UK

Injured : 0 **Dead :** 0

Abstract

Barrels of explosive chemicals, oxidizing agents and poisons, including antimony and arsenic sulphide, had been sealed in a concrete bunker in 1970 when a derelict fireworks factory was levelled to make way for a domestic refuse tip. An explosion on the site left a crater 40 ft deep and 90 ft across and showered debris over a large housing estate.
[storage, underground storage, unknown chemicals, unidentified cause, unidentified cause]

Lessons

[None Reported]

1001309 March 1982

Source : ICHEME
Location : Philadelphia, USA

Injured : 18 **Dead :** 0

Abstract

A shutdown caused a phenol plant to be down for a few hours. The cumene hydroperoxide (CHP) concentration section was in the process of being restarted. Difficulty was encountered with poor vacuum on the first stage of concentration. During start-up both overhead and bottoms are returned to the surge tank. The surge tank is supposed to be cooled to 70-80 degrees C by circulation through an external cooler. This surge tank had a capacity of 30,000 gal and was reported to have originally been used as an oxidiser. The bottom of the concentrator and the surge tank started to show high temperature. The steam flow to the concentrator was shut off, but the concentrator continued to heat up with the steam off. The surge tank heated up, pressurised and vapours from the relief vale and vent travelled about 600 ft before igniting. The ignition source was believed to be a hot steam line. The fire then flashed back to the surge tank, this split the tank at the top seam. The fire and explosion in this tank located in the centre of the plant took down a main process structure with about 15 distillation columns around it, and the fire took 9 hours to get under control.
[explosion, fire - consequence, inadequate instrumentation, surge tank, rupture, high temperature, overpressurisation]

Lessons

Recommendations included:
1. Upgrade concentrator instrumentation.
2. Eliminating the surge tank.
3. Improvement of reliability of boiler operations in general to maintain stable process conditions.
4. Revise guidelines for emergency action at all CHP handling process equipment and tankage.

13142March 1982

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

After separation in a thin-film evaporator, the bottom product was conveyed towards a control valve by a worm screw pump. The system had to be held at above 250 degrees C to keep the bottom product liquid by a diphenyl heating oil at 290 degrees C.
One day the product line burst between the screw pump and the control valve. The heating oil was released into the room.
The cause of the incident was a plug in the control valve. The trapped product was heated up by energy input from the pump and subsequently by heat of decomposition.
[material transfer, overpressure, gas / vapour release, pump dead headed, design inadequate, blockage by polymer]

Lessons

To prevent recurrence, the installation was modified so that the screw pump could no longer work against a closed or plugged control valve. In addition, pressure and temperature controls and a rupture disc were fitted.

1063013 February 1982

Source : EUROPEAN WATER AND SEWAGE, OCTOBER 1996, PAGE 448-451.

Location : , UK

Injured : 0 **Dead :** 0

Abstract

A fire in a warehouse containing chemical herbicides including 325,620 gals of diquat, 11,000 gals of paraquat and 20,000 kg of octyl phenol resulted in severe contamination of soil and the local river system. It is thought that the fire was caused by the overheating of a pallet of octyl phenol while it was being shrink-wrapped. It is also thought that the fire was exacerbated by the application of water rather than foam in an attempt to extinguish the blaze. The water carried flakes of burning octyl phenol to other parts of the warehouse, igniting the pallets on which the drums of chemicals were stored and causing them to leak. The water then carried the chemicals into highway drains and into local rivers, and into the site's foul sewer. The fire was extinguished by foam, but more water was used to flush the warehouse discharge into the river system in order to prevent the diquat/paraquat/water mixture drying out to form highly toxic crystals.
[fire - consequence, warehousing, storage, pollution, design or procedure error, spill, shrink wrapper]

Lessons

The long term effects of large doses of diquat and paraquat on plant life, soil, stream and river bed silts were monitored.
The conclusion was drawn that no major pollution would have occurred if foam or fog rather than water had been applied to the burning octyl-phenol. Water should be applied to extinguish burning octyl phenol.

2338 12 February 1982

Source : ICHEME
Location : , KENYA

Injured : 0 **Dead :** 0

Abstract

Fire at a terminal involving a gasoline tank which was overfilled. Source of ignition was boiler.
[fire - consequence, tank overflow]

Lessons

[None Reported]

2335 09 February 1982

Source : 100 LARGEST LOSSES 9TH EDITION, MARSH & MCLENNAN PROTECTION CONSULTANTS, 1986
Location : Philadelphia, USA

Injured : 0 **Dead :** 0

Abstract

A tank containing 25000 gallons of cumene hydroperoxide was steam heated when the temperature exceeded safe limits and the tank started to vent. An explosion occurred which caused the rupture of the tank. 2 further tanks and 1 containing fuel were involved in the fire. The blast sheared off the sprinkler riser but fire controlled although one phenol plant was destroyed and two others damaged.
[fire - consequence, overheating]

Lessons

[None Reported]

1015302 February 1982

Source : ICHEME
Location : , CANADA

Injured : 0 **Dead :** 0

Abstract

At 5pm, the flame of a flare stack was extinguished. As a direct result of an abnormal operating condition at the cat cracking unit and because acid gas was being flared at the time, the flameout resulted in a significant release of hydrogen sulphide gas which led to a nearby traffic highway to close until the gas dispersed.
The immediate causes of the incident were attributed to a failure of a light ends drum level controller which led directly to an unstable fuel gas system and excessive flaring. To cope with the flaring, excessive steam was used to control smoking and when flaring stopped abruptly, the steam contributed to snuffing out the flame. The basic cause was the inadequate design and operation of the pilot gas system. Underlying causes were lack of training and skill for pilot reignition and minimal routine checking and maintenance. Two motorists were reported to have been affected by the gas while driving on the highway.
[design inadequate, training inadequate, maintenance inadequate, inspection inadequate, flameout, mechanical equipment failure, gas / vapour release]

Lessons

Immediate corrective steps were that acid gas stream to the flare would be eliminated and that acid gas would not be produced until the sulphur plant was restarted. H2S production was minimized and there was an immediate review of the flare reignition procedures and facilities. Appropriate personnel were retrained in the use of these facilities.
Recommendations were:
1. A review of flare ignition procedures and proper pilot operating conditions
2. Retraining of all process personnel
3. Establishment of an emergency procedure to deal with a flare flameout
4. Evelopment of a regular inspection of the pilot system and the ignitor system as a preventative maintenance program for pilot gas regulators and ignition equipment
5. Development of guidelines to deal with an emergency sulphur plant shutdown

Improvements to facilities were recommended to:
1. Installation of a pressure regulation system for pressure control of the pilot gas at the burner.
2. High and low pressure alarms were provided on the pilot gas downstream of the regulator to warn the operators in the control room and an automatic backup fuel gas system was also provided.
3. Dual pilot flame detection thermocouples were installed on each of the 3 pilots so that a low temperature alarm in the control room if the flare and the pilots were extinguished.
4. Facilities were provided to automatically add fuel gas to the flare whenever acid gas needed to be flared on an emergency basis
5. Thermocouple installation to detect a pilot flameout.
6. Installation of an infra-red detection device which can operate in all weather conditions.
7. The establishment of a need for an alternative facility for the incineration of acid gas.

10819February 1982

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A shell rupture occurred on a secondary reformer. A week prior to the burst, a significant increase of steam and water droplets from the water jacket vent pipe had been observed, together with a slight drop in the water level on the visual gauge. This was due to the submerged part of the steam collector inside the jacket was perforated and that water was being entrained by the escaping steam.
The blowout which occurred a week later was extremely violent. There was an instantaneous drop in pressure and the escaping gas blew the hydraulic guard on the jacket and escaped through the vent.
The jacket remained intact and the gas did not ignite. Luckily, no one was scalded, as might have been the case if people had been under the guard vent of standing on the nearby primary reformer platform.
Cooling down after the plant trip provided to be a problem because of gas escaping from the leak. As soon as the plant was under nitrogen circulation, the jacket was cut open at what was judged to be the nearest point to the burst according to the noise caused by the leak.
The main crack was about 350 mm long and situated above the process air inlet nozzle at a height corresponding to the jacket-steam/water interface. The shell had clearly overheated and the cone shell had bulged over approximately 90 degrees.
The following observations from the inside were made:
Before debricking:
1. Traces of unburnt black carbon on the hot face bricks and incoloy liner.
2. The refractory lining appeared to be in a satisfactory condition, apart from hair-line cracks in the bricks and irregular spacing of the expansion joints. These points had been noted on previous inspections and were considered to be normal.
After debricking:
1. Row-by-row debricking revealed a partial absence of insulating concrete (50% alumina) above the incoloy air-inlet pipe and traces of unburnt carbon on the shell wall.
2. The cause of the trouble was immediately apparent, i.e., a site weld behind the hot face on the 200 x 3 mm incoloy air-inlet pipe had failed over about 300 degrees, allowing air to escape upwards into the light insulating concrete. The latter had disintegrated, the air had ignited
[process causes, gas / vapour release, overheating, processing]

Lessons

[None Reported]

1243917 January 1982

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

An explosion occurred on a loading bay at an organics plant. The explosion released a cloud of fumes into the surrounding area, which quickly dispersed. An investigation carried out into the cause of the explosion found that the container had burst under pressure.
[gas / vapour release, overpressurisation]

Lessons

[None Reported]

2288 02 December 1981

Source : ICHEME
Location : , KUWAIT

Injured : 0 **Dead :** 0

Abstract

Damage to a refinery storage cone roof tank due to a vent blocked implosion.
[damage to equipment, refining]

Lessons

[None Reported]

1144619 November 1981

Source : HAZARDOUS CARGO BULLETIN, FEBRUARY, 1982.
Location : Mombasa, KENYA

Injured : 0 **Dead :** 0

Abstract

A marine transportation incident. A cargo ship was declared a total constructive loss after a fire which broke out during discharge operations in Mombasa harbour. The fire broke out in the No. 4 hold, which contained, amongst other things, general cargo, cars, second hand clothes, just under 100 drums of sodium sulphide and an unspecified quantity of oxidising chemicals.The sodium sulphide drums exploded while the fire was raging, spreading flames to the adjacent hold. Fire brigades at the port and from the local area were unsuccessful in putting out the blaze, so the ship was moved from the quayside to the fairway where fire fighting tugs continued to pump water into her holds. It took 4 days to extinguish the fire.
[fire - consequence, unloading, explosion, unknown chemicals, unidentified cause]

Lessons

A Board of Enquiry was set up to investigate the cause of the fire.

9938 05 November 1981

Source : ICHEME
Location : , SWITZERLAND

Injured : 0 **Dead :** 0

Abstract

A guard detected a fire at 01:40 and immediately tried to extinguish the fire in the oil bath with a CO2 extinguisher. This was not successful, and in fact made the situation worse in that the CO2 blew off the aluminium foil covering most of the oil bath. Thus more surface area was exposed and the flames enlarged. This extra heat activated the sprinkler system which extinguished the fire rapidly.
The cause of the incident was found to be the overheating (in excess of 176 degrees C) of the oil bath due to a thermostat failure. The source of ignition was believed to be either a spark from the thermostat or a spark from nearby electrical items.
[laboratory work, fire - consequence, mechanical equipment failure]

Lessons

Recommendations following the incident called for doubly protected thermostat systems to be installed and used on oil bathes, and that such equipment be serviced and fully inspected every 2 years.

1023505 November 1981

Source : ICHEME
Location : , SWITZERLAND

Injured : 0 **Dead :** 0

Abstract

A guard detected a fire at 01:40 and immediately tried to extinguish the fire in the oil bath with a CO2 extinguisher. This was not successful , and in fact made the situation worse in that the CO2 blew off the aluminium foil covering most of the oil bath. Thus more surface area was exposed and the flames enlarged. This extra heat activated the sprinkler system which extinguished the fire rapidly.
The cause of the incident was found to be the overheating (in excess of 176 degrees C) of the oil bath due to a thermostat failure. The source of ignition was believed to be either a spark from the thermostat or a spark from nearby electrical items.
[oil bath, laboratory work, fire - consequence, thermostat failure]

Lessons

Recommendations following the incident called for doubly protected thermostat systems to be installed and used on oil bathes, and that such equipment be serviced and fully inspected every 2 years.

2271 21 October 1981

Source : ICHEME
Location : , SAUDI ARABIA

Injured : 0 **Dead :** 0

Abstract

An explosion on a refinery plant involving a turbine, caused by overspeed.
[refining]

Lessons

[None Reported]

1156126 September 1981

Source : HAZARDOUS CARGO BULLETIN, FEBRUARY, 1982.
Location : , SINGAPORE

Injured : 3 **Dead :** 0

Abstract

A marine transportation incident. A 12 year old large Chinese registered bulk carrier was rocked by a series of internal explosions before a fire broke out the length of the ship. The crew escaped, although three people were seriously burned. The ship was located in the harbour, when the fire became so severe that the ship was towed to shallow waters and beached. The ship was carrying steel plate and a range of unknown chemicals on board. The exact cause of the incident was not clear. The ship was eventually scrapped. The value of the loss cargo was placed at US$20m (1982).
[fire - consequence, product loss, unidentified cause, injury]

Lessons

[None Reported]

10287September 1981

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

An incident occurred at an installation consisting of two 12 tonne LPG tanks with vapour take-off, providing gas to ovens in a factory. The inlet, vapour and drain connections were grouped together under tanks and cross-connected on manifolds. Each vapour line had a T-connection, one branch of which was connected to the factory gas supply and the other to a pipe terminating in a valve and thread hose connection which allowed for vapour return during filling.
The liquid filling line terminated alongside the vapour return line with a similar valve and threaded hose connection. These pipes and valves were not labelled or identified in any way.
The incident occurred when the delivery hose from the tanker was connected to the vapour return coupling. Had this pipe been solely a vapour return line from the tank, the liquid would have simply entered the tank via the vapour space rather than by the normal submerged liquid line but, because the vapour return line had a connecting branch leading to the factory, liquid LPG was able to reach the ovens causing the burners to flare up.
[operation inadequate, backflow, gas / vapour release]

Lessons

Such incidents can be avoided if:
1. Unused vapour return lines are blanked off.
2. Vapour return lines in regular use are separated from vapour off-take lines.
3. Pipes and valves are clearly marked to distinguish gas from liquid and inlet from outlet, etc.

2253 28 August 1981

Source : ICHEME
Location : , KUWAIT

Injured : 0   **Dead :** 1

Abstract

A naphtha storage tank, on a refinery, exploded and the resulting fire spread to five tanks. This was caused by a tank overflow. Source of ignition was furnace. Fatality.
[fire - consequence, explosion, storage tanks, refining]

Lessons

[None Reported]

7375 07 August 1981

Source : LOSS PREVENTION BULLETIN, 054, 32.
Location : Carlybrook, UK

Injured : 1 **Dead :** 1

Abstract

A plant erupted shortly after midnight. Exploding drums of unknown chemicals were hurled into the air. A thousand residents were evacuated. As the villagers returned home another explosion occurred sending a fireball into the air.
[evacuation, fatality, fire - consequence, fatality, unidentified cause, injury]

Lessons

[None Reported]

2218 30 June 1981

Source : ICHEME
Location : , KOREA SOUTH

Injured : 0 **Dead :** 0

Abstract

Fire at a refinery lube oil plant involving the air cooler. Source of ignition was static, caused by tube failure.
[fire - consequence, refining]

Lessons

[None Reported]

9408 16 April 1981

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

Attempts to drain water from a rundown line between the purge vent knock out and the vapour recovery tower when there was a sudden release of isobutane at the drain valve which flashed and ignited. Once the initial flash occurred, smaller fires burned at the drain valve an on the lagging in the immediate vicinity. The operator who was attempting to drain the rundown line received burns to his face and right had.
It was concluded that the sudden release of isobutane occurred as a result of an ice blockage at the drain valve clearing, just after the drain valve had been partially opened. In addition, access to the drain valve is very restrictive.
All electrical equipment in the vicinity of the incident has been checked and found to earthed properly. A temperature survey carried out did not reveal any hot surface which approached the required auto-ignition temperature. Static discharge must have been the source of ignition.
[fire - consequence, leak]

Lessons

[None Reported]

3977 16 April 1981

Source : ICHEME
Location : ,

Injured : 1 **Dead :** 0

Abstract

On opening a difficultly located drain valve on a transfer line, there was no flow due to blockage by ice; further opening of the drain valve allowed a sudden release of isobutane which ignited causing minor injuries to the operator.
[freezing, fire - consequence, leak, material transfer, injury]

Lessons

Drain valves which can ice-up need to be located so that they can be easily operated, and unblocked safely.

1171906 April 1981

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A butadiene plant was shut down for code of practice and inspections. Throughout the morning shift solvent was being transferred to a recovered solvent tank. At approx 13:15 hours the recovered solvent tank was found to have been overpressured causing damage to the tank.
The overpressurisation occurred because the pressure/vacuum valve had been removed from the tank and a blank flange with a 1/10 inch spacer fitted to the flame arrestor. The spacer was inadequate to relieve the vapour generated when the hit condensate from the drip tank was pumped into the tank.
[material transfer, overpressurisation, damage to equipment, incorrect equipment installed]

Lessons

1. The recovered solvent tank should be inspected internally and externally prior to return to service.
2. The tank base must be permanently stabilised and the earthing strips made good before the tank is returned to service.
3. The level indicator on the tank must be repaired or replaced.
4. The flame arrestor should be examined for cleanliness.
5. Planned maintenance of safety relieving devices must always be carried out during
6. Campaign or shut-down periods.
7. Low pressure storage tanks on site should be reviewed to determine if they conform to API 2000 code for venting of atmospheric and low pressure storage tanks.

2168 03 March 1981

Source : ICHEME
Location : ,

Injured : 1 **Dead :** 0

Abstract

Road transport. A 36,000 litre road vehicle was being filled with distillate at a vehicle loading gantry after a previous load of premium petrol. The driver drained the tank compartments to conform to switch loading requirements and after a delay to carry out running maintenance on the vehicle top loaded the distillate via a loading arm with a flexible hose and camlock coupling. He filled two compartments and moved the vehicle to allow filling of the others. After connecting the filling hose and reconnecting the static wire, the driver continued filling and 10 to 15 seconds later, an explosion occurred in the compartment, resulting in a flash through the open tank. The explosion seems to have been a typical switch loading accident caused by the electro-static generation due to a high flow rate. It appears that established procedures for switch loading were not fully followed in this incident.
[flow rate too high, additional incorrect operation, gasoline]

Lessons

The explosion seems to have been a typical switch loading accident caused by electro-static generation due to a high flow rate. It appeared that established procedures for switch loading were not fully followed in this incident.

2166 March 1981

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

Thrust bearing failure of the high pressure stage of a gas compressor in the fluid catalytic cracking unit resulted in a fire. The movement of the rotor caused seizing, seal failures and failure of the suction and discharge piping.
[fire - consequence, catalytic cracker, bearing failure, overpressurisation]

Lessons

1. Fire caused by failure of the high pressure stage thrust bearing - result of severe compressor fouling from sodium carbonate deposits, which induced the thrust imbalance, beyond design loading.
2. Sodium carbonate deposits were the result of either entrained sodium bearing wash water in interstage cyanide scrubber or entrained caustic in the light gasoline rotor wheel wash.
3. A properly operating vibration monitoring system could have indicated impending mechanical distress, thus allowing operating judgement to be used in planning a compressor and/or unit shutdown.
4. Seal modifications apparently caused additional interference and heat generation which increased the magnitude of the rotor failure and the size of the fire.

2154 11 February 1981

Source : 100 LARGEST LOSSES, 9TH EDITION, MARSH & MCLENNAN PROTECTION CONSULTANTS; HAZARDOUS MATERIALS INTELLIGENCE REPORT, 1981, 6 MAR.; CHEMICAL & ENGINEERING NEWS, 1981, 16 FEB.

Location : Chicago Heights; Illinois, USA

Injured : 25 **Dead :** 1

Abstract

While preparing a batch for a reactor in a resins manufacturing plant, steam was applied to a catalyst in a weigh tank because of sub-zero weather. An excess of heat caused the reaction to begin in the weigh tank. Since means for cooling the weigh tank were not available, the exothermic reaction caused the boilover of the weigh tank's contents. A vapour cloud rapidly filled the one-storey building. The explosion disabled sprinkler system. Fatality.
[overheating, cold weather, vapour cloud explosion, batch reaction]

Lessons

[None Reported]

2151 07 February 1981

Source : ICHEME
Location : , SPAIN

Injured : 0 **Dead :** 0

Abstract

An explosion occurred at a fertiliser urea plant involving a tank, caused by overpressure.
[overpressurisation]

Lessons

[None Reported]

2148 04 February 1981

Source : LLOYDS LIST, 1981, 6 FEB.; IRISH TIMES, 1981, 5 FEB.; SEARSON, A.H, EXPLOSION IN CONE-ROOF GAS OIL TANK, 4TH INTERNATIONAL SYMPOSIUM ON LOSS PREVENTION AND SAFETY PROMOTION IN THE PROCESS INDUSTRIES, HARROGATE, ENGLAND, 12-16 SEPTEMBER, 1983, ICHEME SYMPOSIUM SERIES NO. 80, 1983, L15-L21.

Location : Cork, IRELAND

Injured : 0 **Dead :** 1

Abstract

Explosion in cone roof tank containing gas oil when operator was taking a sample was caused by static. Water and gas separation caused static which was collected on a metal sample can suspended from a polypropylene rope. On removing the sample the static was discharged to the hatch point and ignited the gas in the tank. Fatality.
[storage tanks, storage]

Lessons

1. The need to identify and eliminate potential mechanisms by which hazardous conditions in tankage may result from abnormal conditions in upstream process plant.
2. The importance of applying proper rules for prevention of electrostatic ignitions in tankage, particularly with respect to sampling and gauge.

12747February 1981

Source : ICHEME

Location : Hertfordshire, UK

Injured : 0 **Dead :** 0

Abstract

An explosion occurred on a 25-foot bitumen tank. The incident occurred when the plant was running down a 100 tonne bitumen tank to be cleaned.
The heating system overheated, causing the bitumen to vaporise and explode. The explosion blew the manhole cover off the top of the neighbouring tank, and flaming bitumen and part of the heat lining entered the tank igniting its contents.
The flaming bitumen ignited a 130lb propane cylinder causing a second explosion, and a carbon dioxide fire extinguisher exploded soon after.
No injuries were reported.
[fire - consequence, overheating]

Lessons

[None Reported]

7732 21 January 1981

Source : CONTROL OF CHEMICAL EXOTHERMIC REACTIONS, ICHEME, SAFETY TRAINING PACKAGE, 023, 3.11.
Location : ,

Injured : 0 **Dead :** 0

Abstract

An explosion occurred at a plant making liquid epikote. Only relatively minor injuries to personnel were sustained, but one of the reactor systems and its related structure was severely damaged. There was no fire.
Resinous material from the reactor was deposited as a spray up to 2 km from the plant, causing a large number of complaints from the local community. All complaints were relatively minor, and quickly resolved.
The sequence of conditions leading to the explosion arose from a failure of cooling water to the ECH/H2O condenser. This led to only partial removal of the reaction excess epichlorohydrin in the post-reaction steps. A runaway hydrolysis of the epichlorohydrin took place, leading to an overpressure rupture of the vent chiller.
[overpressurisation, runaway reaction, damage to equipment, reactors and reaction equipment]

Lessons

The following recommendations were made:
1. Install a pressure relief able to cope with a runaway reaction.
2. Carry out a Hazop study on the liquid epikote production process, paying particular attention to the critical nature of the ECH/water flow to the condensers.
3. Review the operator/computer/instrument interface in plant control.
4. Conduct formal and thorough training for all operating personnel involved in the control of base epikote resin reactions.
5. Amend, and add to, as appropriate, the operating manuals and instructions for the operation and control of the base epikote resin reactions.

1003202 January 1981

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

During the extreme fluctuations of temperature (4 degrees C to -37 degrees C) over the Christmas period, ice and snow deposit plugged the 0.75 inch mesh screen in the vent of a heavy fuel oil tank. The vacuum created while pumping out product pulled in sections of the side plates above the 30 ft level. Repairs were deferred until spring.
[tank, heavy fuel oil, low pressure, vacuum, weather effects, cold weather]

Lessons

[None Reported]

10481January 1981

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A chemical process employed a vertical shell and tube reactor, with molten salt in the shell and reactants in the tubes. The reactor was being modified, when it was noticed that the shell was bulging. Further investigation showed that two tubes in the reactor had burst. These were tubes which had been found to be leaking in a previous overhaul and had been plugged top and bottom.
The calculated burst pressure of the tubes was 3800 psig (roughly 260 bar gauge). It was surmised that the bursting of the tubes produced a shock wave which was transmitted through the salt and caused the shell to bulge.
When the tubes were plugged, a hole had been drilled through the tube wall near the top plug in order to relieve any build-up of pressure. However, it was found that there were substantial plugs of catalyst and carbonate in the tubes between the burst and the relief hole.
It was concluded that water had been trapped in the tubes behind the catalyst/carbonate plugs, rendering the pressure relief hole ineffective. On re-commissioning the reactor, the water vaporised, and at the high temperatures within the reactor sufficient pressure was generated to rupture the tubes.
[maintenance, repair, modification, heat exchanger, shell and tube heat exchanger, reactor tube, near miss, explosion, overpressure, overpressurisation, solids deposition, cleaning inadequate, reactors and reaction equipment]

Lessons

When leaking tubes in heat exchangers or reactors are plugged at either one or both ends, it is essential to thoroughly clean the tubes by water jetting or drilling before plugs are inserted and vent holes drilled.

2554 1981

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

A serious fire developed on a catalytic reformer resulting in damage to equipment amounting to approximately £500,000 (1981).
No-one was injured in the incident.
The fire was started by failure of the thrust bearing on the hydrocarbon reactor charge pump. This bearing failure caused the coupling, mechanical seal, and bearing housing to break down.
Naphtha sprayed from the damaged seal and probably ignited from the overheated bearing.
The fire spread to the adjacent stripper bottoms pump and was sucked up by the overhead fin-fans causing rupture of the 6 inch stripper column feed line, the 20 inch reactor product line and several small bore steam lines in the area.
The fire was contained to the area around and above the stripper bottoms and hydrocarbon charge pumps, and was extinguished in two phases. The ground level fire in the region of the two pumps was extinguished by flooding the bottom of the stripper column with water. The high level fire was extinguished by purging the reactor product condenser line with nitrogen.
A three level piperack rung over the fire area above which is located a number of fin-fan condenser units. A considerable amount of damage was done to piping, instrumentation and electrical services in this piperack.
The water sprinkler system preserved the fin-fan coolers from much more damage. Tubes were denuded of their aluminium fins and subsequently sagged but no tube failures occurred. It is believed that without the sprinklers, condenser tubes would have ruptured releasing hydrocarbon to the fire area. The fire proofing applied to the support structure beneath the fin-fan preserved the integrity of the structure during the intense fire.
The stripper column had been subjected to considerable heat which buckled the insulation cladding but there was no evidence of damage to the vessel itself which was returned to service without repair.
It is believed that the failure of the hydrocarbon reactor charge pump thrust bearing initiated the fire.
This bearing failure led to subsequent failure of pump seal, bearing housing and coupling.
A feature of the failure was the disintegration of the bearing housing which was discovered to be of cast iron construction. The pump casing was made of cast steel.
[fire - consequence, overheating, reactors and reaction equipment]

Lessons

Cast iron bearing housings to be replaced with cast steel construction as soon as possible.

100921981

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

A fire occurred in a heavy gas oil stripper in a fluid cracker. The stripper was badly bulged, with the fire erupting from a split at one of the most severely expanded areas. The fire caused only minor damage and was extinguished quickly by maximizing stripping steam.
It was suspected that the stripper had bulged and failed due to overheating from the inside. The reason for overheating was investigated. The stripping steam line was traced back to a tie-in with the plant air system, which was incorporated in the original design of the unit. A block valve and check valve segregated the two systems, and a flow indicator was installed on each of the steam lines and plant air lines. Later these flow indicators were removed, and a board-mounted HIC valve used as an indication of flow. In order to have a flow indication when steam was used, piping was installed to route the steam upstream of the HIC. Only one block valve, without a check valve, was left to segregate the air and steam systems. It was speculated that this valve was opened during the three weeks before the fire. The steam tracing systems were being commissioned so repairs could be made. The block valve in the steam line just upstream of the HIC valve could easily have been mistaken as part of the steam trap system and opened. The plant air would then have backed into the steam system. This air probably did not generate much heat while the stripper was in service. However, the day before the fire the line to the stripper bottoms became plugged and the stripper was bypassed. The conditions were then right for air injection to support high-temperature combustion. The heat weakened the vessel wall causing multiple bulges. The wall ruptured 12 hours after the stripper was placed back in service.
[fire - consequence, damage to equipment, overheating]

Lessons

The following conclusions were made:
This was an accident waiting to happen. The accident demonstrates:
1. Most incidents are attributable to a simple root cause.
2. These causes have contributed to accidents in the past.
3. Efforts must be continued and intensified to keep from repeating these experiences.
The following recommendations were made:
Corrective action included eliminating the cross-tie between plant air and steam by blinding the steam line at the check valve and disconnecting the steam line to the HIC. Provisions were made for temporary connection of a steam hose for use in place of aeration air if needed.

2105 16 December 1980

Source : FIRE PREVENTION, 1984, NO. 145, 20; HAZARDOUS MATERIALS INTELLIGENCE REPORT, 1980, 19 DEC.; CHRISTIANSEN V, , ET AL., ENVIRONMENTAL IMPACT OF A WAREHOUSE FIRE CONTAINING AMMONIUM NITRATE, JOURNAL OF LOSS PREVENTION IN THE PROCESS INDUSTRY, 1993, VOL 6, (4), 233-239.

Location : Leeds; West Yorkshire, UK

Injured : 21 **Dead :** 0

Abstract

A warehouse fire. A steel drum was overheated by an electric drum heater, burst and ignited other drums. Over 200 different chemicals were present. Most of the chemicals stored were flammable, toxic or corrosive and were stored in containers of steel, plastic or compressed fibre. 300 people were evacuated.

Estimated cost £600000 (1980).

[fire - consequence, warehousing, overheating, evacuation, unknown chemicals, injury]

Lessons

[None Reported]

2102 04 December 1980

Source : ICHEME
Location : , SPAIN

Injured : 0 **Dead :** 0

Abstract

A fire at a petrochemical polyethylene plant involving a reactor and ethylene. Source of ignition was static.
[fire - consequence, operator error, reactors and reaction equipment]

Lessons

[None Reported]

2287 01 December 1980

Source : PIPELINE ACCIDENT REPORT COMPANY PIPELINE RUPTURE AND FIRE, NATIONAL TRANSPORTATION SAFETY BOARD, WASHINGTON D.C, USA, REPORT NUMBER NTSB-PAR-81-4; LLOYDS LIST, 1980, 3 DEC.

Location : Long Beach; California, USA

Injured : 5 **Dead :** 0

Abstract

A pipeline carrying naphtha ruptured under the roadway in a town. Escaping naphtha under high pressure blew a hole in the pavement and sprayed 20 ft into the air and gutters. Moments later the product ignited with flames reaching 70 ft. The probable cause was the overpressure of the pipeline and rupture where it had been thinned by internal corrosion. The overpressure occurred because valves were closed while pumps continued to operate. Spill.
[fire - consequence, overpressurisation]

Lessons

[None Reported]

9406 14 November 1980

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

An extruder was in commission to empty the feed bin. Two machine operators observed that the extruder was producing oversized pellets which had blocked the scalping screen. This was brought to the attention of the senior operator who came to alter the operating settings on the extruder to improve the pellet quality. Shortly after completing this a cloud of polymer was released from sock connecting the feed pipe to the entrance section of the extruder barrel, forcing the personnel to leave the area. Almost immediately the polymer ignited and a flame spread causing damage to the facing of the extruder control panel and starting several small fires on the floors above the extruder. The fire at the extruder was quickly extinguished. The fire in the weighfeeder room was extinguished. The fire in the weighfeeder room was extinguished after a slight delay. There were no injuries to personnel arising from the incident. It was concluded that the polymer was released as a result of the sock becoming detached. The source of ignition has not been identified but it is considered that either static discharge or a hot spot on the equipment are the most probable causes.
[commissioning, gas / vapour release, explosion, fire - consequence]

Lessons

The following recommendations were made:
1. Modifications to be made to improve the weighfeeder floor and the floors below should be sealed.
2. An investigation to be made into the requirement for the fitting of an on line hydrocarbon analyser and alarms to the power extruder feed bin.
3. The methods used to clear blockages in the feed pipes to extruders to be reviewed to minimise the amount of polymer spilled during the operation.

2083 07 November 1980

Source : CHEMICAL AGE, 1980, 7 NOV.
Location : Decine; Lyon, FRANCE

Injured : 2 **Dead :** 2

Abstract

A fire occurred at a research laboratory where chemicals, soda and solvents, were being neutralised in agitator. Fatality.
[laboratory work, fire - consequence, unknown chemicals, unidentified cause, injury]

Lessons

[None Reported]

2078 06 November 1980

Source : HAZARDOUS MATERIALS INTELLIGENCE REPORT, 1980, 14 NOV.
Location : Richmond; California, USA

Injured : 0 **Dead :** 0

Abstract

A road transportation incident. An explosion of a road tanker of nitrous oxide occurred during a filling operation. Building destroyed. Loading operation. [under filling of vessel]

Lessons

[None Reported]

2048 21 August 1980

Source : ICHEME

Location : , WESTERN GREECE

Injured : 0 **Dead :** 0

Abstract

An explosion in a gas oil storage tank completely destroyed the tank. Discharge of motor spirit into another tank in the installation had been completed and the common supply line was switched to gas oil tank. Offloading of the gas oil parcel then commenced and the explosion took place a few minutes later. At the time the incident occurred the tank some 70 m3 of product and a large quantity of water. The level of the product and the water was sufficient to cover both inlet and outlet connections. The roof of the tank was blown completely off and the product caught fire. On the arrival of the fire brigade 45 minutes later after a journey of 45 km, the firemen found the adjacent gasoline tank in a dangerous condition from radiant heat as the depot fire pump was inadequate and unable to supply sufficient cooling water. With considerable courage and despite difficulties due to the unsatisfactory layout of the depot, the firemen were able to confine the fire to the gas oil tank and it was extinguished one hour later.
[storage tanks]

Lessons

There is little doubt that the high pumping rate stirred up the water in the tank and this action created a static charge which, in turn, caused an incendive spark. Gas oil itself has a high flash point and could not have exploded unless it had been contaminated from the preceding parcel of gasoline discharged through the common line.

2032 15 July 1980

Source : DENMARK FACTORY INSPECTORATE, HSE TRANS NO 5962.
Location : Islands Brygge; Copenhagen, DENMARK

Injured : 27 **Dead :** 0

Abstract

Explosion at soya bean factory. This explosion was due to the ignition of vapour from solvent naphtha, consisting largely of hexane, flowing out of the plant. An extraction plant was started up after a routine inspection and was still in the start-up stage at the change of shift. A little later a production hold-up occurred, excess pressure was set up in the plant at an unknown time, blowing the safety trap door on the extractor. This allowed free passage for hexane, steam and water.
[overpressurisation, separation equipment, injury]

Lessons

[None Reported]

1002819 May 1980

Source : ICHEME
Location : , AUSTRALIA

Injured : 2 **Dead :** 0

Abstract

A vehicle was loading gasoline at an installation. When the fourth compartment was nearly full a flash fire occurred which blew the driver to the ground. Fortunately, the driver did not sustained serious injuries. A second operator who was in attendance, shut the loading valve before fleeing the gantry by the stairway.
All four bays of the gantry were in operation when the incident occurred and another employee on top of an adjacent vehicle was knocked to the ground. He received a serious injury to the face and required hospital treatment.
After the fire had been burning for some 60 seconds the vehicle driver was asked to take the vehicle out of the filling gantry, which he did. Although the hose was still connected it had been softened by the fire, no further damage occurred.
All the other vehicles had by this time been driven to a safe area in accordance with procedure.
The cause of the ignition was believed to be from one of the following:
1. A static spark in the spray from the vent hole in the fill pipe. This was felt to be unlikely as the atmosphere in the vapour space would have been likely to be over-rich.
2. A static spark from the bodies of the men on the vehicle. This was also felt to be unlikely as one man was wearing conductive leather gloves, and the other had no gloves. They would therefore very probably have earthed themselves by contact with the vehicle or gantry metal work.
3. A static spark from the unbonded wire in the hose. This was felt to be the most likely cause of ignition.
[loading /unloading, road tanker, static, fire - consequence, injury]

Lessons

Subsequent investigation revealed the following information:
1. The static wire was correctly connected and had a resistance to earth of 0.5 ohms.
2. The fill pipe of the vehicle in question terminated very close to the tank bottom causing the product to spray through the vent holes, thus increasing vapour evolution.
3. The helical reinforcing wire in hoses similar to the hose used had not been brought out and braised to the end fitting, thus constituting an unbonded conductor with a spark gap between the wire and coupling.
4. Both men on the vehicle were wearing safety shoes but the electrical resistance of their shoes was extremely high.

9972 14 May 1980

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

Pressure surges caused fires in two crude units. Valves in crude feed systems failed closed and fluid flow was almost instantaneously stopped. Surge pressures were then generated which exceeded the design pressures of the equipment. The weakest equipment in each system failed and fires resulted. The valve failures, surge pressures were calculated to have exceeded equipment design pressures by 50 to 100 percent. The magnitude of the surge pressure that can result is highly dependant upon the speed of flow interruption and the kinetic energy of the system.
[fire - consequence, design inadequate]

Lessons

[None Reported]

1003501 April 1980

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

Two vertical tanks situated in a catch-pit were connected by a balancing line and contained about 6,000 gallons each of heavy fuel oil. The tanks were insulated with mineral wool and were fitted with steam coils and electrical heating. At the time of the incident only the electrical heating was used and the oil was at about 120 degrees F.
During the night a fire broke out in the catch-pit. Ten minutes later there was a violent explosion and one of the tanks rose almost vertically into the air about 60 feet and descended on a nearby building.
[tank(vertical), heavy fuel oil, electrical heating, overheating, vaporisation, fire - consequence]

Lessons

It was unclear exactly what caused the incident, but was most likely to have been caused water in the bottom of the tank vaporising and the sudden pressure release rupturing the tank.

2001 30 March 1980

Source : ICHEME
Location : , OMAN

Injured : 0   **Dead :** 0

Abstract

Explosion at a production stabiliser plant. Eqiupment involved: cone roof storage tank. Cause: vent blocked.
[storage tanks]

Lessons

[None Reported]

1991 06 March 1980

Source : NATIONAL TRANSPORTATION SAFETY BOARD, WASHINGTON D.C, USA, NTSB-PAR-81-2;NTSB-HZM MAP-80-6. ENVIRONMENTAL PROTECTION BULLETIN, 035, 18-19.

Location : Manassas And Locust Grove; Virginia, USA

Injured : 0   **Dead :** 0

Abstract

A pressure surge in a major pipeline carrying oil products occurred causing it to rupture in two separate places, releasing a total of about 1600 m3 of kerosene and fuel oil. The release caused extensive pollution of two river systems, killing wildlife and posing serious threats to the drinking water supplies of substantial numbers of people.

The failed pipe from both locations was sent for inspection, testing and analysis. Inspection of the section of pipe that ruptured under a road indicated that failure occurred near the bottom of the pipe where it had been thinned from ground water leakage from past the pipe-to-casing seal into the annular space between pipe and casing, where the water could create a corrosion cell and the shielding effect of the casing would mitigate against adequate cathodic protection.

It was reported that corrosion resulting from damaged coating on carrier pipe inside its casing was, unfortunately, common in pipeline systems. An electrical shorting of the pipe can occur when the pipe coating has been damaged and the separators that position the pipe away from the casing have been broken. If water enters the casing, cathodic protection cannot adequately protect the pipe under these conditions.

After the incident the company was requested to survey every point where the pipe was installed inside the casing. There were over 2500 road or rail crossings where casing was used, of which 277 (11%) were found to be shorted or partially shorted electrically. These 277 locations were considered to be areas where corrosion could occur and the company initiated a programme to either repair or replace the pipe at these positions.

[transportation]

Lessons

[None Reported]

9462 04 March 1980

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A fire occurred on an isolation valve in the exhaust pipework of a reactor on a low density polyethylene (LDPE) plant.
The line could not be extinguished until the process stream had been suitably purged with nitrogen.
An investigation into the incident concluded that equipment failure had resulted in a release of hydrocarbons which were ignited by an unknown source.
[fire - consequence, reactors and reactio equipment, unidentified cause]

Lessons

[None Reported[

1982 11 February 1980

Source : ICHEME
Location : , LIBYA

Injured : 0 **Dead :** 0

Abstract

A fire occurred at a refinery crude oil distillation plant due to a flange leak. Source of ignition was furnace.
[fire - consequence, refining]

Lessons

[None Reported]

1003002 February 1980

Source : ICHEME
Location : ,

Injured : 1 **Dead :** 0

Abstract

A fire followed by an explosion occurred on a road tanker whilst being loaded with kerosene. The tanker had previously been carrying motor spirit. Compartment five was loaded first and was approximately 60% full when the explosion occurred. The driver was on top of the tanker but was only slightly injured. The fire was quickly extinguished by refinery personnel.
[loading/unloading, road tanker, kerosene, static, fire - consequence, explosion, injury]

Lessons

1. The kerosene was being bottom loaded at an initial rate of 81 m3/hr, but at the time of the incident the flow rate was at its maximum of 97m3/hr.
2. The earthing of the pipe work arrangement at the tanker was checked and found to be correct.
3. The inquiry concluded that the incident resulted from a static spark during switch loading and was caused by the high filling rate combined with the presence of a micro-filter.

1002901 February 1980

Source : ICHEME
Location : , AUSTRALIA

Injured : 1 **Dead :** 0

Abstract

An explosion occurred whilst loading the compartment of a trailer with diesoleum. The vehicle had previously carried motor gasoline.
The driver was slightly injured, the gantry suffered minor damage but the vehicle was severely damaged. The ensuing fire was extinguished some 10 minutes later.
The incident occurred after draining the tank, the driver proceeded to carry out some running maintenance while the foreman commenced and successfully filled compartments 1 and 2. The foreman connected the hose to the coupling on top of the fourth compartment and reconnected the earth wire. At this stage the driver took over and started to fill the compartment. The explosion occurred some 10 seconds later. Despite being enveloped by the flash he was uninjured. The driver of an adjacent vehicle was blown off the tank and suffered a sprained ankle.
[loading/unloading, road tanker, diesoleum, static (generation), fire - consequence, damage to equipment, injury]

Lessons

Subsequent investigation revealed that:
1. The conductivity of the diesoleum being loaded was 5 pS/m.
2. The filling rate was 1800 litres/min through a 80 mm bore hose.
3. The product in the vehicle was found to contain some 9% gasoline.
4. The air temperature was 15 degrees C with a light breeze.
5. The vehicle driver was wearing a standard issue uniform of a nylon/wool mixture and non-conductive shoes.
The cause of the incident was believed to be from static generated during the rate of loading. Though it was possible that a static spark from the driver was the ignition source.

1976 01 February 1980

Source : ICHEME
Location : , SOUTH AFRICA

Injured : 2 **Dead :** 0

Abstract

A road transportation incident. An empty road tanker was left unattended in hot weather and then loaded with xylene through a flexible polypropylene hose with a metal flex covering and ending in a filter. As soon as flow started there was an explosion in the tanker followed by fire. The cause was static. The tanker barrel was earthed but the metal spiral on the plastic hose and the metal strainer were not positively earthed. Static could thus be collected on the strainer or spiral and shorted to earth via the tanker barrel. A sparking point between the strainer and the spiral was possible as it was the shortest distance but other places were also possible.
[fire - consequence]

Lessons

Use metal dip pipe to base of tanker and ensure it is properly earthed. Ensure slow charging until pipe covered and then limt velocity to that recommended by standards.

1132124 January 1980

Source : ICHEME
Location : , BELGIUM

Injured : 0 **Dead :** 0

Abstract

An explosion and fire occurred in an oxygen line filter on an ethylene oxide (EO) unit. There were no injuries and plant damage was minor. About 3 months before the incident, the plant had been shut down for maintenance and modifications. A strainer/filter collapsed, due to incorrect insulation and blocking with pieces of rag from previous maintenance. It hit the pipe internal, generating enough heat to start burning metal. The line gradually thinned and ruptured.
[fire - consequence, pipeline failure, overheating]

Lessons

[None Reported]

1971 21 January 1980

Source : THE FIRE AND EXPLOSION AT RIVER ROAD, BARKING, ESSEX, HSE REPORT, 1980, ISBN 0717600602.
Location : River Road; Barking; Essex; Uk, UK

Injured : 9   **Dead :** 0

Abstract

A fire and explosions at a warehouse storing over 100 chemicals, including sodium chlorate and sodium cyanide. The suspected cause was radiant heat from an electric fire igniting adjacent combustible material. The fire spread through packaging materials stored nearby to involve an LPG cylinder and numerous chemicals. Evacuation.
[warehousing, overheating]

Lessons

The report emphasises the need for occupiers of similar premises to pay attention to:
1. segregating various chemicals into different categories with regard to their relevant properties
2. obtaining advice on fire precautions from authoritative sources
3. preparing adequate emergency procedures in conjunction with the emergency services.

The report recommends that all users of liquefied petroleum gas should ensure that cylinders when in use be secured in an upright position and, where reasonably practicable, be transferred from workplaces into LPG storage compounds at the end of each working day.

1970 20 January 1980

Source : 100 LARGEST LOSSES, 9TH EDITION, MARSH & MCLENNAN PROTECTION CONSULTANTS, 1986.
Location : Borger; Texas, USA

Injured : 0 **Dead :** 0

Abstract

A pipe or vessel failure in an HF (hydrogen fluoride) alkylation unit resulted from water accumulating in a flare system and freezing when in contact with propane forming an ice plug. Equipment in the alkylation unit overpressured and failed. A large vapour cloud explosion and fire destroyed the alkylation unit and boiler plant and inflicted varying damage to the crude, Fluid Catalytic Cracker Unit (FCCU), gas converter, reformer and treating areas. The loss caused the entire refinery to be shut down.
[overpressurisation, vapour cloud explosion, fire - consequence, damage to equipment, refining, pipeline failure, vessel failure]

Lessons

[None Reported]

5269 1980

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A fire occurred in a light ends fractionation unit when a feed line to the unit ruptured, causing a major hydrocarbon release which was subsequently ignited by static electricity. It resulted in no personnel injuries, but caused significant damage to instrumentation and kept the unit out of service for four weeks.
The unit is designed to fractionate unstable light naphtha from a number of different sources throughout the refinery. The unit consists of two fractionator towers with a combined total capacity of 41,000 B/D. The dual tower configuration processes two streams, one of which is essentially butane and lighter and the other butane and heavier. The operating pressure of the prefractionator was 160 psig (11 atmos.) and the temperature of the stream to the prefractionator at the point of failure was 170 degrees F (77 degrees C). The feed line to the prefractionator was eight inches in diameter, schedule 20, carbon steel. It was insulated and weatherproofed.
The rupture occurred at the base of a vertical segment of the line feeding the prefractionator.
Subsequent investigation showed severe thinning of the line in the section where the failure occurred, general corrosion throughout the straight run of line above it, and severe corrosion adjacent to the pipe guide. The corrosion resulted from extended exposure to moisture. Moisture apparently entered the insulation through a break in the weatherproofing in the form of rainfall and from extended exposure to mist from a nearby cooling tower. The refinery concluded that the most likely entry point was where the pipe guide passed through the weatherproofing.
Water ran down the vertical section and accumulated at the horizontal section where the failure occurred. The elbow which failed is 16 feet above ground and inaccessible for routine inspection.
The inspections conducted in earlier years at this location revealed no problems. Since the refinery did not anticipate a problem with external corrosion, more recent inspections were only made to detect internal corrosion at more accessible locations selected on the basis of process stream velocity and turbulence.
The overhead instrumentation cables and wiring to motor operated valves and other electrical equipment in the fire zone suffered severe damage. The fireproofing of drums and supports was severely damaged, but it did prevent the supports from sagging and the drums from failure.
[fire - consequence, damage to equipment, separation, refining]

Lessons

Stringent measures should be taken to prevent external corrosion by effective sealing to exclude moisture. However, this is difficult to achieve and corrosion monitoring in vulnerable areas must be carried out.

4804 1980

Source : ICHEME

Location : ,

Injured : 1 **Dead :** 0

Abstract

A fire followed an explosion in a road tanker which was bottom loading kerosene having previously carried a cargo of motor spirit (switch loading).
The tanker had five separate compartments. Compartment No. 5 at the rear was the first to be loaded and was approximately 60% full when the explosion occurred. The driver was on the tanker top at the front end of the vehicle at the time and was only slightly injured.
The force of the explosion ruptured the wall separating compartment 5 from compartment 4. The subsequent fire in both compartments was extinguished by refinery personnel by closing the inspection hatch covers with the aid of a long metal pole kept on the gantry for this purpose.
The enquiry team assumed that a flammable mixture existed in the compartment during the loading and was probably ignited by an electrostatic discharge from the liquid surface to the internal structure of the tank.
[fire - consequence, damage to equipment, injury]

Lessons

Since micro filters are known to produce high static charging levels in an unpredictable manner, relaxation time may need to be built into the system to dissipate the charge, e.g. by the installation of a small earthed buffer tank, the size being dependent upon the conductivity of the liquid (if the conductivity is not measured, a relaxation time of at least a 100 seconds is recommended).
Alternatively the conductivity of the product can be increased with an anti-static additive to a safe level for the particular filter application.
Bottom loading gives a higher peak voltage in the tanker compared with top loading even though the inlet charge density may be the same in both cases.
Research work to date indicates electrostatic fields 25% higher when bottom loading compared with top loading.
Measurements on oils with conductivities less than 10 ps/metre should be made using an instrument of proven accuracy.
Do not practice switch loading.

1377 1980

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

Road transportation. An under-inflated or punctured tyre caught fire. Due to the internal heat it re-ignited several times and when the vehicle's extinguisher was exhausted the blaze spread to the load of chemical containers. Both the containers and the truck were destroyed.
[fire - consequence, damage to equipment, fire extinguisher, unknown chemicals, unidentified cause]

Lessons

Maintain correct tyre pressures and carry fire extinguishers suitable for tyre fires. In addition; the size and type of dry powder extinguisher should be reviewed and the possibility of fitting temperature or pressure sensors should also be investigated.
Tyre maintenance and correct tyre pressures can help avoid vehicle accidents. The inside tyre on twin wheels must not be neglected: there should be no difficulty in checking this provided the wheels have been fitted correctly.
Attention should also be drawn to the importance of training drivers in the correct use of vehicle fire extinguishers.

6587 1980

Source : ICHEME
Location : ,

Injured : 1 **Dead :** 0

Abstract

A vehicle was loading gasoline, when the fourth compartment was nearly full, a flash fire occurred which blew the driver to the ground. Fortunately he suffered no serious injury.
A second employee who was in attendance, shut the loading valve before fleeing the gantry by the stairway. All four bays of the gantry were in operation when the incident occurred and another employee, who was on the top of an adjacent vehicle, was knocked to the ground. He received a serious injury to his face and required hospital treatment. All the vehicles were driven out of the loading gantries to a safe area in accordance with standing instructions.
Installation staff responded instantaneously when the fire broke out and immediately commissioned a fire hose to cool the vehicle tank. As soon as the vehicle could be moved into the open, and hence became accessible, the fire was put out with a dry powder extinguisher.
Subsequent investigation revealed the following information:
1. The static earth wire was correctly connected (resistance of 0.5 Ohm.)
2. The fill pipe of the vehicle in question terminated very close to the tank bottom causing the product to spray through the vent holes, thereby increasing vapour evolution in the ullage space.
3. The helical reinforcing wire in hoses similar to the hose used had not been brought out and brazed to the end fitting, thus constituting an unbonded conductor with a spark gap between the wire and coupling. The hose in question was too badly burned to be checked but it was virtually certain to have been in the same condition.
4. Both men on the vehicle were wearing safety shoes but the electrical resistance of their soles was extremely high.
The most probable cause of ignition was a static spark from the unbonded wire in the hose and steps were taken with the manufacturers to ensure proper bonding in future.
[fire - consequence, road transport, injury]

Lessons

The electrical continuity of such hoses should be tested before commissioning and at regular intervals as prescribed by the Inspection Engineer.

9227 1980

Source : PLANT OPERATION PROGRESS, 1983, APR, 2, (2) 114-116.
Location : Iowa, USA

Injured : 0 **Dead :** 0

Abstract

The failure of a double-wall, 30,000 (27,000 metric) tonne occurred which was caused by a pressure differential lifting the floor.
The incident occurred whilst the tank was being purged with air or ammonia, the dry air purged to the insulation was being operated in manual bypass which cracked open with the pressure being controlled by the relief valve.
[material of construction failure, purging, overpressurisation]

Lessons

[None Reported]

102811980

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A ship was loading acrylontitrile from road tankers with hatches closed and only venting at mast head. The road tankers were offloaded by pressuring the tank with nitrogen. A rumble was heard in the pipework when the road tanker was empty due to the flow of nitrogen. However, the deck of the ship over the tank being filled was found to have been raised by 6 inches due to overpressuring of the tank caused by insufficient vent size. The hatches had to be opened to provide sufficient venting for the ships tank to be loaded.
[marine tanker, unloading, overpressurisation, overpressure, inadequate venting]

Lessons

[None Reported]

8083 1980

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A process operator making a routine check on a unit discovered a fire at the suction drum of a hydrogen reciprocating compressor.
He immediately alerted the control room and the following actions were taken: actuated the fire alarm, shut off fuel to the heater, stopped feed pump and commenced de-pressuring the unit. Since the compressor could not be approached, the motor had to be shut down from the substation. Whilst process operators proceeded with the emergency shut-down, the fire brigade cooled the compressor and associated equipment with water sprays. A foam blanket was laid on the surrounding paved area.
After the battery limit valves had been shut, the pressure in the high pressure circuit decreased, firemen wearing breathing apparatus were then able to approach the compressor and close the suction and discharge valves thereby starving the fire of fuel.
The hydrogen leaked from the first flange on the drain line at the bottom of the suction knock-out drum due to a damaged wire reinforced compressed asbestos fibre joint.
The source of ignition was probably associated with static electricity generated by the escaping gas (hydrogen has a very low minimum ignition energy and wide flammable range). Everything was checked after the incident and was found to be satisfactory.
[fire - consequence, gas / vapour release, processing]

Lessons

Although the drain from the suction drum on a H2 recycle compressor is probably very seldom used, attention is drawn to the presence of H2S (concentration usually less than 0.4% volume but could be much higher). If there is any possibility of gassing during the draining operation, then breathing apparatus should be worn and suitable warning notice displayed at the draining point.
An alternative and safer solution would be to run such drain points to a closed system.

8075 1980

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

A fixed roof tank containing heavy fuel oil was sucked in during a pumping out operation, vacuum was generated inside the tank due to partially choked vents.
The tank roof (43 m in diameter) was equipped with three breathing vents, each fitted with a coarse expanded metal mesh screen to prevent birds from nesting underneath the weather cover. A waxy deposit had virtually sealed the screens.
The tank was fitted with internal steam heating coils and the roof and shell were fully insulated.
After the tank was repaired, the refinery decided to remove the mesh screens from the vents.
[storage tanks, cleaning]

Lessons

Tank vents must be sized to suit the size and type of screening material which is to be used.
Care must be taken to ensure that replacement screens with a smaller free or open area are not installed. If however the contents of a fixed roof tank are liable to be heated above the flash point then pressure and vacuum valves should be fitted." In order that screens can be inspected regularly, provision must be made for this task to be carried out safely.
Consideration should be given to accessibility, toxicity of vapours, and the actual work involved in checking and cleaning the vents and screens.

9981 20 December 1979

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

An explosion occurred during the unloading of polyethylene pellets from a storage hopper. As a result of operator error the polyethylene pellets had been transferred to the storage hopper before they had been correctly purged of ethylene. A mixture of ethylene and air formed above the pellets and, during unloading of the hopper, the flammable mixture was ignited by a static charge.
[operator error, material transfer]

Lessons

The standard operating procedures had been ignored, due to the production problems associated with limited storage capacity. These procedures have been re-emphasised.

9969 13 December 1979

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

After five days of operation of a new recovery system on a fluid catalytic cracker, an automatic shutdown trip of the new power recovery unit occurred without warning. When the shutdown occurred, the check valve in the air blower discharge line failed to prevent a reverse flow of 1,250 degrees F catalyst into the air blower. The catalyst filled the 46 inch discharge line, the air pre-heater, the blower casing and was observed blowing out the snort mute and the air intake filter building. As a result of the damage to the air blower, the power recovery unit was divorced from the fluid catalytic cracker and the plant was restated using the old steam turbine driven air blower until repairs were completed.
An investigation into the incident revealed that an instrument malfunction had caused the automatic shutdown to occur, the air blower discharge check valve was not damaged and operated properly and caused the catalyst reversal and blower damage
[instrumentation failure, damage to equipment]

Lessons

[None Reported]

9134 December 1979

Source : HAZARDOUS INCIDENT FILE, 1981.
Location : , USA

Injured : 0 **Dead :** 0

Abstract

An explosion occurred involving a pressurised water cooled reactor due to agitator failure causing overheating in the chemical reactor.
Part of the power stations core was demolished during the incident, a camera probe of the interior core showed no evidence of a meltdown.
Apparently the plant came within 20 to 60 minutes of meltdown, when the reactors fuel rods and the enriched uranium pellets inside could have melted and seeped into the ground, releasing high levels of radiation.
[reactors and reaction equipment, agitation failure, radioactive, reaction]

Lessons

[None Reported]

1929 20 November 1979

Source : ICHEME
Location : , ISRAEL

Injured : 0   **Dead :** 0

Abstract

An explosion and fire occurred involving a hopper and ethylene at a petrochemical polyethylene plant. Source of ignition was static.
[fire - consequence, silo/hopper]

Lessons

[None Reported]

1928 18 November 1979

Source : ICHEME
Location : , ALGERIA

Injured : 0 **Dead :** 0

Abstract

An explosion occurred caused by water hammer at a production gas stabilisation plant. Source of ignition was flare.

Lessons

[None Reported]

1201231 October 1979

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

The internal components of a Worcester ball valve were ejected when the adjoining pipework was removed during preparation work for entry into a tank.
The investigation showed that:
The design of this type of valve is such that the ball and retention sleeve were held in position by the adjoining pipework. Removal of this pipework whilst the other side of the valve was under even a slight pressure results in the internals being ejected.
[maintenance, overpressurisation, explosion / pressure release]

Lessons

The following recommendations were made:
1. A survey of the works showed that there were about 200 of these valves in use. The cost of replacing all of the valves of this type was £20,000 (1979).
2. This type of valve is now obsolete and has been replaced by one having a grub screw to retain the sleeve and ball.
3. All valves of the old type would be clearly identified.
4. Maintenance and operating personnel will be informed of the problems with this type of valve.

1919 22 October 1979

Source : ICHEME
Location : , NORWAY

Injured : 0 **Dead :** 0

Abstract

Marine transportation. Overpressurisation caused propane release on a marine tanker at a petrochemical jetty.
[gas / vapour release]

Lessons

[None Reported]

1914 16 October 1979

Source : ICHEME
Location : , UK

Injured : 1 **Dead :** 0

Abstract

Fire occurred during the filling of 23 litre cans from bulk storage using a metal dispensing nozzle. The fire was probably caused by static as the flexible hose contained a metal braiding which was not earthed. The nozzle did not reach the bottom of the can. There was also doubt whether the can was earthed.
Butyl acetate.

Lessons

[None Reported]

9426 03 October 1979

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

Discharge pressure of a hydrogen compressor on a chloride plant fell to alarm level without any prior warning and simultaneously three bumps were heard. Smoke was seen coming from the hot motor bearing and the machine had to be stopped locally as it had not tripped. No external fire occurred and the hydrogen product was out to stack, in which the chlorine plant continued to run as required.
Examination of the compressor showed that the studs of the driven end first stage cylinder head had failed and subsequent examination of the piston rod showed that this had failed at the threaded attachment to the cross head, the motor bearing showed severe heating by oil smoke and paint discoloration.
The following conclusions were made:
1. The piston rod failed by fatigue initiated at the cross head end threads.
2. No evidence was found of any individual error in assembly or operation which contributed directly to the initiation of this incident.
3. Indications are that the vibration trip was however keyed out at the time of this piston rod failure, increasing the secondary damage at the motor and resulting in the provision of a possible ignition source for the escaping hydrogen.
4. The damage to the compressor indicates that both the compressor and the driver motor, acting as a flywheel, may have been subjected to extreme impulsive forces, with possible damage being caused to frames or shafts but subsequent inspections have shown any distortions to be negligible and no cracks have been detected.
5. There is some evidence that liquid passes into this compressor in sufficient quantities under some conditions to cause mechanical distress.
[overheating, material of construction failure]

Lessons

[None Reported]

9978 28 September 1979

Source : ICHEME
Location : , BELGIUM

Injured : 1 **Dead :** 0

Abstract

During the maintenance of a strainer that separates oversized lumps from the output of a polyethylene pelletiser, injury occurred to a fitter by scalding from steam released when overheated water flash vaporised. The overheating was a result of the operating procedure not being followed.
[gas / vapour release, design inadequate, operation inadequate, injury]

Lessons

Procedure design inadequate was considered to be the fundamental lesson learnt. Soft resin produced at reactor start-up causes unusually large quantities of oversized, or agglomerated, particles, and these overload the "agglomerate remover"(strainer). The operating procedure was not designed to cover these start-up conditions.

1903 01 September 1979

Source : WHITE B.J, WATSON P.B, AND TRUSLOVE T.E, REPORT ON A STUDY OF CHEMICAL TANKER VENTING AND GAS FREEING ARRANGEMENTS, SCOTTISH ENERGY CENTRE, 1988; CHEMICAL WEEK, 1979, 12 SEP.; NATIONAL TRANSPORTATION SAFETY BOARD, WASHINGTON D.C, USA, NTSB-MAR-80-18

Location : Deer Park; Houston Ship Channel; Texas, USA

Injured : 0   **Dead :** 0

Abstract

A marine transportation incident. While offloading crude oil at the terminal a marine tanker was struck by lightning, burned and sank. A hull fragment, missile, from the vessel penetrated a shore ethyl alcohol tank causing a further explosion and fire in the tank. The explosion in the ship occurred when lightning ignited accumulated vapours on the deck and propagation through an open or improperly secured tank opening.
[fire - consequence]

Lessons

[None Reported]

9422 13 August 1979

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A styrene storage tank was found to have been pulled in. Movement of material from the tank was immediately stopped and the shift management called to the plant.
[storage tanks, material transfer, vacuum]

Lessons

[None Reported]

1890 11 August 1979

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

An 8000 gallon glass reinforced plastic tank lined with polypropylene failed with a split at the bottom seam and one sixth of the tank wall opened up. Failure was due to a slight overpressure on a weakened structure tank caused by three coincident unsafe features.
1. Small spills of caustic soda and hypochlorite weakened seam.
2. Chemical reaction uncontrolled in tank.
3. Reactive components in feed to tank.
Use of tank had changed from original intent. Design modification.
[overpressurisation, human causes]

Lessons

[None Reported]

7734 07 August 1979

Source : CONTROL OF CHEMICAL EXOTHERMIC REACTIONS, ICHEME, SAFETY TRAINING PACKAGE, 023, 3.27.
Location : ,

Injured : 0 **Dead :** 0

Abstract

An explosion followed by a fire occurred in a sulphonator during a 3-nitrobenzene sulphonic acid process. No one was injured and plant damage was mainly confined to the sulphonator, adjacent pipework and electrical wiring.
The explosion was caused by the pressure of gases which were generated extremely rapidly from an exothermic decomposition. Overheating a reduced size of reaction mass caused the decomposition.
[fire - consequence, reactors and reaction equipment, damage to equipment]

Lessons

The following recommendations were made:
1. Procedures should be designed so that blockages do not occur, wherever this is practicable.
2. Should a blockage occur, then the means of clearance should be designed and/or physical provisions made which take into account the possible dangerous effects of operational practices.
3. Safety training should be arranged for the operators so that they gain a better appreciation of the potential process hazards and the manager should check on the problems the operators encounter and on the practices developed to overcome them.
4. In this process for 3-nitrobenzene sulphonic acid, a factor controlling the rate of transfer of the batch from the sulphonator to the dilution vessel is the frothing resulting from the reaction of sodium carbonate with the acid sulphonation mass. Frothing can be avoided by simply substituting caustic soda for sodium carbonate. This would enable a 50 mm diameter transfer pipe to be used instead of a 12 mm diameter pipe and the batch can then be transferred in a much shorter time, at flow velocities which will avoid crystallisation blockages.

9728 10 July 1979

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

An operator charged P2S5 (phosphorus pentasulphide) to a thiophosphate reactor and applied steam with the intention of shutting it off prior to going for his break.
The reactor would be left gassing off, but with no steam on. However, he did not formally hand over the reactor to the relief operator and also forgot to shut the steam off.
The reactor temperature is normally raised in 6 degrees C to 8 degrees C increments with pauses to allow the H2S (hydrogen sulphide) gas generated to be removed by a steam ejector. In this case the temperature rise continued with evolution of a large volume of gas, causing pressurisation of the reactor. The increasing pressure in the reactor resulted in a leak of H2S (hydrogen sulphide) gas, probably from the agitator gland and it was necessary to evacuate the plant.
[reactors and reaction equipment, evacuation, high temperature, overpressurisation]

Lessons

1. A much more formal handover system is required.
2. Operator providing "meal relief" must be adequately trained.
3. Consideration should be given to automatically override the steam supply in the event of overpressurisation.

1131303 July 1979

Source : ICHEME

Location : , UK

Injured : 0 **Dead :** 0

Abstract

A road transportation incident. A lorry, carrying highly flammable solvents caught fire and was extensively damaged. The load, also, was completely destroyed. There were no casualties.
It was concluded that the root cause of the fire was at the rear, offside tyres which caught fire due, either, to under inflation, or brake binding.
It was not considered practicable to entirely prevent this kind of incident (tyre fires) so the recommendations centred around measures to reduce the frequency of such events.
A nearby house was evacuated as a precaution to escape the possible effects of toxic combination gases from the loading being carried (a combination of organic esters and ketones).
[fire - consequence, damage to equipment, overheating, solvents]

Lessons

The main recommendations were:
1. Review tyre design data to ensure use of best products.
2. Ensure high standards of wheel and tyre maintenance.
3. Introduce spot checks on tyre condition.
4. Review devices for "in service" tyre pressure checks.
5. Review fire-fighting equipment on lorries and driver training in this respect.
6. Review means of preventing spread of tyre fires to the load being carried.
7. Increase awareness of consequences of fires involving flammable liquids.

9967 27 June 1979

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A naphtha storage tank ignited following the sinking of the floating roof. As a result, approximately 30,000 barrels of product were lost and the tank was destroyed.
A sharp noise was heard coming from the tank. Investigation from on top of the tank showed the roof was bent down in the area of the inlet nozzle, the roof compartments on this side were flooding and the roof was slowly sinking. It was noted that the anti-rotation guide had broken loose at the top end, it is thought that the noise that was heard was made as the guide broke loose. The product was bubbling vigorously above the inlet line in the open area between the shell and the roof. It is thought that two or more compartments above the inlet line leaked and flooded, causing the section of the roof to fold down.
A fire truck was brought to the tank and a hose hooked up to supply foam to blanket the tank if needed. Efforts to pump the tank out to the reformer were unsuccessful, as sufficient suction conditions could not be maintained at the minimum charge rate. It is assured that this restriction was caused by the blockage created inside the tank nozzle by the roof.
The initial fire is thought to have been caused by static build-up from the unbonded nozzle being used to place a protective foam blanket on the naphtha.
[storage tanks, fire - consequence]

Lessons

[None Reported]

8422 30 May 1979

Source : ICHEME
Location : , UK

Injured : 1 **Dead :** 0

Abstract

Whilst manually emptying oxalic acid from a poly-ethylene lined, polypropylene woven sack into a batch reactor via the vessel manway/charge port, ignition occurred and a small fire erupted from the reactor. The operator received burns to his arms, chest and face.
Investigation into the incident revealed that most likely cause of ignition was the discharge of static electricity to the vessel. The charge being generated by the emptying of oxalic acid from the composite plastic sack. Vessel atmosphere at time of operation would have contained inflammable liquids above their flash point.
[reactors and reaction equipment, fire - consequence, charging reactor, lack of earthing, screw conveyor]

Lessons

1. A new charging system was installed by the company, in which oxalic acid was not charged directly into the reactor but instead was charged via an earthed screw conveyor.

9388 27 February 1979

Source : ICHEME
Location : , UK

Injured : 0   **Dead :** 0

Abstract

Diluted cold heat transfer salt was pumped at an excessive rate from a new auxiliary salt drum into a container which contained hot molten salt. If a dedicated hydrotherm nozzle which would automatically have limited the addition rate. However, dilute salt was allowed to enter via one and a half temporary circulation pipework in addition to the hydrotherm nozzle. This excess addition rate resulted in a sudden generation of steam in the container which emitted via the drum vent and via the salt loading hatch hopper. The rate of emission was observed to be sufficient to cause a deep rumbling noise and a noticeable vibration of the nearby plant offices.
[overpressurisation, heat transfer salt]

Lessons

[None Reported]

1153618 February 1979

Source : ICHEME
Location : , FRANCE

Injured : 0 **Dead :** 0

Abstract

At the conclusion of cleaning of a reactor vessel with toluene, it was discovered that the transfer line for removal of the toluene was blocked due to freezing. During operations to unfreeze the line which took 3 hours, the bottom outlet of the vessel was open and the vessel was pressurised to 5 bar with nitrogen. An emergency dump valve was passing although it appeared to be fully closed and about 7000 litre of toluene was discharged to an emergency dump pit. The shift foreman did not consider it necessary to call an alert as the toluene was contained in this pit.
The control room was not manned during this cleaning operation as no other processes were operating.
Subsequent investigation showed that the dump valve actuator had been damaged or misaligned, probably by applying excessive torque during manual jacking of the valve, and the valve could not fully close.
[reactors and reaction equipment, no flow, cold weather, spill, design or procedure error]

Lessons

A number of recommendations were made:
1. Visual inspection of the reactor vessel at least every 15 minutes when cleaning operations are undertaken.
2. Pressure test of any valve that has been manually jacked before it is returned to normal service.
3. Initiate a major alert for any spill of greater than 1000 litre hydrocarbon even if retained by an emergency containment.
4. Notify the section foreman of any abnormal occurrence that could affect safety.

9710 03 January 1979

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

Ice and water, carried by a brief high gas discharge, were ejected from a flare stack.
The prevailing climatic conditions were freezing.
It is probable (through not certain) that condensate overflowed the molecular seal and formed an "ice neck". A slight thaw, combined with pressure build-up in the flare system, dislodges this ice and showered it over the area around the flare.
[weather effects, overpressure]

Lessons

The cause of the incident was decided to be condensate building up in the blow down drum and the molecular seal drain line (only 1" N.B) and overflowing into the body of the stack. Very cold weather and flaring of cold gas from an ethylene plant, resulted in freezing of this water. A continuous steam flow to the inner nozzle in the flare tip was the source of this water. This steam flow was necessary for operational reasons. Thus, additional drain line, with a nitrogen purge, was considered as the optimum solution.

1811 02 January 1979

Source : ICHEME
Location : , INDONESIA

Injured : 0 **Dead :** 0

Abstract

A blowout occurred on a production natural gas (NG) well which was caused by loss of flow.
[no flow]

Lessons

[None Reported]

1006801 January 1979

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

A fire occurred in a light ends fractionation unit in a refinery when a feed line to the unit ruptured causing a major hydrocarbon release which was subsequently ignited by static electricity. Significant damage was caused to instrumentation and the unit was kept out of service for 4 weeks.
One hour after ignition, the fire was at the height of its severity and had engulfed the prefractionation and the elevated overhead accumulator drums for both towers. The fire burned intensely for 2 hours but was contained in a relatively small area due to firefighting equipment, wind direction and substantial fireproofing equipment.
The unit was used to fractionate unstable light naphtha from a number of different sources and consisted of 2 fractionation towers with a combined total capacity of 41,000 B/D.
The rupture occurred at the base of a vertical segment of the line feeding the tower.
[fire - consequence, gas / vapour release, damage to equipment

Lessons

Subsequent investigations showed severe thinning of the line where the failure occurred, general corrosion of the straight run of line above it and severe corrosion adjacent to the pipe guide. The corrosion was the result of moisture in the form of rainfall and mist from a nearby cooling tower entering the insulation through a break in in the weatherproofing. The most likely entry point was where the pipe guide passed through the weatherproofing where water ran down the vertical section and accumulated at the horizontal section where the failure occurred. The elbow of the line which failed was inaccessible for routine inspection and previous inspections did not anticipate external corrosion being a problem.
Corrective action was as follows:
1. Enhancement of fire protection for instrumentation and electrical wiring to allow orderly unit depressurization and shutdown.
2. Identification, inspection and application of surface protection to insulated surfaces operating at 100-250oF which was susceptible to external corrosion. An epoxy coating is now required on lines of this type.
3. Criteria used for the selection of surfaces for inspection: uniquely corrosive atmosphere, lines or equipment containing hydrocarbon vapour or streams that would vapourize at atmospheric conditions, proximity to sources of ignition; and toxicity of the process stream. The more factors which exist, the greater the risk and higher priority for work.
4. Improvements to electrical and instrument fireproofing.
5. Unit survey undertaken for potentially similar problems with external corrosion. Any repair program will work on a prioritised basis with higher risk areas first.

9884 1979

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

The vent form the low pressure stuffing box chamber in a hydrodealkylation unit hydrogen recycle compressor plugged with diphenyl. As low pressure packing was leaking less than the high pressure packing a cast iron diaphragm ruptured. There was no significant release of hydrogen or other damage. [diphenyl, compressor, rupture, vent blocked, design inadequate, inspection inadequate]

Lessons

In case of any events, particularly on low pressure equipment, the possibility of vapours condensing and forming a solid deposit should be considered. Where there is any risk of this the vent should either be heat traced or inspected and cleaned on a regular basis as is appropriate.

1807 1979

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 1

Abstract

A 400 litre drum was positioned underneath a valve and plastic hose and filled with vinyl acetate. The drum was removed to a research department where the contents were used. The space in the drum was replaced by air as the liquid was used. When empty the drum was returned for filling. This was carried out again by filling the drum from the plastic hose. An explosion occurred in the drum killing the operator. A substantial fire also ensued from material running out of the open valve. The cause of the explosion was believed to be static generation on the plastic hose igniting the explosive mixture in the drum. Fatality.
[drums]

Lessons

[None Reported]

1806 1979

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

Penicillin crystals were charged to a recrystallizer from a plastic container into an acetone and ethanol mixture. When the container was being removed from the recrystalliser after emptying a fire occurred. The fire was caused by static from the container to the manhole.
[fire - consequence]

Lessons

[None Reported]

1790 14 December 1978

Source : ICHEME
Location : , PUERTO RICO

Injured : 0 **Dead :** 0

Abstract

An implosion occurred in a cone roof tank containing fuel oil at a refinery storage.
[damage to equipment, storage tanks, refining]

Lessons

[None Reported]

1772 03 November 1978

Source : CHEMICAL MARKETING REPORTER, 1978, 13 NOV. & 20 NOV.; CHEMICAL AND ENGINEERING NEWS, 1978, 13 NOV.; EUROPEAN CHEMICAL NEWS, 1979, 8 JAN.

Location : Houston; Texas, USA

Injured : 7 **Dead :** 1

Abstract

An explosion occurred at a chloroprene plant. The manufacturing process involved quantities of sulphur and rosin to be dissolved in the monomer prior to polymerisation. For this to be achieved the monomer had to be warmed above its storage temperature. Means of heating the monomer were not originally provided and were added on as a late modification to the original construction of the plant. Prior to the explosion the temperature indicator/transmitter on one of the two charge tanks was found to be faulty and had been replaced on the previous shift by a local dial thermometer. The charge hand had initiated a system of relaying this temperature from the first floor to the second floor operator by telephone. There is considerable doubt that the temperature indicator was giving correct indications of the temperature. The explosion and fire was on the polymerisation section of synthetic rubber plant, caused by overheating of vessel.
[fire - consequence, overheating, fatality]

Lessons

[None Reported]

1759 11 October 1978

Source : AFTENPOSTEN, 1978, 12 OCT.
Location : Skadskoer, DENMARK

Injured : 8 **Dead :** 0

Abstract

Explosion probably due to overheating in process furnace.

Lessons

[None Reported]

1011430 August 1978

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

An explosion took place in the firebox of a boiler on a refinery site whilst it was being warmed up after a scheduled shutdown. Four pilot burners and two main burners had been alight for several hours under manual control when it was noted that temperatures began to drop. Shortly afterwards the explosion occurred, causing considerable damage to equipment.
Boiler fuel was 'plant gas' containing about 50% hydrogen. The boiler was not fitted with a flue gas combustibles analyser.
The cause of the explosion was not clear, although it appears that incomplete combustion must have allowed a build-up of fuel gas. Possible explanations were:
1. Loose scale left in the fuel gas lines after cleaning, causing incorrect burner operation.
2. Restricted air supply (possibly due to premature commissioning of the air preheater).
[start-up, commissioning, furnace, boiler explosion, unidentified cause, inspection inadequate, design or procedure error]

Lessons

The main changes implemented as a result of the enquiry were:
1. More careful inspection/cleaning of the fuel lines after shutdown.
2. More careful monitoring of boiler start-up.
3. Better instrumentation.

1707 August 1978

Source : CHEMICAL WEEK, 1978, 6 SEP.
Location : City Of Industry; California, USA

Injured : 0   **Dead :** 0

Abstract

Rail transportation. Liquid styrene monomer overheated in a rail tanker. Vapour released and vapour cloud formed which caused the evacuation of 500 people.
[gas / vapour release, overheating]

Lessons

[None Reported]

1701 29 July 1978

Source : ICHEME
Location : , INDONESIA

Injured : 0   **Dead :** 0

Abstract

A blowout occurred on a production oil well involving natural gas (NG). Source of ignition was friction.
[no flow]

Lessons

[None Reported]

1687 15 July 1978

Source : ICHEME
Location : , ITALY

Injured : 0   **Dead :** 0

Abstract

Road transportation. A fire occurred involving a road tanker carrying ethylene. Source of ignition was static.
[fire - consequence]

Lessons

[None Reported]

1650 30 May 1978

Source : 100 LARGEST LOSSES, 9TH EDITION, MARSH & MCLENNAN PROTECTION CONSULTANTS LTD., 1986
Location : Texas City, USA

Injured : 10 **Dead :** 7

Abstract

An unidentified failure led to the release of light hydrocarbons which ignited. An intense fire followed in the tank farm and a sphere failed within 5 minutes and sent missiles throughout plant. Within 20 minutes, five horizontal bullets, four vertical bullets and one sphere failed from missile damage or the BLEVE (Boiling Liquid Expanding Vapour Explosion). Pieces of the tanks travelled in all directions falling into operating units and tank farms and starting further fires. Fragments hit the fire water tank and electric pumps. Two diesel pumps were used. The accident was caused by the rupture of an isobutane storage sphere which had been overfilled and overpressured due to the failure of its level monitoring equipment.
[overflow, overpressurisation, mechanical equipment failure, propane, butane, fatality]

Lessons

1. Propane tank batteries preferably should be isolated to more remote sections of the plant. Spheres also should be remotely located whenever possible.
2. The positioning of the propane tanks should be done in such a manner as to point or "aim" them away from major valves or occupancies. These tanks when ruptured act as bullets and become missiles. The spheres, more than likely, will rise vertically with the footings acting as launching pads.
3. Early warning is needed in the event a vapour cloud is forming.
4. A low dike should be built, if possible, around the butane spheres to help contain the heavier vapour.
5. A method of cooling the tanks to prevent vaporisation should be installed.
6. Alarms are needed to warn operators of high levels in the tanks or the presence of hydrocarbon vapour in the area.
7. It is extremely important to maintain good records of the type and age of all safety and operating equipment used in conjunction with the operation of these tanks. This includes both field and board mounted equipment. It is equally as important to maintain a record of all maintenance work orders and routine inspections of this equipment.
8. Tight and properly maintained seals are very important on the unit charge and product transfer pumps.
9. Ground should slope away from the tanks in the direction of prevailing wind.

1635 06 May 1978

Source : ICHEME
Location : , ITALY

Injured : 0 **Dead :** 0

Abstract

A fire occurred involving a column and fuel oil on a refinery visbreaker plant which was caused by a flange leak. Source of ignition was autoignition.
[fire - consequence, refining]

Lessons

[None Reported]

4083 03 May 1978

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

Due to an unanticipated demand, the normal day operation of a Residues/Waste Oils incinerator was to be put on a shift basis. The shift operators had been trained to maintain normal operating conditions, but had not been instructed on how to deal with unusual fuel conditions. Residues in the fuel had caused blockages in the burners and the incinerator had been shutdown. Several attempts were made to start-up the incinerator, and after lighting one of two burners excessive overheating occurred, causing damage to the induced draft fan.
[damage to equipment, flow restriction, training inadequate, heating]

Lessons

The management and training needed to be improved to ensure that personnel were only asked to perform duties in which they had been adequately instructed.

9212 25 April 1978

Source : DEPARTMENT OF TRANSPORTATION REPORT, 8050536. HAZARDOUS MATERIALS INCIDENT REPORT.
Location : Nebraska, USA

Injured : 1 **Dead :** 0

Abstract

A leak occurred on a "T" fitting during material transfer. After investigations it was found that the driver had hooked up in preparation and started to unload into consignee bulk storage facilities. A leak was noted on off-side "T" fitting, the driver then placed the pump into neutral and stopped the engine. Apparently the driver then struck the cap fitting with a hammer. The cap was either loose or was cross threaded as it blew off under the pressure. The cap was found 10 feet away and the hammer approximately 20 feet. After approximately one and three quarters of an hour, the cargo pump destroyed itself, falling to the ground. [human causes, damage to equipment, spill, overpressurisation]

Lessons

[None Reported]

1613 April 1978

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

A refrigerated butane storage tank was overpressurised and damaged as it was being returned to service. The 38,000 bbl butane tank is designed to be operated at a pressure of 20 inches of water. The normal start-up procedure calls for the tank to be purged with carbon dioxide (CO_2) until the oxygen (O_2) content is below 11.5%. The 6 inch hatch is then closed and butane is slowly admitted to the tank. Venting through a 2 inch vent and the rate of butane addition are controlled to maintain the tank pressure at 12 inches of water until a sufficient level of liquid is established to allow the refrigeration system to be placed in service, and the automatic pressure control activated.
The overpressurisation occurred during the initial butane addition and was a result of an operator error, followed by failure of the relief valves to open. When the operator noticed a steady pressure increase on the pressure recorder, he opened the 2 inch vent and partially reopened the 6 inch hatch to relieve the pressure, but did not reduce the butane addition rate as outlined in the procedure. The pressure continued to build and exceeded the range of the pressure recorder scale (30 inches of water) for a period of 2 1/2 hours. The two 6 inch relief valves are sized for fire condition relief and are more than adequate to keep the tank pressure at a safe level; the valves however, failed to open.
As a result of overpressurisation, the tank floor dished, pulling the circumferential footings out of the ground. It is not known what pressure the tank sustained but it was calculated that a pressure of 40-55 inches of water would have exerted a total force sufficient to create the damage found. The two relief valves were removed to check why they had not worked. Normal workshop procedure for these valves was to clean and inspect only, as no test equipment was available to check the low relief set pressure of 28 inches of water. A special test apparatus was built and the valves tested to 60 inches of water; the valves did not open. The valves were spring loaded and adjustable from 14 inches of water to 20 psig. As purchased, the valves were preset to 28 inches of water. According to the manufacturer, the initial spring setting should not require readjustment. The adjustment screw was found to be improperly set; it is not known when the change from the factory setting was made. When reset, the valves functioned properly.
[storage tanks, overpressurisation, refrigerated storage tank, safety relief valve failure]

Lessons

The following steps have been taken by the refinery to a prevent a recurrence:
1. New relief valves of a different design were installed. These valves depend on the fixed weight of a disc for pressure relief and are not adjustable.
2. When the new valves are removed for future inspection and cleaning, they will be tested for correct relief pressure.
3. Start-up instructions have been rewritten to emphasise the importance of proper pressure control and any corrective actions to be taken.
4. A new smaller butane inlet line was installed to allow closer control of butane being added on start-up.
5. Modifications were made to the 6 inch hatch to allow emergency venting from ground level if required.

Although an O_2 content of 11.5% vol. is permitted by the National Fire Protection Association in purging out air before entry of hydrocarbon it leaves little margin of safety and a figure of 5% should be aimed for. Testing for O_2 content should take place at several points to ensure that no pockets of air remain.

1563 22 January 1978

Source : GUARDIAN, 1978, 23 JAN.
Location : Chatteris; Cambridgeshire, UK

Injured : 0 **Dead :** 0

Abstract

Vat of paraffin wax overheated and was in danger of exploding.
Area evacuated. Near miss.
[overheating, evacuation]

Lessons

[None Reported]

1560 15 January 1978

Source : CHEMICAL WEEK, 1978, 25 JAN.
Location : Philadelphia; Pennsylvania, USA

Injured : 2   **Dead :** 1

Abstract

Road tanker exploded while karathene, dinitro-octyl-phenyl-crotonates, was being unloaded. Pressure-temperature explosion may have occurred as road tanker was heated with steam coils to heat material before offloading. Fatality.
[high pressure, high temperature, unloading]

Lessons

[None Reported]

4090 10 January 1978

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

During preparation for maintenance of a drain on a steam line, a static electricity discharge was generated between scaffolding and a ladder which was in the steam leak.
[near miss]

Lessons

Re-emphasise the knowledge about static build-up from steam leaks, and the preventative measures available. (Training inadequate)

122681978

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

An incident occurred which resulted from cleaning machine parts with a solvent, methyl methacrylate, in a polyethylene bucket.
An operator, while placing a third machine part in the bucket, narrowly avoided being burned by a flame, which shot up from the bucket to a height of 2 metres.
An investigation into the incident revealed that the solvent was pured into the bucket from a draw-off valve on a pressurised line, causing the bucket to accumulate an electrostatic charge. The charge then generated a spark when the machine part was placed in the bucket.
[fire - consequence, near miss]

Lessons

The report stated the following:
Where hydrocarbons and other low conductivity liquid is moving at relatively high linear velocity, as in this case through the draw-off valve, generation of charge will occur in the liquid. Therefore, valves for drawing-off liquids with low conductivity are to be provided with proper means of earthing. Whenever the liquid and/or the receiving vessel are bad onductors, charge accumulation to a dangerous level might occur.

9879 1978

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A pair of large team turbine driven hot oil pumps suffered from the severe vibration when changing operation from one to the other. In the end it loosened a flange on the small discharge valve bypass line and leak ignited. The cause was improper setting of the turbine governors. The difference of speed was on occasions sufficient that the faster pump reduced the flow on the other below the minimum safe level while both were on line during a changeover. This caused the pump vibrations. Until the incident no-one though to get expert advice on the reason for the vibration.
[hydrocarbon, start-up, pump, turbine, flange, blowout, fire - consequence, inspection inadequate, excessive vibration, flange leak, safety procedures inadequate]

Lessons

Centrifugal pumps and compressors should not be allowed to operate in parallel unless they are of the same design and driven at the same speed. Turbine driven pump governors need to be checked regularly where parallel operation is necessary.
Operations should report and supervision should investigate the cause of any severe vibration on a plant even if it only occurs for short periods.

9880 1978

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A high pressure hydrodesulphuriser charge pump was shut down urgently and the discharge valve then closed. However, due to a leaking discharge non-return valve on the high pressure pump an a tight non return valve on the tank farm pump the line between the two pumps was grossly overpressured and four flange joints leaked heavily. The problem was compounded because even when the pump discharge valve was closed it leaked too. The source of continuing high pressure was the hydrogen supply to the hydrodesulphuriser.
[hydrocarbon, shutdown, non-return valve, gasket, blowout, inspection inadequate, design inadequate, overpressurisation, joint leak]

Lessons

None return valves which are critical to the safety of a unit should be listed. Valves on this list should be inspected and repaired to as new condition at each scheduled shutdown.
As far as practicable operation procedures and design should avoid reliance on non-return valves to prevent a dangerous incident.

9864 1978

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

During the emergency shutdown of a coker unit the charge pump was stopped and steam injected into the discharge line to purge the furnace tubes. This was done before the pump discharge valve was closed as any delay in the steam purge would result in coking of the furnace tubes. Reverse flow of steam through a faulty non-return valve caused the pump to overspeed in reverse rotation and fail.
[hydrocarbon, fire - consequence, valve failure, inspection inadequate, safety procedures inadequate]

Lessons

1. Critical reverse flow valves, such as this, must be put on a critical list to ensure that they are inspected and restored to a new condition at each planned shutdown.
2. A procedure was introduced to close the charge flow control valve soon as an emergency shutdown was initiated.

1521 27 December 1977

Source : FIRE JOURNAL, 1978 SEP.; LATHROP J.K, 54 KILLED IN TWO GRAIN ELEVATOR EXPLOSIONS, FIRE JOURNAL, SEPT, 29-35 & 55; THE TIMES, 1977, 29 DEC.; GUARDIAN, 1978, 3 JAN.; HOUSTON CHRONICLE, 1989, 24 OCT.

Location : Galveston; Texas, USA

Injured : 0 **Dead :** 18

Abstract

Rail transport. A dust explosion at grain elevator ignited by a spark caused a serious fire when offloading grain from rail cars. Wheat was being loaded onto a ship. There was no explosion venting on silo. Fatality.
[fire - consequence, loading, silo/hopper]

Lessons

[None Reported]

1203312 December 1977

Source : ICHEME
Location : , GERMANY
Injured : 0 **Dead :** 0

Abstract

The Dewaxing Unit involved in this incident used dichloroethane - methylene chloride (Deem) for dewaxing, with three rotary drum filters for wax recovery. The filter area for each filter is 60m 2, with pressure tight filters hoods, which are maintained at a low constant pressure by a balance line connected to the gas holder.
The unit was shut down from the 9th to the 12th December 1977 principally for work on the electric motor of the propane compressor, but at the same time partially blocked spray nozzles in filter 'Y' were replaced.
At 06.30hr on the 12th December the start-up of the unit commenced, using only two of the three filters, namely 'X' and 'Z'. At about 07.00hr two of the available four filter gas compressors were commissioned to provide a vacuum in the main filtrate and wash filtrate accumulators, and also compressed filter gas for cake-removal in the filters.
Shortly after starting the filter gas compressors, the hood of the filter not in commission, 'Y', collapsed suffering extensive damage.
An immediate check on the prevailing process conditions revealed that the 6 inch valve in the main filtrate line to 'Y' was open whereas all other main valves to 'Y' were closed. Therefore the filter 'Y' was not completely isolated as was assumed on commissioning filters 'X' and 'Z'. This valve was probably overlooked on preparing the filter for handover to the maintenance department at the shutdown. With the open filtrate valve, and the filter cloth in filter 'Y' free of cake and offering no resistance, a vacuum of 0.4 bar abs. resulted in the filter hood causing it to implode. If the 6 inch valve in the balance line to the gas holder had been opened before the filtrate valve, as is the correct normal procedure, then the vacuum condition would not have arisen.
The filter hoods are each equipped with an atmospheric liquid seal (U-tube containing a low viscosity dewaxed oil) to safeguard against overpressure. The seal offers by virtue of its construction, no protection against the high vacuum condition. Should a vacuum arise in the filter hood, the hinged lid on the atmospheric leg remains closed preventing ingress of air.
The design pressure conditions for the hood are, normal operation 50 mm WG, maximum 150 mm WG, test pressure with air equivalent to 200 mm WG. The seal as well as offering no protection against vacuum condition is in all probability undersized for pressure conditions in that the seal diameter is only 80 mm compared with the 150 mm of the balance line. It was found that the filters on the No.1 Dewaxing Unit were of the same type. The cost of fabricating a new hood utilising existing end walls and base frame, resheeting the filter, and installing the hood amounted to about 100,000 DM, and in addition throughput was limited to 80% for a period of 10 days.
[separation, filter, seal, overpressurisation, operation inadequate, implosion, damage to equipment]

Lessons

Measures taken to prevent repetition:
1. The hinged lids on the atmospheric legs of the filter U-seals in both dewaxing units have been removed.
2. The operating instructions for starting up and shutting down filters have been supplemented with an instruction giving particular reference to the inherent danger of implosion and stressing the proper sequence of valve operation.
3. Provisionally the U-seals have been modified to limit the amount of seal liquid that can be introduced and thereby protecting the filter hoods at pressure/vacuum in excess of about 300 mm WG.
4. The refinery is seeking an optimum technical solution to give the filters adequate protection against the occurrence of unduly high pressure/vacuum. Ideally the overpressure device should relieve to a closed system to avoid polluting the atmosphere in the filter building with solvent vapours. This could well mean that separate devices will be used to cater for pressure and vacuum conditions.
Most refineries with dewaxing plants, will have seals on their filters of a type which give protection both against pressure and vacuum. The various points raised by this incident should be carefully considered by each refinery.
The use of a plastic sight glass for these dewaxing units using a flammable solvent for dewaxing, e.g. MEK/Toluene is not appropriate, although this is acceptable on the Di-Me type unit.

1048803 November 1977

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A reactor was overpressurised. This led to an escape of hydrogen sulphide into a working area through the agitator gland, or possibly the man lid which was insecurely fastened. The cause of incident was the failure of a pressure control system (due to loose mechanical components). Although there was a pressure relief valve on the reactor, the agitator gland and man lid failed below the relief valve set pressure.
[gas / vapour release, overpressure, reaction vessel, safety relief valve, instrument/controller, control failure, safety relief valve failure, seal failure, bolts incorrectly tightened, design inadequate, design fault, overpressurisation, reactors and reaction equipment]

Lessons

The training of the operators was thought to be inadequate in dealing with instrument failures.
The design of the reactor and its fittings was clearly inadequate. The reactor had been subjected to previous safety reviews, but this particular scenario had not been foreseen. The agitator gland needs re-specifying.
The man lid was opened from time to time in order to check the addition of materials (hence the insecure fastening). The addition system needs to be modified to avoid this.

9520 November 1977

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

Overpressurisation occurred on a fully refrigerated storage tank. The tank failed along the roof wall seam. Ammonia released as a buoyant cloud until equilibrium established. No injuries.
[storage tanks, tank failure, gas / vapour release]

Lessons

[None Reported]

7649 05 October 1977

Source : LOSS PREVENTION BULLETIN, 134, 3-4.
Location : ,

Injured : 1 **Dead :** 0

Abstract

A sight-glass, situated in the drain line of a diluent drier, blew out and shattered whilst the drier was being prepared for regeneration. An operator was showered with glass and liquid isobutane. The operator received several minor lacerations and cold burns to the face though with no permanent injury. An investigation identified two possible causes of this incident, but could not positively identify any sequence of events which could have definitely led to either of these.
1. Over-pressure of the section of drain line in which the sight-glass was located.
2. Failure of the sight-glass below its safe working pressure.
Four possible mechanisms for over-pressure were identified:
1. The drain line block valve, downstream of the sight-glass caused a back pressure. The drain line from the drier passes via two block valves rated 40 bar(g) after which the design pressure changed to 10 bar(g). The sight-glass was rated at 12 bar(g), and downstream of this was a further block valve common to a second drier intended for use when additional plant was installed. This valve was found to be 2 and 1/2 turns open after the incident. However, tests using water showed that, even in this position, the valve would not have restricted draining to any significant extent.
2. Small amounts of drier material could have be lost to the drain lines. However, water flushing of the drain lines at a high rate did not result in any appearance of drier material from the lines.
3. The possibility of blocking, due to released traces of water from the drier, followed by 'flash-chilling' across the valve and the formation of ice was considered. There was no evidence of a high frequency of blockages that this theory would have implied.
4. Hydraulic shock failure of the glass was considered. There was no restriction downstream, that could have led to a sufficiently high hydraulic pressure capable of causing this.
[overpressurisation, gauge glass failure, spill, heating, injury]

Lessons

The following recommendations were made:
1. The block valve downstream of the sight-glass should be removed. Further, in general, unnecessary valves should be identified and removed so as to reduce the chances of restrictions due to inadvertent closure.
2. If valves need to be open to ensure safe operating conditions, they should be chained, or otherwise fixed, in the open position.
3. Sight-glasses should be of a design that affords protection from accidental damage and rated at a safe pressure well above the line pressure that they are likely to encounter.
Further Recommendations:
1. Alternatives to sight-glasses could and for hazardous material handling should be used. Pressure gauges could have been used, which would have indicted that the line was clear and would have been less liable to damage.
2. Due to the high pressures encountered, safety relief systems may have been advisable to protect the sight-glass if an alternative was not feasible.
3. Since the operation was carried out two to three times a year, then a pre-commissioning audit/review should have been carried out, with the scope of any Hazop including such transient modes.

1070828 September 1977

Source : ICHEME
Location : , UK

Injured : 1 **Dead :** 0

Abstract

An eruption occurred on a reactor during processing of plasticised latex and partial loss of contents to atmosphere.
Plasticised latex was being manufactured by heating a PVC copolymer latex with plasticiser and soaps, to form PVC copolymer particles. During the first-stage heating process, the clockwork mechanism on the temperature recording chart drive failed and was repaired and the zero adjusted. During second-stage heating, the temperature reached 134 degrees C on the chart recorder, which was 6 degrees C above that specified. This amount of overshoot, however, was apparently considered normal.
At the start of the shift the following morning, the recorded temperature of 46 degrees C was higher than the normal 20 - 25 degrees C, and difficulty was experienced in loosening the nuts on the manhole cover because the solidified reactor contents were pressing on the underside of the manlid. The top of the reactor was too hot to touch and was cooled by spraying it with water. During further attempts that morning to remove the cover, the reactor contents erupted. The pressure inside the reactor sheared all but two of the remaining cover bolts, forcing the manlid cover to swivel and resulting in the ejection of a considerable amount of brown degraded reactor material.
The reactor had a protective devise in the form of a bursting disc. The disk had blown but the solid polymer had extruded up the vent line above the disk thus causing it to block. The pressure gauge on the reactor registered zero at the time of the incident, but this was caused by polymer blocking the line.
One worker received minor burns in the incident.
The company investigation into the incident, which included pilot plant testing, concluded as follows:
1. The polymer latex/plasticiser mixture was heated to 140 degrees C, which was higher than the usual 128 degrees C. This resulted in a 6 degrees C overshoot on heat-up, and a 6 degrees C offset in the temperature recording system. This temperature difference was due to incorrect zero adjustment of the chart recorder during repair.
2. The temperature reached was sufficiently high to cause destabilisation of the latex, and thickening of the reactor contents.
3. Subsequent exothermic degradation of the destabilised latex, possibly catalysed by iron contamination in the presence of air, kept the reactor contents at a high temperature and pressure. The situation was further aggravated by the viscous nature of the latex in the reactor. The result was a rapid ejection of reactor contents when the cover was opened.
[product loss, reactors and reaction equipment, vent blocked, explosion / pressure release]

Lessons

1. The steam system for the latex reactors to be automated to prevent the polymer contents exceeding the specified temperature of 128 degrees C.
2. A separate audible alarm should be installed to warn operators of an increase above the specified reactor temperature.
3. Procedures for calibrating temperature recording systems should be revised.
4. The existing pressure relief system to be re-designed because it appears to be inadequate to handle unusual situations.
5. An investigation to be carried out to determine if a lower operating temperature can be used.
6. An alarm to be installed to indicate failure of the agitation system, because failure results in destabilisation of the latex.
7. Iron contamination of the reactor to be prevented. In particular, the strainers on the steam system should be replaced.
8. The existing operating procedure requires revision. The revision to include the action needed should the reactor contents solidify.

1462 05 September 1977

Source : CHEMICAL WEEK, 1977, 14 SEP.; ICHEME
Location : , USA

Injured : 2 **Dead :** 0

Abstract

A non-solvent unit autoclave overpressured and exploded during a routine start-up of a vinyl chloride polymerisation reaction. The resultant fire ball was approximately 300 feet in diameter and debris was hurled over a large area. One two-ton piece of the autoclave shell was blown 600 feet, indicating the force of the explosion.
The started-up phase of this type of polymerisation normally consists of batch charging chilled monomer to the reactor with agitators running and metering in the desired amount of catalyst through an orifice run. At this time steam is introduced to the reactants through a bottom nozzle to raise the temperature and pressure to the desired operating levels.
This incident was caused by an overcharge of Isopropyl Peroxy Dicarbonate (IPP) catalyst. Approximately 30 to 40 times the normal charge of catalyst was introduced, we believe inadvertently, through a tubing by-pass triggering a runaway reaction.
The runaway reaction was of such extreme intensity that it could not be contained in the standard design and operating practices, which are equivalent to or exceed industry standards. Once it was initiated, it could not be detected early enough by normal operating actions to be brought under control by emergency procedures.
No mechanical defects were found in the design or condition of the equipment and eyewitness confirmed all safety devices functioned as designed.
Metallurgical examination of recovered pieces of the autoclave indicates the initial vessel failure was in the head and was caused by simple overpressure.
Subsequently the vessel failed catastrophically in a brittle fracture mode, with failure originating in at least twelve sites in the lower shell of the autoclave.
There appeared to have been at least two deviations from the standard operating procedure:
i. The water blowback feed to the catalyst feed line was not set up properly using a double valve and vent system to isolate it from the catalyst header.
ii. The agitators were not turned on.
The first deviation allowed the huge excess of catalyst to be fed, initiating the runaway reaction. The second deviation escalated the event from a limited overpressure failure and fire to an overpressure with subsequent highly destructive detonation caused by homogeneous nucleation.
[overpressurisation, chemicals added incorrectly, explosion, fire - consequence]

Lessons

The following recommendations were made;
1. Catalyst should be batched charged for start-up of autoclaves.
2. Cross-ties to the catalyst system should be eliminated.
3. Agitators and steam (the heat source) should be interlocked to prevent heating up without agitation.

1445 12 August 1977

Source : ICHEME
Location : ,

Injured : 0   **Dead :** 0

Abstract

A road tanker made a delivery of 80% acetic acid to a company storage tank. The receipt tank collapsed after delivery. An investigation concluded the cause to be:
1. The tank was correctly designed and installed, with both a vent and an overflow line.
2. At some time the vent was sealed, presumably to prevent the release of acid vapour when tankers were discharging. The overflow then became the only vent. This modification was not submitted for plant design approval.
3. It had become established practice to put a few inches of water into the bund surrounding the tank, to ensure that any acid which overflowed was immediately diluted.
4. On this occasion the hose supplying water to the bund was left running. The water level continued to rise until it covered the lower end of the overflow line.
5. When the automatic pump supplying the head tank in the process building started to withdraw acid from the receipt tank, water was drawn up the overflow pipe creating a barometric leg. The partial vacuum thus formed in the tank then caused it to collapse.
[modification procedures inadequate]

Lessons

[None Reported]

1442 09 August 1977

Source : ICHEME
Location : ,

Injured : 0   **Dead :** 0

Abstract

Fire at a refinery crude distillation plant. Source of ignition was autoignition. Equipment involved: pump. Substance: involved crude bottoms. Cause: flange leak.
[fire - consequence]

Lessons

[None Reported]

1202628 July 1977

Source : ICHEME
Location : , UK
Injured : 0 **Dead :** 1

Abstract

On the 28th July 1977, a contractor's foreman steeplejack fell some 20m from a bucket and received injuries, from which he died immediately.
Work was in hand to replace some 17m of brickwork at the top of one of the refinery power stations boiler stacks. This had progressed to the stage where access ladders had been positioned up to the top of the stack, and rigging was being installed in order to transfer brickwork to and from the stack to by means of a materials bucket.
The foreman entered the materials bucket to act as ballast and it was raised to a height of some 20m to check the line of rigging to ensure adequate clearance for the bucket. Two other employees of the contract were involved in controlling the winch and co-ordinating the ascent. Statements from these two men established that the procedure of using a man as ballast was common practice. Neither saw the foreman fall from the bucket.
After the incident the bucket was found to be upside down in the discharged position.
Subsequent investigation established that:
1. The bucket was designed for the use of transporting materials and was not meant to be used for personnel.
2. The bucket was in good condition, and its locking device operated satisfactory with both forks free of any distortion. The bucket was in a tilted position.
3. No failure had occurred in the associated equipment, e.g. rigging, wires, pulleys, winch, all the equipment either being owned by or on hire to the contractor.
4. The foreman was an experienced steeplejack, having been with the same employer since 1961, and was entrusted by his employers to carryout supervision of contract work.
5. Weather conditions were good at the time of the incident, although there was some wind.
Although a number of investigations were carried out it was not possible to establish how the materials bucket locking device became unlocked, or in which direction the deceased was standing in the bucket, i.e. with his back or face to the locking device. The accident would not have occurred if the contractors regulations forbidding the use of the materials bucket for personnel had been adhered to.
[maintenance, lifting equipment, unidentified cause, fall, fatality]

Lessons

The safety features and regulations of use for equipment designed for lifting personnel are very much more onerous than those for the lifting materials only.
The above incident is a classic example (but by no means unique) of the breaking of such regulations.
Whilst such elevated work is normally solely the concern and responsibility of a contractor, refineries should take note of the incident and ensure that they never place their employees in a similar situation.

1417 06 July 1977

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A fire occurred on the inert gas line at a regeneration furnace outlet on a polyethylene plant. The fire was small but persistent, and was only finally extinguished after 15 minutes. No one was injured and little damage resulted.
The incident was caused by a backflow of ethylene from the ethylene treater into the regeneration furnace via an inert gas line. The ethylene escaped from the inert gas line to atmosphere through a leaking joint at the furnace outlet. As soon as the furnace pilot light was ignited during the treater regeneration procedure, the escaping ethylene caught fire.
When the isolation valves (double block and bleed) were examined, the bleed valve was closed. On opening this bleed valve, pressure was released as an escape of ethylene took place. Ethylene then continued to leak to atmosphere at a low rate.
[processing, fire - consequence]

Lessons

The following recommendations were made;
1. Isolation could be improved by installing swing blanks at key points.
2. Operators should be trained to ensure that the established operating instructions are always followed in detail, particularly those relevant to safety.

1411 July 1977

Source : ICHEME
Location : , GERMANY

Injured : 0 **Dead :** 0

Abstract

Thirty tonnes of HDPE, high density polyethylene, were being transferred from a double cone mixer to a 100 cum (cubic metres), 50 tonnes storage bin or silo. 10 minutes later there was an explosion which destroyed 2 silos and a vent bag filter. Parts of the silos were blown several hundred yards and into an adjacent factory. Ignition thought to be in bag filter and possibly caused by static. Dust explosion.
[silo/hopper, material transfer, damage to equipment]

Lessons

[None Reported]

1397 18 June 1977

Source : LLOYDS LIST, 1977, 20 JUN,; ICHEME.
Location : Llandarcy; Swansea, UK

Injured : 0 **Dead :** 0

Abstract

A fire occurred in a building which contained double pipe scraped heat exchangers separated by a wall from the ammonia compressor house. A waxy solvent mixture passes through the exchangers, the solvent being methyl ethyl ketone/toluene.
At about 0500 hr, an operator noticed a fire as "a glow reflected against the pumphouse wall". The fire quickly spread to the other scraped chillers/ exchangers, including some which were out of commission but full of lube oil for corrosion protection. The flames ignited the cork lagging surrounding the exchangers/chillers and pipework and spread throughout the chiller house. The covered structure above the exchangers caused the heat to be retained within the building.
After investigation it was established that the material feeding the initial fire must have come from the chillers/exchangers. It was known that the exchanger G1-4 glands were leaking, several days before the fire. Under normal circumstances, any material leaking out of these glands would drain into the exchanger sump and hence to the plant drainage system. However, because of the high wax content of the material, the drain could block if the leakage rate were high, and allow solvent-rich mixture to overflow the sump. In addition to natural draining, it is speculated that a particularly bad leak on G1-4 could have resulted in a jet of solvent being directed to the source of the fire. A single damaged brass sprocket found on G1-4 suggests that solvent could have leaked at sufficient pressure to traverse the gap between the gland and the drive assembly. In this respect, the lower diagonally opposite gland in the bank showed a very bad leak during steaming and therefore could well have been the source of the main leakage. It is also significant that the drive sprocket on this particular shaft was scored and might therefore have been a source of ignition.
Despite the lack of a firm explanation of the flame propagation, a mechanical source of ignition associated with the chiller/exchanger drive mechanism was considered the most likely source of ignition.
Before dismantling for repair, it was evident that the clearances between the sprocket hub and the bearing cover varied greatly on G14 and G2-3 exchangers. In some cases it appeared that there was contact between these two items with definite indications of scoring on the sprocket hub. Since both these items are constructed of steel, spark formation and/or overheating were virtually certain.
Two reasons for such metal to metal contact were established, both involving the sprocket hub. The shackle pins connecting the sprocket hub and drive hub are only threaded into the drive hub; they simply slot into holes in the sprocket hub itself. Thus since the sprocket hub/shaft bearings are only a push fit, the hub is free to move on the shaft, being limited on one side by the fixed drive hub and on the other by the bearing housing cover bolts. Provided the drive chain tension is sufficient, all sprocket hubs are kept in alignment by the chain itself. However, slackness in the chain and/or poor initial alignment between the drive and idler wheels, can result in the sprocket hub moving along the shaft. Following the fire, various shift crews recalled that the drive chains were "slapping", i.e. were loose, although this fact was not recorded in the unit log. Slackness would allow the sprocket hub to move up its shaft and give metal-to-metal contact with the bearing cover bolts. If such contact occurred it would almost certainly result in spark formation.
[heat transfer, heat exchanger, overheating, mechanical spark, fire - consequence, refining]

Lessons

The need for cleanliness and a high standard of maintenance on dewaxing equipment is clearly demonstrated by this incident. Wax/oil build up on and around these types of exchangers has always been a problem. The incident has also shown the speed at which solvent/heavy oil will burn when the "wick effect" of contaminated lagging is introduced; it was increased in this case by the heat build up under the roof of the building. The re-built exchangers system will be in the open air.

1296712 June 1977

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

A fire occurred in an acid chlorine plant. The incident occurred when acid chloride vapours ignited in the distillation column. The cause of the incident is unknown.
[fire - consequence, gas / vapour release, unidentified cause]

Lessons

[None Reported]

1378 14 May 1977

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

Damage to a cone roof tank at a refinery plant storage. Cause: vent blocked implosion.
[damage to equipment]

Lessons

[None Reported]

6650 May 1977

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

Damage estimated between £25,000-50,000 (1977) was sustained to an unleaded motor gasoline tank in an explosion without fire.
The incident occurred during transfer of a tank 96 contents into tank 81 for a blend of unleaded motor gasolines.
Before blending, tank 81 was at a low dip of 1 metre and remained so for 2 days. Ambient temperatures ranged from 32 degrees C during the day to a low of 12 degrees C during the previous evening and morning of the incident. Approximately 5 minutes after the transfer started, a noise (boom) was heard in the vicinity of tank 81. The transfer pump was immediately stopped and roof distortion of tank 81 was observed.
Preliminary investigation suggests that the mild explosion may have been triggered by a static electricity discharge produced by pumping at a high rate into a tank with an atmosphere made flammable through natural breathing during temperature changes during the period.
[material transfer, high pressure]

Lessons

[None Reported]

9371 17 March 1977

Source : ICHEME
Location : , UK

Injured : 1 **Dead :** 0

Abstract

Acid wash tower incident. A fitter was sprayed with liquid whilst removing suction spool on an AN plant. The suction block valve was partially blocked and the pipework was under 4-5 psig. A recently modified shut-down procedure was being followed.
[unknown chemicals, spill, unidentified cause, injury]

Lessons

[None Reported]

1344 22 February 1977

Source : ICHEME
Location : ,

Injured : 0   **Dead :** 0

Abstract

A fire occurred on an ethyl benzene final heater when material was released from a crack near the base of the heat exchanger releasing ethyl benzene and steam. Metallurgical examination indicated that the shell metal failed because of local overheating to 1000 degrees C. This temperature was generated during the burn off of carbon on the shell side. The carbon deposit caused carburisation of the metal which may have contributed to the metal failure.
[fire - consequence, processing]

Lessons

The following recommendations were made:
1. The ethylbenzene feed system should be examined for any possible reduction to the severe operating conditions.
2. The burn-off of carbon deposits in exchanger shells should be discontinued until a suitably controlled procedure is produced.
3. The condition of the shells of the other ethylbenzene final heaters should be examined.

1326 26 January 1977

Source : EUROPEAN CHEMICAL NEWS, 1977, 4 FEB.;
Location : Marl, GERMANY

Injured : 0 **Dead :** 0

Abstract

Aldehyde column reflux pump seal failure plus overheating led to leak and firing of ethylene oxide vapour which heated an ethylene oxide pipeline which was full and uninsulated. The decomposition of the ethylene oxide in the pipeline propagated to a reflux drum which exploded. Further explosion in distillation column about 1 minute later. Explosion fragments found 300 m away.
[processing]

Lessons

[None Reported]

1317 16 January 1977

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

Fire at an organic chemicals plant. Equipment involved: valve. Substance involved: hydrogen. Cause: flange leak.
[fire - consequence, processing]

Lessons

[None Reported]

1005311 January 1977

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

An employee was going from ground floor to fifth floor in a freight elevator, when arriving at the fifth floor he could not open the door because the elevator had stopped 30 cm too low. He directed the elevator back to the first floor to inform supervision. During this he noticed a pungent smell of overheated rubber and pieces of smouldering rubber fell on the roof of the elevator cage. Investigation into the cause of the incident found that a fault in the elevator control equipment activated the brake before the motor creeping speed was switched off. Consequently, the motor had to work against the brake for some considerable time which caused it to overheat and finally to ignite the belts.
[instrumentation failure, overheating, fire - consequence]

Lessons

[None Reported]

104511977

Source : ICHEME
Location : , NETHERLANDS

Injured : 0 **Dead :** 0

Abstract

While blanketing a cargo with nitrogen from a shore installation a small error was made by the operator. Instructions required pressure to be raised to .6 bar. Operator interpreted this as 6 bar and consequently overpressurised tank.
[human causes, overpressure]

Lessons

[None Reported]

120241977

Source : ICHEME
Location : ,

Injured : 1 **Dead :** 0

Abstract

A 30ft. section of the 10 inch overhead rundown line on a crude oil distillation unit was required to be cut out and renewed. The line was supported by a hanger and slide. Gas freeing operations were completed and a hot work permit was issued. Electric arc cutting started at 11:10 hr, and when the pipe was almost cut through, the welder stopped work and moved back to await crane support before completing the cut.
At 12:20 hr the 30ft section of 10 inch line fell from its support, onto the pipe track below and in doing so struck a 1 inch bypass line around the LPG product flow controller. The 1½ inch line was wrenched from its 1½ inch API Socket and there was an immediate release of LPG which ignited. The LPG burned for about two minutes until the 3 inch section of the line between the battery limit and flow control valve had depressured.
The welder jumped off the overhead piperack at the beginning of the incident and sustained a fractured ankle.
Fire Department personnel observed the ignition of the LPG from their Station and were quickly on the scene applying cooling water to an adjacent column structure, and extinguishing smouldering material.
It was extremely lucky that the section of LPG line struck by the falling 10 inch line contained only a limited quantity of LPG. Had there been a long section of line back to isolation valves, or the 3 inch line itself had been struck, the fire would have been more difficult to control and extinguish.
[maintenance, pipe, unidentified cause, fire - consequence, LPG]

Lessons

[None Reported]

120281977

Source : ICHEME
Location : , UK

Injured : 1 **Dead :** 0

Abstract

A 4,500 gallon capacity vacuum tanker of gross weight 32 tonnes was parked near API Separators to offload recovered gas oil. The vehicle was positioned at right angles to the separator on a slightly inclined surface of loose chipping, approximately five feet from the separator rail.
After parking the vehicle and applying the air operated hand brake, the driver left the cab to couple up the offloading hose leaving the co-driver in the cab.
When the driver got to the rear of the vehicle it started to move back towards him. He jumped clear of the vehicle which crashed through the rail and approximately 15 feet of tanker came to rest in the south bay of the separator. The co-driver felt the vehicle moving backwards and jumped from the cab.
The driver was treated at the Medical Center for shock and the co-driver for a slight pain in the left thigh. Other than this there was no injury to personnel.
[unloading, rail tanker, unidentified cause, near miss, injury]

Lessons

1. Wherever possible ces should be provided at all sumps or locations for such vehicles if they are used on a routine basis. Concrete ridges correctly positioned can often be used as a alerting device to prevent vehicles backing through sump rails.
2. Where vehicles are used at non-routine duty locations, then it is up to the supervisor in charge of the area who has made the request for them to ensure that safe access is possible.
Such vehicles are often supplied on contract and although the driver is largely responsible for its mode of use, the driver cannot necessarily be expected to be familiar with local ground conditions.
3. The refinery therefore cannot absolve itself from the need to ensure safe siting of such vehicles.

1050312 December 1976

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

A 25,000 barrel capacity, cone roofed tank used for storage of residual fuel oil, failed.
The entire roof was pulled inwards and side plates were buckled along one side. At the time of the incident, no operations were being carried out in the tank, and the ambient temperature was about 0 degree F. There was no actual leakage of the tank. It was noted that there was a column of solid ice between the tank roof and the bottom of the tanks goose-necked vent.
[storage tanks, material of construction failure, near miss, collapse, vacuum, cold weather]

Lessons

It was concluded that the tank roof collapse was caused by ice accumulation in and under the vent. A vacuum was pulled during the last transfer of oil out of the tank, two days before the incident. This occurred because the vent was either blocked or partially restricted, by ice. The root cause, however, was traced back to modifications carried out to all such tanks in the autumn preceding the incident. The roofs were insulated (lagged) as an emergency saving measure. Previously, only the walls had been insulated. Without roof lagging, any moisture present from filling, emptying etc. would condense on the underside of the roof and freeze in winter. On warm days, it would then vaporise out of the vent. With roof lagging, condensation on the roof will not occur. Instead, water goes straight to the vents which, in cold weather, if the water contact is sufficient, will become blocked by ice. After the incident, all other tank vents were found to be partially restricted by ice. The vents were redesigned and insulated in order to prevent a recurrence.

1022202 December 1976

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

Two explosions occurred at a road loading facility (the second explosion occurring within about two hours of the first) during switch loading. Switch loading can produce a flammable atmosphere, but an ignition source has be to present, for example, an electrostatic discharge.
It is believed that cause could have been static electricity, as a possible ignition source. Methods to eliminate explosions is focused upon. This is particularly important to ascertain the causes as loss of life or injury could be caused.
Suggestions are made to possible solutions, including the use of an Anti-Static Additive, charge generation mechanisms, inerting the tank atmosphere. In conclusion, the incident could have been due to static electricity ignition sources. But other ignition sources are possible. Reducing flow rates will minimise the electrostatic ignition risk, but not eliminate it. In order to eliminate the risk:
1. Use of an anti-static additive.
2. Inerting the tank atmosphere.
Both methods would increase costs. The anti-static additive would be simpler.
[road tanker, autoignition]

Lessons

The adoption of anti-static additive was recommended to eliminate electrostatic ignition risk.

1267 20 October 1976

Source : ICHEME

Location : ,

Injured : 0   **Dead :** 0

Abstract

Fire at petrochemical reformer plant. Equipment involved, heat exchanger. Substance involved: naphtha. Cauase: flange leak.
[fire - consequence, processing]

Lessons

[None Reported]

1123629 September 1976

Source : FIRE JOURNAL, MARCH 1977.
Location : , USA

Injured : 0 **Dead :** 0

Abstract

Two 100 lbs. cylinders of propane were being removed from the basement boiler room of a school, when one cylinder accidentally toppled back down the stairs. The cylinder valve assembly broke off, releasing LPG, which then ignited, leading to a confined vapour/air explosion. Due to the strength of construction of the boiler room, explosion effects were quite limited, and there were no injuries to the students in the school, even though it was fully occupied at the time. The explosion occurred about 5 seconds after the valve was damaged, and it is estimated that about 12.5 lbs. of liquid propane was released before ignition. Explosion overpressure is estimated at 6-7 psi. The source of ignition is thought to have been one of the boilers. (Later ignition of the release would have resulted in greater damage).
[gas / vapour release, overpressurisation]

Lessons

Adequate protection of cylinder valves and stems is essential where the location or movement of the cylinders renders them liable to damage.

1235 20 August 1976

Source : MCKAY F.F, WORRELL G.R, THORNTON B.C, LEWIS H.L, HYDROCARBON PROCESSING, NOV,1977, 487-494; MCKAY F.F, A CASE HISTORY OF AN ETHYLENE DECOMPOSITION IN A PIPELINE, IN: SYMPOSIUM ON ETHYLENE DECOMPOSITION, TEXAS CHEMICAL COUNCIL, HOUSTON, TEXAS, MAY 1983.

Location : , USA

Injured : 0 **Dead :** 0

Abstract

A rupture occurred in a 12 inch, 1300 psig ethylene line as a result of overheating from an ethylene decomposition flame. There was no detonation. The initiation of the decomposition reaction resulted from the admission of air and ethylene in a meter run that was compressed suddenly by opening to the pipeline pressure. The flame travelled 170 feet before the pipeline ruptured about 15 minutes after the decomposition was initiated.
[processing]

Lessons

To avoid decompositions:
1. Always nitrogen purge any lines containing air before allowing ethylene in.
2. Pressurize with nitrogen to as near the ethylene pressure as possible. Allow heat, if any, to dissipate. Then slowly increase pressure with ethylene.
3. Avoid sudden compressions. Do not let pressure in a system jump, almost instantaneously from a low pressure up to pipeline operating pressure.
4. If decomposition takes place, block in and depressure the system to a flare. If this is not possible, the system should be blocked in, the area cleared in case a rupture should occur and fire fighting and emergency equipment called on standby.
5. Use an arrestor that will stop decomposition flames under all circumstances.

9958 23 July 1976

Source : ICHEME
Location : , USA

Injured : 0   **Dead :** 0

Abstract

Circulation was lost in a reboiler heater, automatic shutdown devices failed to activate the burner trips, the condition went unnoticed for at least five minutes during which time the controls called for more heat to the tower while none was being removed from the heater. The result was badly deformed heater tubes that required a unit shutdown for tube repairs or replacement. It was thought at this time that damage was limited to the reboiler and all maintenance emphasis was on these repairs.
Investigation into the cause of the incident revealed the following:
1. When circulation was lost through the heater, the automatic heater shutdown failed.
2. The contents of the heater vaporised and the heater tubes overheated to such an extent that they badly deformed.
3. As vapour traffic up the tower causing high liquid levels.
4. The level control on the bottom of the first tower increased the reflux to the second tower and the rising level increased the reflux to the third further aggravating the level problem in No.3. There is some conjecture that the level may have covered the heater outlet to No.3 and was prevented from backing into the heater by the rate of vaporisation out of the heater.
5. The operator restarted the reboiler pump without first shutting off all burners to allow the heater tubes to cool.
6. Vaporisation at an extremely high rate occurred due to the heat level in the heater and the extremely narrow boiling range of the tower bottoms.
7. A pressure surge was recorded at the bottom of all three towers with the most severe being in No.3 and diminishing as it travelled up the three towers. Severe liquid entrainment similar to a water knock in a stream line was undoubtedly incurred in at least the bottom of No.3.
8. This pressure surge accompanied by high liquid entrainment similar to water knock in a stream line caused the tray damage in No.3.
9. The destructive forced were dissipated by the tray damage in No.3 and the direction changes in the vapour line to No.2. Additionally more normal liquid levels in No.1 and No.2 did not result in high liquid entrainment in those towers.
10. None of the charts or operators statements support the possibility that the wreck occurred during start-up following the initial repairs
[safety equipment failure, overheating, damage to equipment, heating]

Lessons

[None Reported]

1212 09 July 1976

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

Explosion at a petrochemical ethylene plant. Equipment involved: compressor. The cause was water hammer.

Lessons

[None Reported]

1169408 July 1976

Source : ICHEME
Location : , GERMANY

Injured : 0 **Dead :** 0

Abstract

Several small fires and grass fire broke out, on a crude distillation unit and on a flare stack area of a refinery.
It all began with the trip out of a crude oil pump and the loss of feed to the crude distillation unit. Since product streams were no longer being cooled by incoming feed an increase in pressure occurred on the unit and several relief valves lifted to the flare system. A number of flanges leaked due to thermal shocks, and a fire developed at the heavy gas oil level control valve on the main column. At the same time a fire broke out in the flare stack area due to carry over from the heavily over-loaded flare stack. The refinery fire brigade was alerted to the flare stack area fire first and extinguished the ground fire in this area. Meanwhile the unit operators had successfully coped with the unit flange and ground fires, with steam lances and dry powder fire extinguishers. They were then joined by the refinery fire brigade who applied foam to the area to minimize the risk of reignition of flammable liquid spillages, and dealt with other small flange fires with water fog. It was during this period that the dry grass in the flare stack area re-ignited. The firemen who had been left on duty in that area were not able to handle the new emergency situation. The fire was already approaching the bunded area of the ATK tanks when the refinery fire appliance arrived on the spot. Driving the fire appliance alongside the flame front, the firemen extinguished the flames with a water cannon. Then the area between the flare stack and the ATK tanks was flooded with water to prevent further reignition.
About the same time, due to the upset on the distillation unit, a relief valve on the LPG storage spheres lifted. LPG was released to atmosphere but fortunately did not ignite The crude distillation unit is highly integrated with many operations in the refinery in both providing feedstock to other plants and disposing of effluent gas and liquid streams from other units. With the failure of the crude distillation unit, a variety of operations had to be simultaneously carried out in the process units and in the tankfarm area. Furthermore, upsets in the LPG recovery unit influenced the fuel gas supply and thereafter the operation of all heaters and boilers in the refinery. As the total refinery operation was affected, auxiliary firemen could not be recruited from the operating staff but only from the workshops.
Fortunately, the incident occurred during normal working hours and the workshop staff was available. The refinery is now investigating how to recruit auxiliary firemen outside normal working hours.
[fire - consequence, distillation, incorrect pressure, flange leak, pump failure]

Lessons

[None Reported]

1208 July 1976

Source : CHEMICAL AGE, 1976, 23 JUL.
Location : Pontypool, UK

Injured : 0 **Dead :** 0

Abstract

Fire in warehouse. Unidentified cause.
[warehousing, fire - consequence]

Lessons

[None Reported]

1202 June 1976

Source : THE TIMES, 1976, 4 JUN.; FINANCIAL TIMES, 1976, 5 JUN.
Location : Zaragoza, SPAIN

Injured : 40 **Dead :** 8

Abstract

An explosion occurred in a gas factory, which is thought to have been caused by the engine of a parked road tanker overheating. Two buildings destroyed.
[processing, fatality]

Lessons

[None Reported]

1179 16 May 1976

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

Fire at a refinery desulphuriser plant. Source of ignition was autoignition. Equipment involved, heat exchanger. Substance involved: kerosene. Cause: flange leak.
[fire - consequence, refining]

Lessons

[None Reported]

1169 01 May 1976

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

A road transportation incident. Overpressurisation of a road tanker of ethylene led to an explosion and fire.
[fire - consequence]

Lessons

[None Reported]

1166 May 1976

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

An exothermic runaway reaction occurred in a batch reactor for unsaturated polyesters. Various joints leaked due to overpressuring and when the pressure relief system failed to work a release occurred. The reactor bursting disc assembly was ineffective because the vacuum support was wrongly positioned. Improvements to design and instrumentation are recommended and more frequent process readings. It was found that even when the vacuum support ring was correctly positioned it reduced the flow area of the bursting disc by half.
[overpressurisation, safety equipment failure, gas / vapour release]

Lessons

[None Reported]

1150 08 April 1976

Source : CHEMICAL AGE, 1976, 16 APR.
Location : Mizushima, WESTERN JAPAN

Injured : 0 **Dead :** 0

Abstract

Explosion damaged desulphurisation unit in naphtha producing refinery. Source of ignition attributed to static.
[refining, separation]

Lessons

[None Reported]

12491April 1976

Source : TANKER CASUALTY REPORT NO. 20, TANKER CASUALTY DATA EXCHANGE SCHEME, INTERNATIONAL CHAMBER OF SHIPPING, LONDON.
Location : ,

Injured : 0 **Dead :** 0

Abstract

An incident occurred in a ship during tank cleaning, resulting in the partial collapse of a tank bulkhead.
A 214,085 tonnes dwt tanker had discharged a cargo of Light Arabian and Kuwait Crude several days before and was on ballast passage to a Persian Gulf port to take on another load. The ship inert gas system, using boiler flue gas, had been in operation throughout the discharge and produced average oxygen content of 3 - 4% in the tanks.
On the day of the incident the ship was engaged in transferring tank washings from the No.5 centre tank to the starboard slop tank, running the water bottom across to the port tank and finally pumping the water overboard. The transfer of washings began using a main cargo pump and then changing to the use of an eductor driven by clean seawater. Shortly after starting the eductor discharge, a sharp bang was heard which was followed by a violent shuddering of the vessel.
Inspection showed that a 9 metre deep section at the top of the transverse oil tight bulkhead at the foreward end of the starboard tank had collapsed forward into the No.5 wing tank.
It was concluded that overpressurisation of the tank due to a line valve had been left closed, combined with the pressure of water in the tank, caused the bulkhead to collapse. Another factor was the relatively weak attachment of the bulkhead to the top deck girder due to minimal welding.
[marine transport, weld failure, crude oil]

Lessons

Ship operating procedures were amended to ensure that the lever on the valve in question was left in place to indicate a closed valve.

9358 08 March 1976

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A fire occurred on a methanator. The methantor ruptured following back flow of ethylene through a faulty double block and bleed, an exothermic decomposition and self hydrogenation occurred over the nickel catalyst bed in the methanator.
The incident was caused by a backflow of ethylene into the methanator from an ethylene treater, owing to inadequate isolation by a double block and bleed system. It has been confirmed that, over nickel catalyst, ethylene will undergo an exothermic decomposition and self hydrogen reaction. This reaction can be initiated at temperatures as low as 100 degrees C.
[fire - consequence, reverse flow]

Lessons

The following recommendations were made:
1. Double blocks and bleed failed, in this instance, to give adequate isolation. Areas in the factory, where high quality of isolation is required, to be reviewed to ensure that this is adequate.
2. Operating procedures have to be clear and must be followed exactly. This is particularly so where isolation is across a high differential pressure and where the valves are exposed to high temperature or corrosive conditions. For this service it appears desirable to provide more positive isolation, such as swing blanks, unless the valve seating can be improved.
3. Catalyst and chemicals in contact with ethylene to be checked to ensure that an exothermic reaction cannot take place.

1068301 February 1976

Source : COMPENDIUM OF SHIPPING INCIDENTS, 1967-1979, NO. 20.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A marine transportation incident. Whilst loading cargo into a tank on a ship, the tank over pressurised, resulting in serious distortion of the tank's bulkheads. It was discovered after the incident that an inerting (vent) valve had been left closed and that a relief valve was stuck in its seat, thus making it inoperable. Prior to the incident, the vent valve concerned had been open and nobody could explain how it subsequently came to be closed.
[overpressurisation, damage to equipment, mechanical equipment failure, operation inadequate]

Lessons

The following recommendations were made:
1. Make sure that tank valves are all correctly set, at all times, for the operation being carried out.
2. No authorised manipulation of valves is allowed.
3. There can be no inadvertent interference with valves by shore personnel.
A tank with all valves closed has it's internal pressure doubled as its free volume is halved. This is crucially important when filling a tank.

1111 16 January 1976

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

Explosion of a cone roof tank of fuel oil at a refinery storage area. Source of ignition was static.

Lessons

[None Reported]

10684January 1976

Source : COMPENDIUM OF SHIPPING INCIDENTS, 1967-1979, NO. 21.
Location : , NORTH WEST EUROPE

Injured : 0 **Dead :** 0

Abstract

A marine transportation incident. A tank was extensively damaged by hydraulic pressure whilst receiving ballast. Due to deteriorating weather at sea, the tanks needed to be filled to give extra ballast. It was being filled and all vent valves were open, and relief valves set correctly. The estimated filling rate was about 1200 tonnes per hour and tank capacity 2000 tonnes. Further deterioration of weather meant that, for a time, close inspection of the tank could not be carried out. When inspection was done, it was seen that water was running from the tanks. The tanks lid has lifted under hydraulic pressure and there was significant damage to all four tank bulkheads.
[high pressure, damage to equipment, loading, weather effects]

Lessons

The following conclusions were made:
The tank had hydraulically overpressurised due to the water fill rate actually being about 2100 tonnes per hour (not, the estimated 1200 TPH). This arose because two pumps were in use at the time, when only one was needed.
Officers were not fully aware of the ship's pumping capabilities. Only one pump should have been used to fill one tank, particularly in adverse weather conditions which made adequate supervision and inspection very difficult.

110491976

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

The charge pump on a desulphuriser unit tripped. The charge flow control valve then opened wide on low flow. The high pressure hydrogen supply to the unit flowed backwards through a faulty non-return valve, the charge tank.
The tank vents were not designed for this high flow of gas and so the weak roof to the wall seam failed. Fortunately, the gas did not find a source of ignition and so there was no fire. The pump could have failure due to reverse rotation but did not.
[hydrocarbon distillate, shutdown, mechanical equipment failure, reverse flow, inspection inadequate, safety procedures inadequate, rupture]

Lessons

1. A list of critical non return valves where failure could cause a serious incident to be prepared. Each of the valves in this list to be repaired to as new condition at scheduled shutdowns.
2. Where at all practical reverse flow should not be relied on as the sole means of preventing a serious incident. In this case operations were instructed to close the flow control valve any time that the pump tripped.

101571976

Source : ICHEME
Location : Rotterdam, NETHERLANDS

Injured : 0 **Dead :** 0

Abstract

An incident ocurred which involved a cargo of butyl ether being blanketed with nitrogen from shore installation. The shore valve was fully open but the PV valve on the ship's tank was insufficient for flow resulting in the over pressuring of the ship's tank after 20 minutes.
[loading, tank, flow rate too high, overpressurisation]

Lessons

[None Reported]

107781976

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A road transportation incident. A road tanker carrying caustic soda was unloading into a storage tank using an air compressor to pressurise the tanker. At the first sign of 'pulsing' in the discharge hose (indicating the end of liquid discharge) the tanker driver stopped the compressor. However, a fine spray of caustic soda was ejected from the storage tank overflow pipe for about a minute. There was also an overflow of liquid from the tank dip-pipe despite the fact that the tank level was about 2 feet below the top of the dip-pipe. The tank had clearly been over-pressurised by air.
[storage tanks, overpressurisation, spill]

Lessons

The following actions were recommended:
1. The tank vent was modified to ensure that over-pressurisation could not occur.
2. Road tankers were to use pumped discharge (rather than air pressure) in future.
It was noted that there was a safety disadvantage in the change to pumped discharge, in that there was likely to be more liquid left at the low point of the discharge hose. However, on balance the pumped system was believed to be safer.

1106 1976

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A rail transportation incident. A rail tanker containing ethylene oxide cracked (cause unknown) following a rise in pressure. The leak ignited and explosion caused considerable damage over a 300 m radius.
[damage to equipment, unidentified cause]

Lessons

[None Reported]

1104 1976

Source : DAVENPORT J.A, A SURVEY OF VAPOUR CLOUD INCIDENTS, CHEMICAL ENGINEERING PROGRESS, 1977, 73, SEP., 54-63.
Location : Puerto Rico, USA

Injured : 2 **Dead :** 1

Abstract

A storage tank overpressure led to the release of vapour/mist, which was 10 to 25 ft high. Ignition occurred at a furnace 450 ft from the tank. Scorched area was about 800 ft diameter. Pentane cloud was consumed in 10 to 30 secs.
[overpressurisation, fire - consequence, fatality]

Lessons

[None Reported]

9865 1976

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

The charge pump on a desulphuriser unit tripped. The charge flow control valve then opened wide on low flow. The high pressure hydrogen supply to the unit flowed backwards through a faulty non-return valve, the charge pump and its suction line to the cone roof charge tank.
The tank vents were not designed for this high flow of gas and so the weak roof to the to the wall seam failed. Fortunately, the gas did not find a source of ignition and so there was no fire. The pump could have failed due to reverse rotation but did not.
[hydrocarbon, shutdown, non-return valve, rupture, valve failure, reverse flow, inspection inadequate, safety procedures inadequate]

Lessons

1. A list of critical non return valves where failure could cause a serious incident should be prepared. Each of the valves on this list should be repaired to as new condition at scheduled shutdowns.
2. Where at all practical reverse flow valves should not be relied on as the sole means of preventing a serious incident. In this case operations were instructed to close the flow control valve any time that the pump tripped.

116901976

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A fire occurred on a metal clad polyurethane lagged, electrically traced pipeline causing some £5,500 (1976) damage at this refinery.
The fire which was close to a jetty head produced a substantial amount of black smoke, and caused fire damage to an adjacent switchboard.
It is assumed that an electrical fault ignited the polyurethane lagging, as the line heating was at the time under investigation for a fault. However since the power was switched off at the same time that the fire was noted, possible the disturbance of the lagging and exposure to air were sufficient to cause ignition of a portion of the line already overheated by the electrical fault.
[operational activities, pipeline, electrical, lagging fire, electrical equipment failure, overheating, fire - consequence, polyurethane]

Lessons

The use of polyurethane lagging is not generally recommended within refineries due to its combustible nature and the highly toxic gaseous products given off under fire conditions. The problem is obviously very acute where such lagging is used in indoor situations. Where polyurethane is used, it should be of the fire resistant type, metal clad, and its locations known to firefighting personnel so that appropriate precautions can be taken in any fire.

1099 1976

Source : DAVENPORT J.A, A SURVEY OF VAPOUR CLOUD INCIDENTS, CHEMICAL ENGINEERING PROGRESS, 1977, 73, SEP., 54-63.
Location : Louisiana, USA

Injured : 0 **Dead :** 0

Abstract

Overpressurisation caused split in 6 inch underground pipeline from storage well releasing 6000,000 lb of propane. Vapour cloud was 30 to 40 ft high and vapour was noted 1 mile downwind.
[gas / vapour release]

Lessons

[None Reported]

9874 1976

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A kettle type reboiler was being used to generate steam from a hot oil stream. The water level in the reboiler was used to control the feed water flow to it. The steam flow was below design and the control valve was oversized. As a result the control was very rough and at autoignition temperature a fire resulted. [hydrocarbon, evaporation, steam generator, fire - consequence, damage to equipment, joint leak, instrumentation failure, design inadequate, inspection inadequate]

Lessons

Oversized control valves can be a safety hazard as well as hampering smooth control of the plant.
The cost of correcting such problems by fitting reduced trim can be nominal as it was in this case.
A careful check on the plant operation and control during commissioning would have revealed this fault before it caused an incident.

1015131 December 1975

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A marine transportation incident. An explosion occurred as a marine tanker completed loading propane. The explosion, in the electric motor room, blew a deck cover onto the jetty, and damaged the mast, bulkheads and bulkhead doors. The ensuing fire was quickly extinguished. The cause of the accident was not identified.
[damage to equipment, unidentified cause, fire - consequence]

Lessons

[None Reported]

1167011 November 1975

Source : ICHEME
Location : ,
Injured : 0 **Dead :** 0

Abstract

An oil precipitator on the discharge line of this starting air compressor in a LPG recovery unit was found to be glowing red.
The compressor was immediately shut down. The overheating caused flaking of paintwork, and the oil precipitator buckled at its inlet nozzle. The compressor was a 2 stage oil lubricated reciprocating compressor with an intercooler, supplying the starting air for the gas compressors in the LPG recovery unit. The compressor is switched on automatically, when the air pressure drops to 13.5 bar, and is switched off at a starting air pressure of 17.5 bar.
After opening up the oil precipitator and its associated pipework, residual coke was found on the internal surfaces; the thickness of the coke was in excess of 2 mm. The refinery concluded that the formation of coke took place by the carryover of lubricating oil, and that the coke was ignited by the hot air discharging from the compressor at 160 degrees C.
[processing, precipitator, compressor, residue, inspection inadequate, overheating, damage to equipment]

Lessons

The oil precipitator will be inspected regularly for coke at intervals not exceeding 500 hours.

1068 07 November 1975

Source : VAN EIJNATTEN A.L.M, EXPLOSION IN A NAPHTHA CRACKING UNIT, CHEMICAL ENGINEERING PROGRESS, 1977, 73, (9), 69-72; VERVALIN C.H, HPI LOSS INCIDENT CASE HISTORIES, HYDROCARBON PROCESSING, 1978, 57, FEB., 183-201.

Location : Beek, NETHERLANDS

Injured : 107 **Dead :** 14

Abstract

During start-up of a naphtha cracker there was a release of mainly propylene which ignited and the resultant explosion caused extensive damage to equipment and an adjacent tank farm. Metallurgical inspection of fractures concluded that the cause could be attributed to cold brittleness of a weld of a pipe to a relief valve. Many injuries were caused by flying glass. Fatality.
[cracking, weld failure, injury]

Lessons

1. Hazard and operability studies to be carried out to find potential weak spots, taking into consideration deviations in process conditions, especially process abnormalities as are often encountered in start-up situations.
2. P and I diagrams must be up to date.
3. Updating of operating guides, instruction, and reinstruction needs considerable care.
4. The Plant Manager should approve changes in his plant. He must be advised by a multi-disciplinary acception committee on every change including non-identical replacements.

1167102 November 1975

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A minor fire occurred in the power station of a refinery.
The water spray to the de-superheaters in the power station failed due to an electrical upset. This resulted in the temperature of the steam supply to cooling water pump turbines increasing from 230 degrees C to 310 degrees C and caused oil soaked lagging on one of the pump turbines to spontaneously ignite. The quantity of contaminated lagging was small and the fire was quickly extinguished with dry powder.
[electrical equipment failure, refining, power plant, overheating, fire - consequence]

Lessons

Although this was a relatively minor incident it indicates the degree of good housekeeping needed even in an area where the risks are normally regarded as low if fires are to be avoided.
The loss of cooling water pump turbine capacity would itself be extremely disruptive in a refinery.
1. The vent hose should be of 1 inch minimum internal bore for all plug sizes.
2. The discharge end of the hose must always be at least 10 m downwind and placed in such a manner that it will not discharge vapour into the areas where ignition could occur.
3. The vent tube and hose must be checked to ensure they are free from any form of blockage.
4. Under no circumstances should the pressure be allowed to build up behind the plug.
5. Site management should ensure that staff engaged in this type of operation are fully conversant with the approved procedures and are alert to the potential hazards.
6. The statutory regulations which exist for most countries, including the UK covering hot work on plant or equipment which contains or has contained a flammable substance must be observed.

1167413 October 1975

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

An incident involving a new plant and a major spillage of LDF fortunately did not result in ignition.
During the night-shift of 13th October 1975, approximately 160m 3 of LDF escaped through a parted flanged joint at the battery limit of this recently constructed deisopentaniser Unit. The bulk of the spillage was trapped in a sub-surface pit on the unit and approximately 152m 3 was subsequently recovered.
Before the incident, pumping operations had been carried out using a line from which the deisopentaniser feed line branched off. The lines involved had been checked for leakages by the tank farm operators before the product transfer. However, the checking did not include the battery limit valves of the new deisopentaniser unit, because this area comes under the responsibility of that unit's operators. Also, in this instance the tank farm operators did not inform the shift supervisor of start of pumping. It could not be established why the flanged joint had been parted and why the deisopentaniser unit feed line had been certified "clear for commissioning."
Recovery of the LDF was handled very carefully to prevent ignition. On discovering the spillage, the electrical supply for the flooded area was isolated at the sub-station, and the LDF blanketed with foam. The unit drainage system although completed was not open to the refinery drainage system and hence, as stated, the bulk of the spillage was trapped in a sub-surface pit. It was recovered by using a combination of a portable pump with a flameproof motor and a vacuum tanker, after establishing that a dangerous atmosphere existed only very close to the surface layer of the LDF in the pit.
Fortunately the cold ambient conditions reduced the vapourisation risk.
[material transfer, flange, spill, unknown chemicals, unidentified cause]

Lessons

[None Reported]

1257610 August 1975

Source : ICHEME

Location : Niihama City, JAPAN

Injured : 0 **Dead :** 0

Abstract

A pipe connected to a polymerisation reactor became blocked. During an emergency inspection gas leaked through the flanged part and caught fire. Due to a high electric resistance, polypropylene particles became charged with static electricity which generated friction which ignited the gas.
[fire - consequence, reactors and reaction equipment, no flow]

Lessons

[None Reported]

1035 06 August 1975

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

Flange leak led to explosion and fire at a petrochemical plant. Source of ignition was furnace.
[fire - consequence, processing]

Lessons

[None Reported]

1154214 June 1975

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A fire occurred in and around the 'air box' of a boiler. The boiler normally used two out of three burners which were mounted centrally in holes in the wall between the 'air box' and the furnace. There was a fourth burner hole which was unused and plugged.
A trainee operator carrying out a routine visual inspection of the boiler observed smoke coming from the sight holes. By the time the regular operator was summoned, flames were issuing from the sight holes indicating a fire in the 'air box'. The operator notified the shift manager who called the works fire team and the County Fire Brigade before going to the boiler house. On arrival at the boiler house the shift manager agreed that the boiler should be shutdown immediately. About 15 minutes elapsed between discovery of the fire and the decision to shut down the boiler.
The works fire team arrived while the boiler was being shutdown and fought the fire with carbon dioxide until this was exhausted. The fire brigade arrived a few minutes later and fought the fire with foam until it was extinguished. The brigade remained for a further hour to ensure that the fire did not recur.
During the investigation of the incident, it was discovered that one of the burner holes had been modified in a manner which reduced the hole diameter and extended the wall thickness. This modification caused the flame to impinge on the hole and reduced the combustion efficiency. The design of the hole allowed unburned oil to flow back into the 'air box'. This oil accumulating in the 'air box' ignited.
From the residue in the 'air box' it was estimated that at least 40 gallons of oil was involved in the fire.
[fire - consequence, normal operations, modification procedures inadequate, reverse flow]

Lessons

The fundamental cause of the incident was the modification to the burner hole. The original burner hole was designed to avoid flame impingement and even if impingement occurred the oil would preferentially flow towards the furnace not back to the 'air box'. No record was found of why or when the hole was modified or who authorised the modification. A previous modification by the boiler supplier was identified after the original incident report was issued.
The investigation team recognised that this was the same type of managerial failure as occurred at Flixborough.
It was recommended that new procedures were introduced so that all proposed modifications were reviewed, the technical implications were thoroughly examined and details of the modification were recorded.

1257414 June 1975

Source : ICHEME
Location : Sakai City, JAPAN

Injured : 1 **Dead :** 0

Abstract

A leak occurred on a naphtha distillation line. The leak was detected whilst gas leak testing during turnaround maintenance. The flange portion of the valve was removed and ground by a grinder, during which inflammable gas remaining in the line ignited from a spark.
On repairing the valve, the line was purged with nitrogen so as to expel inflammable gas present through the flare stack; a flow of inflammable gas occurred back into the line through the valve on the downstream side, which was not closed. The gas leaked and caught fire.
One person received burns in the incident.
[fire - consequence, reverse flow, injury]

Lessons

[None Reported]

1021 20 May 1975

Source : ISBELL J.R, FAILURE IN AMMONIA PLANT TRANSFER LINE, AMMONIA PLANT SAFETY VOL.19, 1977, 144-147.
Location : Kerens; Texas, USA

Injured : 0 **Dead :** 0

Abstract

A tee in the primary to secondary reformer transfer line ruptured suddenly and violently causing an immediate shutdown of the ammonia plant. No precise cause for the failure was found. The general problem is discussed. Unidentified cause.
[plant shutdown]

Lessons

[None Reported]

1014 27 April 1975

Source : YORKSHIRE POST, 1975, 28 APR.

Location : Knottingley; Pontefract; Yorkshire, UK

Injured : 0 **Dead :** 0

Abstract

Acetylene cylinder became overheated and was dumped into the canal.
[overheating]

Lessons

[None Reported]

122311975

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 1

Abstract

A contractor was killed when the top manhole cover of an air drier vessel was blown off during pressure testing.
At the time of the incident pressure testing was being carried out with a diesel-driven pump.
Although the required test pressure was 15 kg/cm2, it was calculated from the distortion that the vessel was pressured up to approx. 40 kg/cm2 when the accident occurred.
[overpressurisation, design or procedure error, fatality]

Lessons

The report stated the following recommendations:
1. The type and capacity of the pump used for hydrostatic testing was wrong.
· A hand- or air-operated test pump of a small capacity is to be used after the filling of the equipment to be tested with water from the cooling-water system or from a firewater hydrant.
· Air must be properly purged from the equipment under test.
2. The test pump was connected to a nozzle on top of the vessel, instead of to the bottom part.
3. The pressure gauge was wrongly connected; moreover, there must always be an additional pressure gauge on the test pump. The range of the pressure gauges must be suitable for the purpose.
4. The supervision must not be left entirely to a contractor. Own supervision must not be restricted to a check of the line-up, but must also be in attendance during the actual testing.
5. No personnel must be allowed in the vicinity of any equipment when it is being pressurized.

9872 1975

Source : ICHEME

Location : , UK

Injured : 0 **Dead :** 0

Abstract

A high pressure, high temperature hydrodesulphuriser reactor charge heat exchanger suffered from repetitive leaks from the tubesheet to shell joint. These were not cured by replacing the gasket and adhering strictly to the bolt tightening schedule.
A check on the design showed that the flanges did not meet the standard to which they had been supplied. Re-machining the flange faces to a new configuration corrected the problem.
As the oil was above autoignition temperature fire resulted.
[maintenance, shell and tube heat exchanger, fire - consequence, flange leak, design inadequate, hydrocarbon]

Lessons

1. Independent checking of equipment vendors design calculations is desirable.
2. If the same problem occurs more than once on a piece of equipment do not repair it, look for a design fault.

9863 1975

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

At start-up of a crude oil fractionation unit a heavy leak developed on the inlet flange in one of the group of stab in exchangers in the vacuum column. The oil was above its autoignition temperature and so a fire resulted. The fire worsened the leak.
There was no obvious cause but calculations showed that owing to higher temperature differences which were likely to occur during start-up, the pipework had inadequate allowance for thermal expansion.
[joint leak, fire - consequence, vacuum distillation column, blowout, thermal expansion, design inadequate, hydrocarbon]

Lessons

1. Design allowance for thermal expansion stresses must include shutdown and start-up as well as normal operating conditions.
2. The pipework was modified.

984 1975

Source : THE TIMES, 1975, 8 AUG.; FINANCIAL TIMES, 1975, 8 AUG.
Location : Brest; Brittany, FRANCE

Injured : 100 **Dead :** 2

Abstract

Explosion of explosives factory possibly because of heavy charges of static electricity in atmosphere. Fatality.
[natural disaster, processing, explosive]

Lessons

[None Reported]

976 1975

Source : DAVENPORT J.A, A SURVEY OF VAPOUR CLOUD INCIDENTS, CHEMICAL ENGINEERING PROGRESS, 1977, 73, SEP., 54-63.
Location : Louisiana, USA

Injured : 0 **Dead :** 0

Abstract

Overpressurisation caused a split in a 6 inch line releasing 600 000 lbs of propane. Cloud was 30 to 40 ft high and vapour was noted 1 mile away. No ignition.
[gas / vapour release, processing]

Lessons

[None Reported]

959 28 November 1974

Source : FINANCIAL TIMES, 1974, 29 NOV.; CHEMICAL AGE, 1974, 6 DEC.; EUROPEAN CHEMICAL NEWS, 1974, 6 DEC.
Location : Duxford; Cambridge, UK

Injured : 0 **Dead :** 0

Abstract

Explosion occurred in the monomer unit of polyisoprene and polybutadiene plant. A vat overheated.
[processing, overheating]

Lessons

[None Reported]

9949 21 October 1974

Source : ICHEME
Location : Chicago, Illinois, USA

Injured : 0 **Dead :** 0

Abstract

A severe fire and two explosions resulted from failure in slurry system. A leak was noted on a one inch connection on the top of a common discharge header outside the slurry pump house in a pipe rack. Due to the line insulation, the exact source of the leak could not be determined, a maintenance man was instructed to carefully remove he insulation so corrective measures could be taken. In the process of doing this, the nipple and valve blew off and the area was sprayed with hot 670 degrees F slurry oil which produced a heavy dense cloud of heavy oil mist in the area. This oil mist expanded very rapidly in the area of the leak and it covered a very extensive area of the refinery. Initially, there was no ignition from the heavy oil mist. The explosions were caused by two three inch block in slurry system flushing lines that had failed due to overheating.
The cause of ignition of the oil mist cannot be determined since the mist did not appear to have been in the immediate area of the fired heater which was located on the opposite side of the unit. Ignition was either caused by static electricity and/or autoignition. The area of failure and the surrounding zones were well covered by water at the time of ignition.
[burns, damage to equipment, fire - consequence, gas / vapour release]

Lessons

[None Reported]

952 18 October 1974

Source : BLANKEN J, SWAYING OF A CO_2 STRIPPER, AMMONIA PLANT SAFETY VOL.17, 1975, 146-147.

Location : ,

Injured : 0 **Dead :** 0

Abstract

An explosion occurred in the main process vent system of an ammonia plant causing the rupture of a 24 inch bellows piece. The most likely cause was the burning vent gas flame travelled back down the vent pipe and ignited a vent gas and air mixture at the silencer. Air had somehow leaked into the vent system. [air leaking into system, processing]

Lessons

[None Reported]

9094 27 July 1974

Source : DEPARTMENT OF TRANSPORTATION REPORT, 4110346.
Location : Alabama, USA

Injured : 0 **Dead :** 0

Abstract

A rail transportation incident. A leak occurred from a manway cover on a rail tanker car which was caused by external heat and corrosion.
[overheating, spill]

Lessons

[None Reported]

1154524 June 1974

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A 25 litre mild steel cylindrical container was being filled with isopropyl acetate. On completion of the filling operation a flame was observed issuing from the neck of the container. Subsequently a small fire developed in the area that was extinguished by operators using dry powder. The damage was limited to empty 200 litre and 25 litre containers and a pallet.
The fire occurred at completion of filling of the first of 40 containers. The filling was carried out using a 1inch general purpose hose from the isopropyl header on No. 6 drum filling machine to the No. 7 drum filling machine weigh scale. The filling method was to place the 25 litre can on the weigh scale, earth the can using the standard earthing arrangement and fill the can by placing the nozzle on the hose into the neck of the can. The flow was controlled by a 1inch valve and a visual check was maintained on the weigh scale indicator.
The first can had been filled to the correct weight, the valve closed and the nozzle removed from the can. The operator removed the earthing clip, turned and picked up a metal shive from behind him and started to insert the shive into the neck of the filled can. The shive was almost in place when there was an ignition described as #not an explosion, just flames#.
A second operator observed the flames and came to provide assistance. As he approached, the flames spread from the can to the floor and the wooden pallet. The operators went towards a door to operate the fire alarm and telephone for assistance. A third operator was entering the building by another door and saw flames reported as 9 feet high in the vicinity of the No. 7 filling machine. Two other operators collected a 75 kg mobile dry powder extinguisher, entered the building and extinguished the fire which had reduced to flames about 2 feet high. The local fire brigade also attended and used water to coll the pallet that was still glowing and to extinguish a small fire under the weigh scale.
An investigation was carried out and the main results can be summarised as:
1. Tests of the electrical resistance indicated that, although the static earthing conformed to the IP Code of Practice, the method of earthing the containers did not give a consistently reliable earth return and the earthing clip was not mechanically suitable.
2. The works technical department carried out a study that showed it was possible for static electricity to have caused the ignition.
3. Tests on a similar container produced flames as described and the flame intensity and duration was consistent with the can being knocked over but it was extremely difficult to overturn the can.
4. The flexible hose was not normally used for filling containers and it was not suitable as it had no earth continuity conductor.
5. The No. 7 machine was not available for the filling operation as it had been dedicated to other materials and it was important to avoid contamination.
There were two unexplained occurrences during the incident:
1. A metal shive was found inside the can and it had marks of three hammer blows with a drum key.
2. No one reported the can knocked over but this was the only possible source of fuel for the size of fire.
[loading, fire - consequence, lack of earthing,

Lessons

It was concluded that the most likely source of ignition was a static discharge between the operator and the container.
The main recommendations were that:
1. 25 litre cans are only filled using the full operating mechanism of the standard drum filling machines.
2. Ad hoc methods using flexible hoses should be prohibited.
3. Effective arrangements should be introduced to ensure that all flexible connections satisfy Safety Standing Orders with respect to earth continuity.
4. Safety Standing Order 6 should be revised to clarify what is meant by #precautions against static accumulation must be taken#.
5. Regular checks should be introduced to ensure that the earthing facilities give the correct electrical continuity.
6. Consideration should be given to installation of visual/audible alarms on earthing systems to check continuity.

9352 17 June 1974

Source : ICHEME
Location : , UK
Injured : 0 **Dead :** 0

Abstract

An explosion took place in the final product on a polyisobutylene plant. This resulted in the rupture of the tank roof, which was detached and deposited and deposited 100 feet away in an adjacent plant. Damage was caused to a compressor house and adjoining pipe track. Coincident with the event a road tanker was filling with the product from the same tank when the explosion occurred. There were no injuries but a minor fire in the tank was quickly extinguished by the use of foam.Investigations showed:

1. The depolymerisation of polyisobutylene in the presence of air could occur at the storage temperature of 120 degrees C to give a level of 1.5% (vol) (LFL 1.5%). Similar tests carried out under nitrogen showed the level of c4 to be 1/10 of the level in air.
2. The filter return line to the tank was just below the tank level at the time.
3. It was believed that the relative movement of the level indicator float against the guide wires could have provided a point of discharge between the electrical charge collected on the float and the guide wire just above the liquid level.

[storage tanks, explosion]

Lessons

It was concluded that:

1. A flammable mixture of C4 hydrocarbons existed near the surface of the polyisobutylene probably as a result of a measure of depolymerisation of the stored material.
2. A significant charge of static electricity was created on the surface of the polyiosobutylene by the recycling of the material through line filters. Discharge was probably through the float and guide wire of the level indicator.
3. This charge then sparked to earth. The discharge ignited the flammable vapour causing a deflagration which, in turn, over-pressured the tank and lifted the roof and depositing it 100 feet away.
4. The electrical resistivity of the product was 7 X 1013 ohm cm.
5. The tank would in future be nitrogen blanketed.
6. Due to the high resistivity of the product the tanker loading operation and drum filling operation would be re-examined.

1094317 June 1974

Source : ICHEME
Location : , SCOTLAND

Injured : 0 **Dead :** 0

Abstract

An explosion took place in the final product tank of a polyisobutylene plant, resulting in the rupture of the tank roof, which was detached and landed 100 feet away. Damage was caused to adjacent equipment, no injuries sustained. At the same time operations were in progress to fill a road car standing at the loading gantry from the tank. Tests indicated that a flammable mixture of C4 hydrocarbons existed near the surface of the material in the tank, probably as a result of depolymerisation of the material. A significant charge of static electricity was created by recycling of the material through the line filters, which then sparked to earth. The discharge ignited the vapour, causing a deflagration which in turn overpressured the tank.
[damage to equipment, loading, road transport, overpressurisation]

Lessons

Recommendations - storage tanks.
1. Nitrogen atmosphere to be maintained at all times in polyisobutylene final product storage tanks. Oxygen content to be no more than 5%.
2. Recycle return material to be below the liquid level of the tank at all times.
3. Consider resiting the recycle return to the tank inlet connection.
4. Roof repairs or alterations to be carried out in accordance with the current British Standard.
5. Further technical investigation needed into depolymerisation under given storage conditions. This information to be made available to users.

Recommendations- road car and drum loading facilities.
1. Outlet ends of loading arms for road tankers to be submerged.
2. A sound earth connection is needed on the sliding head of a drumming machine.
3. Consideration to be given to the use of filter units designed to dissipate charge readily.
4. When new tankage is provided for polyisobutylene, sufficient residence time to be provided downstream of line filters to allow relaxation of static charges.

1025530 April 1974

Source : ICHEME
Location : Yokkaichi City, JAPAN

Injured : 0 **Dead :** 0

Abstract

A chlorine storage tank was being filled with liquid chlorine from a road tanker, the residual liquid chlorine in the filling pipe was expelled through a neutralisation column, when chlorine leaked from the seal pot and the neutralisation column.
The residual liquid chlorine was purged into the atmosphere through the neutralisation column with the intake valve left open by mistake, so that the chlorine flowed back from the storage tank.
[storage tanks, human causes, loading, unloading, backflow]

Lessons

[None Reported]

1098804 April 1974

Source : ICHEME
Location : , USA

Injured : 8+ **Dead :** 0

Abstract

A road transportation incident. A fire occurred on a tank truck. The first fire crews called to the incident found that the undercarriage of the trailer was involved, including all of the tires of the far left side. This part of the fire was quickly extinguished.
The back doors were then forced open. Pallets of an unknown material were found pilled up at the rear of the truck. The containers on the pallets were paper sack very similar to concrete bags.
It was found that the fire was mainly involved in rolls of cloth packed behind the pallets and the containers of the material were becoming increasingly involved in the fire.
The material was found to be tris (2 hydroxyethyl) isocyanurate.
[fire - consequence, unidentified cause, injury]

Lessons

[None Reported]

878 05 March 1974

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 1

Abstract

A 55 US gallon drum was unloaded using air pressure to force the liquid out through a dip pipe. The drum was overpressured and failed at the bottom seam due to faulty regulator causing rupture and fatality.
[overpressurisation, unloading, boiler flocculent, drums]

Lessons

[None Reported]

1117222 February 1974

Source : ICHEME
Location : ,
Injured : 0 **Dead :** 0

Abstract

A tube ruptured in the steam superheater of a boiler plant at a refinery. No personnel were injured but the coils in the radiant section of the superheater were destroyed. The estimated cost of renewing is between £15,000-£20,000 (1974).
The boiler plant capable of producing some 59 T/hr of steam at 32 bars and 320 degrees C, comprises:
1. One oil/gas fired auxiliary boiler.
2. One oil/gas fired steam superheater.
3. One unfired waste heat boiler, which utilizes heat supplied by the flue gases from the above boilers plus crude distillation and associated hydrotreater unit, and generates steam and preheats boiler feed water.
Crude distillation/hydrotreater unit was on scheduled shut-down but the associated boiler plant was kept on stream while the identical boiler plant was shut down for maintenance. After the latter was restremed, boiler plant was shut down and it was during this operation that the incident occurred.
By 08:00 hrs., the burners in the auxiliary boiler and steam superheater had been reduced to one each (both on fuel gas) with the hand valve on the superheater burner throttled manually. The quantity of steam produced at this time was 9 T/hr. A few minutes after 08:00 hrs. the fuel gas supply to the auxiliary boiler was reduced to a minimum and it was later established from control charts that the steam supply from the superheater to the steam main ceased at 08:10 hrs because there was insufficient heat being supplied to the waste heat boiler (with crude distillation/hydrotreater shut down) to generate steam and maintain supply from steam drum to the superheater.
However, the fuel gas supply to the superheater, controlled by the steam temperature down-stream of the heater, was still on automatic control and with subsequent fall in steam outlet temperature the fuel supply to the furnace steadily increased. By 09:00 hrs. the fuel gas pressure at the burner had increased toapproximately 4 bars, i.e. almost that of the pressure in the fuel gas main, so although the hand valve on the burner was partly closed the flame was considerably increased, resulting in overheating and subsequent failure of the steam coil at 09:40 hrs.
[heating, maintenance, boiler, process control & instrumentation, tube failure, overheating, rupture]

Lessons

More attention on the part of the operational personnel to the instrumentation could well have averted this incident since indication of an unusual condition in the superheater was given by the fuel gas and steam flow measurement instruments but, in the absence of any alarms went unnoticed.
An inspection of the combustion chamber would also have revealed the very large flame at the single burner.

1025314 February 1974

Source : ICHEME
Location : Ichibara City, JAPAN

Injured : 0 **Dead :** 0

Abstract

An operator opened a valve on an oxygen feeder pipe which was connected to a catalyst regenerator on an acetaldehyde plant. The valve broke causing a fire. The fire was extinguished within half a minute.
Regeneration catalyst liquid flowed back to the oxygen line to the catalyst regeneration column, leaked through the check valve causing organic material to be deposited inside the valve. This caused an unwanted chemical reaction, with high pressure, caused unstable peroxide which caught fire by frictional heat.
One person sustained burns.
[fire - consequence, valve failure, backflow, hot surface, processing]

Lessons

[None Reported]

9603 1974

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

An ethylene cracker was being brought on steam for the first time. Some hours after the furnaces had first received feed and were producing cracked gas, one of a series of low pressure heat exchangers in the gas separation plant became over-pressurised and fractured. In turn this split open a high pressure heat exchanger and large amounts of flammable vapour escaped. Ignition occurred after 34 seconds and the serious fire that occurred burned for 12 hours. The aluminium heat exchangers, 30m above ground on an open steel structure, were destroyed and ancillary equipment was seriously damaged. [overpressurisation, gas / vapour release, damage to equipment, fire - consequence]

Lessons

[None Reported]

111901974

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A very unusual fire occurred while a rail car was being filled with gas oil. No motor spirit vapour was present.
The tanker was being splash filled forming a lot of mist. The flash point of gas oil is about 60 degrees C but a mist has a flash point very much lower. The splashing produced a charge of static electricity on the gas oil and when this discharged it ignited the gas oil mist. As soon as the mist had burnt the fire went out of its own accord.
[loading, rail tanker, static, fire - consequence, gas oil]

Lessons

To avoid similar incidents never splash fill. The fill pipe should reach to the bottom of the tanker.

114211974

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

During the middle of winter on a windy cold day, pump out trials were being undertaken on the first above ground tank to be fitted with in-tank pumps at an installation. On this tank, flange leak sources were fitted with shrouds, whilst flanges and valves had large drip/vaporisation trays underneath them. Prior to the pump test all valves glands were tightened hard down.
Towards the end of the trails, with everything normal, personnel left the tank top to shut down and isolate the second stage pumps. A loud crack was then heard and vapour seen to issue from beneath the in-tank pump platform. Investigation showed that again a very small gland leak had been blown by the wind beyond the edge of a drip tray to land on the tank roof. A 'V' shaped crack approximately 2,100 mm long resulted.
[testing, gas / vapour release, weather effects]

Lessons

[None Reported]

111941974

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

Two explosions occurred within nine days of one another in a combined lube/seal oil reservoir supplying two refrigerant compressors; both explosions resulted from the same cause.
The tank is approx. 8 ft. square in cross section and except for the top, which is bolted on, is of all welded construction. The tank contained a separate vessel for sour seal oil return; the oil in this compartment flowed to the main reservoir by gravity, any vapour being vented to atmosphere. An oil/water separator was also included in the system. The first explosion followed by a flash fire opened half of the top lid, shearing 36 x 2 inch bolts, and slightly distorting some return oil lines and instrumentation. Following this explosion a continuous nitrogen purge was maintained on the tank but failed to prevent the second explosion nine days later which caused similar damage. Frequent checks were made on the vapour space in the tank during the period between explosions and although results varied, it is reported that explosive mixtures were always found. Subsequent investigations concluded that the explosive atmosphere was generated from hydrocarbon vapours returned in the sour seal oil and air induced through the pulsating separator and possibly via air vents. Ignition might have occurred from static electricity generated by falling oil or water settling out through the oil in the reservoir.
[cooling, tank, compressor, static, explosion]

Lessons

The following recommendations were made:
1. Fit an air de-entrainment pot in the separator return line
2. Fit an external heater on the sour seal oil line to facilitate removal of flammable vapours
3. Monitor the lube oil quality regularly
4. Operate with higher levels in the main lube oil reservoir