1298610 August 2000

Source : CHEMICAL SAFETY AND HAZARDS INVESTIGATION BOARD, AUGUST 14, 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 : Richmond, USA

Injured : 0 **Dead :** 0

Abstract

An oil leak occurred on a flare stack causing as gas cloud devlope over a nearby city.
The incident occurred on the hydrotreater, which uses hydrogen gas to strip gas oil of sulphur-containing impurities.
The company fire department doused the oil with foam to stop it from catching fire, but the leak forced workers to shut down the hydrotreater. This in turn requires excess hydrogen gas containing impurities to be vented to the flare stack and burn, producing sulphur dioxide and nitrogen oxides.
[gas / vapour release]

Lessons

[None Reported]

1247515 April 2000

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

Injured : 0 **Dead :** 0

Abstract

A road transportation incident. A road tanker carrying 125,000 cubic feet of flammable liquid hydrogen caught fire when the tankers vent stack malfunctioned. The area within a one-mile radius was evacuated. No one was injured in the incident.
An investigation into the cause of the vent stack failure is underway.
[fire - consequence, mechanical equipment failure, evacuation]

Lessons

[None Reported]

1233620 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]

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]

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.

106031998

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

During the removal of a 42 inch blind (after maintenance) on an overhead vapour line, fuel gas from the opened flange ignited, resulting in a flash fire.
Fortunately, seven contractors working at the scaffolding platform at the time escaped without injury.
Fuel gas had entered the tower from the flare and overhead drum. The source of ignition was considered to be the hot surface of the temporarily fixed halogen lights located directly
downwind. Steam was injected into the base of the tower to extinguish the flange fire.
The immediate cause of the flash fire was the removal of an isolation blind when there was flammable gas present (reverse flow of fuel gas from the flare system) with potential sources of
ignition nearby.
The basic causes were:
1. Inadequate control and coordination of the various activities that were being carried out simultaneously by the maintenance contractors and operations personnel.
2. Changes to plant conditions after the issue of a hot work permit for the removal of the blind (work on desalters, increase in fuel gas flow to flare).
3. Failure to thoroughly check the unit to identify potential remaining hazards for the deblinding tasks (tower open to flare, use of temporary non-flameproof equipment).
4. Failure to recognise the risks and prepare a written procedure in accordance with in-house rules.
[fire - consequence, design or procedure error]

Lessons

[None Reported]

1145308 November 1997

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A process plant upset resulted in a smoky flare lasting 8 minutes. The smoke drifted across a local road, causing nuisance and potential hazards to drivers. Four external complaints were received, including one from the local police. The IPC limit was not exceed by the incident. A seized non-return valve meant that the gas was vented to a different stack from normal, in addition, a steam control valve, which aids smokeless flaring had been removed in error, as it was assumed that the warm-up line would provide sufficient heating for smokeless venting.
[processing, gas / vapour release, valve failure]

Lessons

The lessons learnt covered the following areas:
1. Establishing ownership of the various sections of the system to ensure responsibility for maintenance, operation and modifications work.
2. Review of the flare system design against best practice for smokeless flaring.
3. Updating of operating and maintenance procedures for the flare system.
4. Review of procedures to inform the Scottish EPA in the event of work which might effect smokeless flaring capabilities.
5. A review of the radio system to ensure staff can be contacted effectively.
6. Review of the plant operating procedures to minimise the potential for a similar process upset.

1120121 October 1997

Source : ICHEME
Location : , USA

Injured : 3 **Dead :** 0

Abstract

H2S (hydrogen sulphide) was released while a relief valve was being replaced. The pipe fitters working on the valve were wearing air supplied breathing apparatus and were not injured. However, other nearby workers were exposed to H2S, three of which were hospitalised overnight.
The incident occurred during schedule maintenance on a hydrodesulphurization and regeneration unit. Eight relief valves had been removed from various parts of the units and two had already been replaced prior to the incident. Battery limit blinds had been installed on the majority of key lines. As a result, turnaround personnel believed they could cover all maintenance work on a single work permit. Therefore, no specific work permits were prepared authorising the replacement of the relief valves. The relief valves were located in the line going into the 24 inch blowdown header to flare. The 24 inch blowdown valve had been open throughout the turnaround. The 8 inch valve in the line to the blowdown header was also open since it was inoperable and could not be closed. On the 21 October 1997, two contractor pipe fitters had removed the 6 inch and 8 inch blind flanges and began to replace the west side safety relief valve. During this sequence of work, H2S was released.
[gas / vapour release, flare line, flare system, blind/spade/slip plate, safety relief valve, isolation inadequate, maintenance procedure error, injury]

Lessons

The following recommendations were made:
1. A hazard analysis must be carried out before commencing any work involving opening a flare line.
2. Work on a live flare system requires special dispensation from a senior manager.
3. A detailed procedure covering isolation, draining and purging requirements must be prepared prior to maintenance work.
4. Detailed safety instructions for the opening of any pipeline must be included in the work permit.

1158212 September 1997

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

Abstract

Similar incidents occurred within four weeks of each other on related flare stacks on a petrochemical plant. The second occurred after the actions recommended after the first event, a small explosion, had been implemented.
In the first incident an explosion occurred as spectacle pieces were being removed on the flare header by contractors. The investigation blamed inadequately trained personnel, inadequate mechanical supervision, inadequate process expertise in flare operation and failure to observe correct authorisation procedures. Some modifications were made to written procedures to detail required safety precautions. The accessibility of the working area was also criticised. This was attributed to piecemeal development over many years.
In the second incident, an estimated 0.1 tonnes of vapour, believed to be mostly nitrogen, was released. This occurred after a 24 inch spool had been removed to fit a blank. After removing the spool, it was discovered that the blank would not fit. It was 40 minutes before a suitable blank was located and fitted. During this period the flare header was isolated from each of three live process headers by single valves. All three valves were passing.
The enquiry found that the level of manufacturing team supervision was not as required by written procedures. The temporary operating instruction issued to cover the job was not being followed, and the blank had not been checked to confirm that it would fit.
Following the second incident, it was recommended that complex flare work of this nature should be directly supervised by a Works Shift Manager or Works Shift Controller. A thorough review of procedures was also instituted.
[maintenance, design or procedure error, operation inadequate, training inadequate, gas / vapour release, management system inadequate]

Lessons

Both incidents had the following features in common:
1. Non-compliance with procedures.
2. Inadequate supervision.
3. Inadequate engineering pre-planning.
4. Insufficient access / egress.

8874 May 1997

Source : HAZARDOUS CARGO BULLETIN, 1997, AUG. STATUS WEEKLY.
Location : Ronningen, NORWAY

Injured : 0 **Dead :** 0

Abstract

A plate suffered a blowout followed by a loud bang when a rupture disc broke during a reactor shutdown. 1,800kg of ethylene gas escaped.
[reactors and reaction equipment, leak, bursting disc]

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.

8699 01 December 1996

Source : SEDGWICK LOSS CONTROL NEWSLETTER, ISSUE 1, 1996.
Location : La Plata, ARGENTINA

Injured : 0 **Dead :** 2

Abstract

A flare knockout drum on plot overfilled and liquid slug ruptured flare line leading to major fire. Numerous pipelines BLEVE'd (Boiling Liquid Expanding Vapour Explosion). Main propane bullet protected by water deluge. Fatality.
[fire - consequence, overflow, processing]

Lessons

[None Reported]

11978 31 August 1996

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

Approximately 1.3 tonnes of aqueous acetone was released (70% acetone) when a bursting disc failed due to a high base pressure during start-up.
[bursting disc failure, high pressure, spill]

Lessons

[None Reported]

8283 29 April 1996

Source : SEDGWICK LOSS CONTROL NEWSLETTER, ISSUE 2, 1996.
Location : Grannagh, Kilkenny, IRELAND

Injured : 4 **Dead :** 0

Abstract

An explosion blew off part of the roof and a wall during maintenance. The explosion was linked to a flame arrestor in the line leading to a newly commissioned incinerator. Substance involved: paraformaldehyde.

Lessons

[None Reported]

1160028 January 1996

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A high pressure vent line from an ethanol unit was vented to flare, in an attempt to clear a suspected blockage in the line (hydrate formation) which contained a mainly ethylene stream, saturated with water vapour. An explosion occurred and a yellow column of flame was seen at the flare tip. The vent valves were immediately closed.
Minor damage was sustained and after an inspection of equipment and lines it was determined that the system should remain in operation with some additional nitrogen purging. The high pressure vent line was left isolated. It was determined that a more detailed inspection of the system should be carried out.
An enquiry team investigated the incident. It was concluded that an explosion had occurred in the flare knock out drum, but it was not possible to confirm the cause of the incident.
[damage to equipment, flow restriction, venting]

Lessons

1. A full inspection should be undertaken.
2. The design conditions of the high pressure vent line should be reviewed and the tracing requirements for the line should be confirmed.
3. The measuring and alarming of temperatures on the vent line should be undertaken.
4. Nitrogen purge flow requirements should be checked and a method of measuring the nitrogen flow to the flare should be identified.
5. A procedure should be prepared for depressurising the vent line, allowing for the low temperatures that could be seen.

8225 29 October 1995

Source : ENDS REPORT, 1995, DEC.
Location : Ruabon, UK

Injured : 0 **Dead :** 0

Abstract

A leak of hydrogen sulphide occurred when 3 - 10 kg leaked from an unseated valve and bursting disc.

Lessons

[None Reported]

8466 05 October 1995

Source : EUROPEAN CHEMICAL NEWS, 1996, AUG, 12.
Location : Yorkshire, UK

Injured : 0 **Dead :** 0

Abstract

Sulphur trioxide escaped from low level temporary chimney during the start-up of the sulphuric acid plant following a biannual shutdown. Gas oil was being used in the burner to preheat the catalyst, and the combustion gases were being emitted through a temporary chimney just 20 ft high. At the same time the company decided to use the plant's oleum scrubbing tower to produce pure sulphur trioxide for sale. The tower was incapable of being isolated from the upstream section of the process, and some of the evaporated sulphur trioxide escaped to air via the temporary chimney. The company claimed that only a few kilograms had been released. The discharge continued for 2-3 hours and formed a mist.
[gas / vapour release]

Lessons

[None Reported]

6809 20 August 1995

Source : SEDGWICK LOSS CONTROL NEWSLETTER, ISSUE 3, 1995.
Location : Port Arthur, Texas, USA

Injured : 0   **Dead :** 0

Abstract

A fire that occurred at a refinery was confined to a vent on a tank filled with hot coker feed in the refinery's tank farm. The fire, which lasted about one hour, had no impact on refinery operations. The refinery sells the coker feed to other refineries.
[fire - consequence, refining, storage tanks]

Lessons

[None Reported]

8379 01 August 1995

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A substantial carryover of kerosene occurred from a section of the plant into the flare system. Liquid flowed from the overflow pipe at the base of the flare into the sewer system. The sewer overflowed and some 30 m 3 (cubic metres) spilled around the flare stack.
It was found that during water wash of the clay treater, the outlet valve of the treater was left in the open position. The incident was caused because the flushing operation for the clay treaters was not documented as a procedure.
[cleaning inadequate]

Lessons

Operating procedures and job tasks need to be evaluated and available in written format.
Checklists for verifying vessel isolations are useful.

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]

8384 31 March 1995

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

Flare knock-out drum overflow. During the start-up of the CDU/Hydrotreater units, light gasoline entered the flare system via a pressure control valve. The flooded flare knock-out drum spilled over into the seal of the flare and, from there, via the overflow of the water seal. Light gasoline spilled over into the oily-water system of the flare area and further downstream into the flare area trap. The oily-water drain system in the flare area filled up until product overflowed at various locations of the paving. It was found that the level controller on the gasoline fractionator reflux drum had failed. The basic cause was due to the high level alarm on the flare knock-out drum being overlooked because of many other alarms appearing during the start-up of the plant.
[environmental]

Lessons

Flare stack drums must receive regular operating personnel attention if potentially dangerous situations are to be avoided.
Indications from critical alarm functions are ideally separated from others of less importance, to assist operators at periods of high activity such as start-ups.
Careful selection is necessary.

8154 09 January 1995

Source : SEDGWICK LOSS CONTROL NEWSLETTER, ISSUE 2, 1995.
Location : Linyuang, TAIWAN

Injured : 0 **Dead :** 0

Abstract

Fire in the flare area of this 200,000 tonne /year MTBE (methyl tert butyl ether) facility led to a 14 day interruption of production.
[fire - consequence, processing]

Lessons

[None Reported]

7626 1995

Source : LOSS PREVENTION BULLETIN, 130, 8-10.
Location : ,

Injured : 0 **Dead :** 0

Abstract

During a routine relief stream inspection two bursting discs were discovered in one holder. It is believed that the two discs were installed during commissioning two years previously.
The incident occurred on a research plant which was commissioned in 1993. The two discs were discovered during the first routine, two yearly inspection of the relief streams in 1995. Pressure systems records confirm that there was no interim replacement of the discs on this relief stream, so that the two discs were almost certainly installed during commissioning in 1993.
The bursting disc holder and five discs were purchased by the project team from a reputable manufacturer. The discs were 0.625 inch (1.59 cm) diameter, thickness 0.004 inch (0.1 mm) with a burst pressure of 120 bar at 300 degrees C. The holder was passed to the construction contractor for installation on the plant and the five discs were retained by the plant supervisor.
Following normal commissioning practice, the bursting disc was installed by a plant fitter. This involved removal of the holder from the plant, dismantling it in the workshop, reassembly of the holder with the disc in place and installation on the plant. Installing the disc in the holder was therefore done in clean workshop conditions. The disc, which is individually packed in a cardboard box, was supplied by the plant supervisor.
Following the incident the four discs remaining from the original order were found in the plant store. Discs of this type are not used elsewhere on site and it is most unlikely that similar discs were available in the workshop.
The two discs that were found during the routine inspection were a very close fit together and were difficult to separate. Most observers were not able to detect the double disc. The four remaining discs were checked, by measuring the metal thickness on the flange, and all found to be single.
[incorrect equipment installed, installation inadequate]

Lessons

The following recommendations were made:
1. The incident should be raised again with the supplier, seeking a more formal and authoritative reassurance that their procedures can prevent repetition.
2. Share information about the incident through Safety Departments and Engineering Departments both inside and outside the company.
3. Implement a procedure for checking discs before installation.
4. Include the requirement for checking the disc on the 'Scheme of Examination for the relief stream'.

6767 16 November 1994

Source : THE CHEMICAL ENGINEER, 1994, 24 NOV.
Location : Carrington; Manchester, UK

Injured : 0 **Dead :** 0

Abstract

An automatic shutdown was triggered and resulted in material being released to a 40 m vent stack. A flash fire ignited the material leaving the stack causing an explosion and fire ball that ripped through low density polyethylene plant.
[processing]

Lessons

[None Reported]

7520 09 September 1994

Source : LOSS PREVENTION BULLETIN, 123, 13-14.
Location : ,

Injured : 0 **Dead :** 0

Abstract

This incident ocurred during the application of a polyurethane foam and a silicone finish to the roof of a vacant building. Shortly after workers applied a perimeter coating of silicone, a spark from a nearby welding operation ignited vapour from the coating. A worker immediately used a fire extinguisher to put out the fire. The site superintendent and the fire department were notified, but further assistance was not required. The damaged section of roof was repaired the same day, and all welding activities were suspended until work on the roof was completed.
[fire - consequence]

Lessons

The following steps should be taken to prevent or control fires associated with roof fires.
1. Identify and communicate all potential hazards before work begins.
This process is particularly important when unseen hazards exist, such as the presence of flammable vapours. Precautions to ensure that materials do not reach their flashpoints should be planned and executed. All required thermometers, thermostats, and other safety devices for Heating equipment should be routinely inspected by qualified personnel.
2. Control hazardous materials on the job site.
This should include co-ordination of concurrent work so that hazards are recognised and minimised. Ensure that nearby workers are not exposed to hazards.
3. Develop fire protection plans that will minimise the potential for roof fires and ensure their control.
4. Plans for responding to potential roof fires should include controlling a fire to prevent its spread to other areas.

6671 19 August 1994

Source : SEDGWICK LOSS CONTROL NEWSLETTER, 3RD QUARTER, 1994.
Location : Houston; Texas, USA

Injured : 0 **Dead :** 0

Abstract

A runaway reaction led to a ruptured bursting disc and venting of about 2 tonnes of cyclopentadiene and fish oil. The vapour cloud ignited but was extinguished by plant personnel.
[fire - consequence]

Lessons

[None Reported]

1193116 July 1994

Source : ICHEME
Location : , UK

Injured : 3 **Dead :** 0

Abstract

An incident occurred during night shift on a bleach plant. The process involved production of chlorine and caustic soda by electrolysis of brine and then reaction of these products to form sodium hypochlorite solution.
A strong smell of chlorine was detected in the control room of an adjacent plant. The operator at the bleach plant was contacted and asked to investigate. No immediate problem was found but after about 50 minutes the shift manager from the adjacent plant located a release of chlorine from an absorber in the bleach plant. The shift manager recommended that the bleach plant be shut down and that an engineer be called out to investigate. He then left the bleach plant assuming that the plant would be immediately shut down.
The chlorine smell at the control room of the adjacent plant seemed to be reducing but did not disappear. A BA (breathing apparatus) set was left in the control room as a precaution. More than an hour later, the fumes became so strong that the control room operator had to wear BA and other personnel had to leave.
The shift charge engineer went to the bleach plant and, from discussion with the engineer who had been called in to investigate, learned that the plant had not been shut down. The plant was finally shut down almost two hours after the first recommendation for shut down.
Investigation showed that the cause of the release was undetected opening of a bursting disc allowing chlorine to pass through an absorber to a vent.
Release of chlorine through the bursting disc should have been detected by an installed instrument and a caustic soda flow started to the absorber to remove the chlorine.
Subsequent investigation was not clear whether the bursting disc had opened due to over pressure or due to corrosion. The bursting disc was constructed of teflon coated graphite. In the event of damage to the coating chlorine would penetrate and cause progressive deterioration of the disc.
The chlorine detector downstream of the bursting disc was saturated with water and inoperative. The chlorine detector was located in a stagnant pipe.
[chlorine gas, normal operations, gas / vapour release, plant shutdown, bursting disc failure]

Lessons

As a result of the incident investigation the immediate response to prevent a recurrence was to maintain a continuous flow of caustic soda through the absorber. This would ensure that any chlorine release through the bursting disc would be scrubbed out before the gas was vented. It was intended that this mode of operation would be used until there was confidence that chlorine would be detected. The chlorine detector was relocated and a trial of alternative detectors was initiated.
The bursting disc was to be replaced after three months and the disc removed would be sent to the manufacturer for examination to determine whether there was any deterioration.
The greatest concern from the investigation was the failure to immediately shut down the plant when the chlorine release was detected. There were a number of contributory factors to the decision by the operator and engineer not to shut down. These included: -
1. Failure of chlorine detectors indicated that there was no chlorine release from the bursting disc.
2. No local smell of chlorine or indication of leak on bleach plant.
3. Different ownership of bleach plant and adjacent plant leading to lack of clarity of responsibility and authority.
The main recommendation to address this latter problem was an instruction to the bleach plant personnel to immediately shut down the plant if chlorine was detected on the plant or on any adjacent plant.

8370 05 June 1994

Source : ICHEME
Location : ,

Injured : 9 **Dead :** 0

Abstract

During hot work modifications to a knockout drum, a flash fire occurred. It was found that there was incomplete gas displacement in downcomer of knockout drum off-gas line.
Procedure did not specify the need to open high point bleed at the top of the off-gas line to allow trapped gas to vent and this caused the incident.
[fire - consequence, design or procedure error]

Lessons

Gas freeing of vessels must take account of all attached pipework in the system; this is particularly important where the position of isolating blanks introduces "deadlegs" into the system.

6531 02 May 1994

Source : THE GUARDIAN, 1994, 3 MAY.; THE CHEMICAL ENGINEER, 1994, MAY.
Location : North Sea, UK

Injured : 0 **Dead :** 0

Abstract

Production from an offshore platform and neighbouring field were shutdown and non-essential staff evacuated platform by helicopter when an incident triggered small explosions in the flare stack.
[evacuation]

Lessons

[None Reported]

1091917 March 1994

Source : ICHEME
Location : ,

Injured : 4 **Dead :** 0

Abstract

Three contractor employees and one company employee were exposed to a mixture of isobutane and hydrofluoric acid (HF). The amount of HF released was estimated to be less than the equivalent of one pound.
The release, in a small vapour cloud was as the result of breaking containment on a three quarter inch line being replaced during the turnaround.
Although during the emergency there was found to be a failure of the safety showers, quick and effective response by the refinery emergency response team prevented the incident from escalating into a major event. All four casualties were hospitalised, but they were released the next day.
Two were treated for HF burns, and two received precautionary treatment for HF inhalation. Subsequent investigation determined that plugging of the line had inhibited effective line purging, leading to the release after breaking line containment. Once the work permit had been issued, vague instructions, as well as questionable practices, compounded the magnitude of the incident.
[gas / vapour release, permit to work system inadequate, safety procedures inadequate,]

Lessons

The following recommendations were made:
It is essential that systems which have been purged to allow them to be worked on by maintenance be verified as clear before containment is broken.
Techniques used by workers to cut into/open, equipment/lines should be done is such a way as to limit any spillage/leakage as far as possible in addition to the verification by operations personnel.
Safety showers must be regularly checked as being operating correctly. These must not be isolated while any possible need for their use exists on the plant; e.g., usually throughout the turnaround.
HF Alkylation Plants must ensure that they have an adequate emergency response to deal with accidental exposure of personnel to HF, both for burns and respiratory problems. Liaison with outside medical services/hospitals is essential to en-sure that correct treatment is rapidly available, with the necessary aftercare.

6464 15 March 1994

Source : LLOYDS LIST, 1994, 1 APR.
Location : Newark Bay, USA

Injured : 0 **Dead :** 0

Abstract

A caustic solution was being transfered from a marine tanker when it started listing and then started leaking as material came out of the tank vents.
[spill, material transfer, caustic soda]

Lessons

[None Reported]

6359 31 December 1993

Source : OIL AND GAS JOURNAL, 1994, JAN.
Location : Linden; New Jersey, USA

Injured : 20 **Dead :** 0

Abstract

Malfunctioning safety vent caused the release of a noxious gas.
[gas / vapour release]

Lessons

[None Reported]

6248 October 1993

Source : LOSS PREVENTION BULLETIN, 117, 17.
Location : Georgia, USA

Injured : 1 **Dead :** 0

Abstract

Workers were transferring a 93% solution of sulphuric acid from a 3785 litre storage tank to 378 litre "day tank" when a 2.5 cm carbon steel transfer pipe line failed. The failure caused sulphuric acid to be sprayed about 18 metres from the origin of the leak. A worker walking through the area was sprayed by the acid mist and received second degree burns on his back. After being washed down in a safety shower by fellow workers, he was taken to a medical facility for treatment. The procedure for transferring acid from the bulk tank to the day tank required that the valve at the dilute tank be closed and that a transfer pump be used to facilitate the transfer of acid from the bulk tank to the day tank. When the accident occurred, the valve at the dilute tank was closed and the transfer pump had been started. The pump built up pressure in the pipe, causing the mist of acid.
An inspection indicated that the failed line was constructed of carbon steel and appeared to be a "Schedule 40 pipe", although the engineering drawings specified use of "Schedule 160 pipe", which has walls approximately twice as thick. In addition, it was known that the flow of acid through the line normally reduces the thickness of the pipe wall by about 5 microns per year. The section of the line that failed had been replaced approximately 10 years ago. On this occasion, as soon as the leak was discovered and the transfer pump shut down, the area was barricaded and thoroughly washed. All piping was subsequently inspected using non-destructive evaluation (NDE) techniques, and pipes of insufficient thickness were replaced.
[pipeline failure, incorrect equipment installed, spill, material transfer]

Lessons

This incident provided several lessons relating to configuration control and the handing of corrosive materials:
1. Whenever system components are replaced or repaired, engineering documents must be checked to ensure that the correct materials are used. Engineering documents (especially drawings) must be carefully managed to ensure that they are kept up-to date. However, specifying the correct materials and components for maintenance and repairs is not enough. Follow up must be conducted to ensure that the entire process is performed correctly, appropriate replacement items must be ordered, inspected on receipt, adequately documented in work orders, installed, and functionally tested.
2. Management must ensure that all hazardous materials and processes are identified and that procedures are developed and implemented to ensure safety. A preventative maintenance programme, including a replacement schedule or through NDE testing, should be established to replace components where failure would result in serious safety or environmental consequences.
3. Implementation of relevant standards related to mechanical integrity, procedures, and training should have prevented the use of incorrect schedule piping. Although many standards apply to facilities with quantities of hazardous material above a certain thresholds, these recommended practices will prevent accidents even when applied to facilities that are not covered by the standard.

8333 August 1993

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A platformer unit fire at a refinery. A fire occurred on a platformer reactor stack, and it burned for 5 hours. There was damage to equipment. It was found that a vertical section of feed inlet line to the No. 2 reactor failed. The failed section of line was noticeably out-of-round, which would have led to increased stresses. Costs estimated to be $1.5 million (1993) for maintenance/other and $6.2 million (1993) for production losses.
[fire - consequence, reactors and reaction equipment, refining]

Lessons

1. To prevent future failure of these and other high temperature piping systems, companies must be critical of fabrication qualification and selection.
2. On emergency response fire water delivery capabilities for elevations greater than 100 feet should be reviewed. Fire water systems are susceptible to host biological organisms which can plug or impede delivery equipment and tests should be made regularly, especially in warm climates.

6071 13 May 1993

Source : LLOYDS LIST, 1993, 25 MAY.
Location : Bilbao, SPAIN

Injured : 0 **Dead :** 0

Abstract

Gas leak into chimney connected to conversion unit exploded causing damage to refractory bricks.
[explosion]

Lessons

[None Reported]

1194306 April 1993

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

An explosion and fire occurred in the final powder degasser on a polyethylene plant. There were no injuries or danger outside the factory, and no loss of planned production. However, significant repair and cleaning costs were incurred. Leading up to the incident, the plant was in the process of shutting down. A trial had been running, and difficulties had been experienced with the vent recover unit (VRU), which could not cope with the hydrocarbon quantities being degassed at the given reactor withdrawal rates. This affected the operation of the secondary degasser to the extent that eventually there was no effective degassing of the powder in this unit. Significant quantities of hydrocarbon therefore passed into the final air degasser where a flammable atmosphere was established.The source of ignition was static. Vessel earthing was adequate but static generated inherently in the degasser fluidised bed would have provided sufficient ignition energy to ignite the flammable hydrocarbon/ air mixture.The damaged vessel was found to have only minor damage; during the fire it had been subjected to temperatures of 600-700 degrees C and some slight deformation had occurred because of reduced mechanical strength at such conditions.An analyser was highlighted as a key area in monitoring hydrocarbon in the degassing train. Following the incident the alarm setting was reduced and equipment redundancy provided to ensure a reliable reading. Relevant operating instructions were reviewed and training carried out to ensure that appropriate actions are taken when there are high hydrocarbon levels in the system. Limitations of the VRU and associated systems were established and corrective engineering identified. Response from the emergency services was excellent and only minor concerns were raised.
[fire - consequence, shutdown, vapour recovery system, polymerisation, incorrect chemical concentration, hydrocarbon]

Lessons

Root cause analysis identified the following:
1. Immediate causes:·
Breakthrough of hydrocarbon into the final degasser creating a flammable hydrocarbon/ air mixture.
Source of ignition was static, inherently generated in the fluidised bed.
The resulting fire was burning polymer
2. Basic causes:·
The degassing system was unable to achieve the required degassing of the powder during the shutdown phase at the given reactor product withdrawal rates. This allowed increased quantities of hydrocarbon to pass into the air degasser.For over four hours prior to the explosion, a flammable atmosphere existed in the interface between the inert powder conveying system and the air degasse.
Plant operating instructions were inadequate and the potential risks associated with increasing hydrocarbon levels in the degassing system were not recognised.
Equipment constraints in the VRU significantly impacted the hydrocarbon removal capability of the degassing system.

5809 05 October 1992

Source : LLOYDS LIST, 1992, 13 OCT.
Location : Merom; Indiana, USA

Injured : 20 **Dead :** 3

Abstract

3 workers carrying out maintenance work on a smoke stack in the flue gas desulphurisation plant were missing in an explosion and fire. Fatality.
[fire - consequence]

Lessons

[None Reported]

5803 01 October 1992

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

When changing the bursting disc on an ethylene oxide reactor, it was found that the original disc was of the wrong type (reverse buckling) and the holder had been deliberately modified to accept the disc. The locating pin had been ground off.
[near miss, incorrect equipment installed, reactors and reaction equipment]

Lessons

[None Reported]

5802 October 1992

Source : CHEMICAL WEEK, 1993, 3 MAR.
Location : Corpus Christi; Texas, USA

Injured : 0 **Dead :** 0

Abstract

Electrical failure caused disruption of plant and venting to flare stack of butadiene which vented unburnt emissions for about an hour. The emissions affected people 5 miles away.
[gas / vapour release, power supply failure]

Lessons

[None Reported]

5787 20 September 1992

Source : LLOYDS LIST, 1992, 22 SEP.
Location : Stallingborough; Humberside, UK

Injured : 0   **Dead :** 0

Abstract

Ducting leading to a chimney caught fire. Fire started in disused part which was being demolished.
[fire - consequence]

Lessons

[None Reported]

7518 28 August 1992

Source : LOSS PREVENTION BULLETIN, 123, 9-11.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A failure of a storage vessel containing liquefied nitrogen occurred. The catastrophic failure of the vessel resulted in the collapse of almost half of the factory, damage to the walls of 25 houses and 39 cars, buses and trucks within a 400 metre radius. Fragments of the vessel were projected up to 350 metres (part of the top head of the outer shell, 1.5 metres wide and 8 mm in thickness). The estimated property loss was 440 million yen.
After investigation it was found that the rupture disc had ruptured outwards despite the closed inlet valve.
The following conclusions were made:
1. The isolation of the relief valve was carried out at some time after the inspection, probably as a result of the relief valve lifting or having been carelessly closed. As a result the vessel was put under closed conditions.
2. Under closed conditions the pressure rose as a result of the inflow of heat until the bursting pressure was reached.
3. The inner shell burst at about 70 kgf/cm2 followed immediately afterwards by the outer shell.
[vessel failure, bursting disc, damage to equipment]

Lessons

Operators must have a basic knowledge of safety and an understanding of how it applies to their daily tasks.

10795 12 May 1992

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A high pressure relief disc on a plant burst, releasing a cloud of steam and soot which was carried by wind over homes in the neighbourhood.
There were no injuries and there was no danger of exposure to toxics. A degree of complaints came form residents who were awakened by the noise of the valve bursting and cars and windows were soiled by soot.
[gas / vapour release, explosion / pressure release, bursting disc, damage to equipment]

Lessons

[None Reported]

7433 May 1992

Source : LOSS PREVENTION BULLETIN, 110, 25-26.
Location : ,

Injured : 6 **Dead :** 0

Abstract

A plant experienced an uncontrolled ("runaway") polymerisation in the reactor which produced a maleic co-polymer. This resulted in a pressure build up and discharged vapours finding their way in to the work area. Six employees were treated for respiratory irritation.
On the day in question, charging the batch proceeded normally. The reactor was heated to 114 degrees C, when the first catalyst addition was made. As the exotherm developed, the reactor was put on normal cooling. The exotherm did not abate and the reactor was put on full cooling. The operator realised then he was not able to control the reaction. The pressure rose and the operator opened a 3 inch vent line to an adjacent vessel, but the pressure continued to rise. He then opened the vent line to the roof through a condenser and evacuated the plant.
The pressure in the reactor rose to an estimated 40-50 psi. A 35 psig relief valve lifted but the 50 psig bursting disc did not burst. However, the agitator seal O-ring blew out and a heavy concentration of vapours were released into the area.
After investingations it was found that:
The reaction runaway was due to styrene back flowing into the other monomer line via the left open block valve. An old non-return valve failed to prevent this. The second batch contained this styrene in the initial charge. The maleic/styrene co-polymerisation is much more vigorous than the maleic/monomer co-polymerisation and consequently exceeded the reactor control.
[runaway reaction, gas / vapour release, high pressure]

Lessons

[None Reported]

5628 10 April 1992

Source : LLOYDS LIST, 1992, 11 APR.
Location : Port Stanvac,

Injured : 0 **Dead :** 0

Abstract

A fire resulted from overflow from flare stack.
[fire - consequence]

Lessons

[None Reported]

1088915 January 1992

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

Abstract

An operator went to carry out a gas test at the feedline on a tower. The feedline discharged into a low pressure flare gas header.
The gas test was required to allow a hot work permit to be issued so that flash assisted pictures could be taken of the flange facings of the lines connected to feedline. The pictures were required for investigation of an incident which occurred earlier in the day at the same location. There was scaffolded access platform beneath the safety valve.
A work permit issued by the chief operator of the unit to maintenance to remove the safety valve, required that air supplied breathing apparatus be worn for this job. Two maintenance contractor#s pipefitters were on the scaffolding with air supplied breathing apparatus had removed the safety valve.
The operator climbed the scaffolding to take the gas test, he was not wearing air supplied breathing apparatus. Before he could fully perform the test he was overcome by gas, suspected to be nitrogen emanating from the open flare line. He backed away, turned and slumped to his knees.
He was disoriented and briefly lost consciousness.
One of the pipefitters grabbed the operator to prevent him falling under the scaffold guardrail. After one to two minutes the operator felt better and was assisted to ground-level by maintenance personnel.
He was forcibly given fresh air, later oxygen, and taken to the nurse#s station. Shortly afterward he was taken to hospital for examination. He was released and sent home that evening.
Conclusion:
1. The gassing of the operator was due to inhalation of low pressure gas, primarily nitrogen, which had entered the section of flare system involved inadvertently.
2. The operator should have been aware and followed permit restriction regarding requirements. further, he did not use sound judgement in entering a potentially hazardous area with only minimum protection.
[testing, safety procedures inadequate, people]

Lessons

[None Reported]

1333 1992

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

An operator attempted to clear a blockage caused by caustic soda in the drain line at the bottom of a depropanizer reboiler. The operator dismantled the drain line leaving a 50mm gate valve in place. This was found to be blocked but was eventually cleared using steam. A mixture of butane and butylene at 17 bar pressure then started to escape from the valve.
This valve was closed by operators using breathing apparatus in accordance with the emergency procedures, but not before the depressuring valve was opened. A decision was taken to reduce pressure in both the depropanizer and an associated propane/propylene splitter. Gas was diverted into the flare line via a 400mm ball valve. Just upstream of the point where the flare line met the flare header were a 250mm diameter sump and a drain line.
The sump and drain line were blocked by a mixture of scale and discarded welding rods which, according to the company, were probably left by contractors who worked on the plant in 1988. The blockage had allowed 30m3 of liquid to collect in the flare line.
When the diverted gas hit this huge slug of liquid, the vibration dislodged about 100m of the flare line, which fell 10m to the ground and buckled on impact in the area of contact.
The buckling of the pipe was typical of that seen in ductile collapse of steel pipe, where the walls of the pipe fold inwards to form uniform lobes on the inside of the pipe. At the trough between two of the lobes there was a series of long open-mouthed cracks. The region of cracking extended over a total length of approximately 170mm. The cracks were found to have propagated to a depth of 7.7mm in one place, leaving 2.3mm of metal remaining from a nominal thickness of 10mm. The length of the damaged pipe was quite small.
The view of the inspector was that the incident could have been a major disaster in that their calculations showed that, if there had been a leak followed by a vapour cloud explosion, there would have been total destruction of plant and equipment within a 60m radius and collapsed buildings within 240m.
Since the incident several hundred thousand pounds have been spent on improving the flare system.
[processing, flow restriction, corrosion, solids deposition, gas / vapour release]

Lessons

The above incident provides a reminder of problems which can be experienced with corrosion and deposition in flare pipeline systems. Unfortunately, blockage and corrosion is probably most likely to occur at the low drain points provided specifically to remove liquid condensation.
Finding problem points is not easy. In the past blockages have been looked for by pipeline radiography with some success, followed by selected cleaning of sections, such as bends, crossovers, and expansion loops.
The use of higher grade steels and purging at dead ends of the flare line systems are methods used at some sites to reduce problems.

1038 21 December 1991

Source : ICHEME
Location : ,

Injured : 0   **Dead :** 0

Abstract

On Saturday, December 21, 1991, a sudden release into a isocracker compressor flare header destroyed a safety relief valve and damaged a sight glass on a liquid collection pot. A release of hydrogen rich vapor to atmosphere occurred, necessitating a shut down of the isocracker.
The damage was limited to that previously described, and there were no injuries. The isocracker was returned to service on December 25.
The incident cause was an accumulation of liquid in the flare header. The problem was compounded by undersized header and piping, and triggered by unstable operating conditions.
Additionally, deficiencies in the incident response procedures were uncovered.
Based on the investigation findings, recommendations have been made to review and revise procedures and to re-engineer the flare header.
In this incident the losses are limited to reduced production and repair costs; however, there was a potential threat to life and major equipment.
[gas / vapour release, plant shutdown, processing, draining of line insufficient]

Lessons

1. Drain drip pots frequently to prevent liquid build-up.
2. Locate source(s) of liquid and remedy now, where possible, or during the shutdown.
3. Ascertain any testing required for individuals exposed to high levels of noise or hazardous vapours.
4. Redesign the liquid removal system to ensure no build-up.
5. Redesign the flare header to reduce velocity and back pressure.
6. Adjust the operating and emergency procedures to reflect the dangers of rapid feed rate changes.
7. Review the maintenance requirements for compressor alarms and trips.
8. Review the refinery quality control procedures for work done in outside workshops.

5460 November 1991

Source : THE CHEMICAL ENGINEER, 1991, 12 DEC.
Location : Stanlow, UK

Injured : 0   **Dead :** 0

Abstract

An operator attempted to clear a blockage in the drain line at the depropaniser reboiler. The drain line was dismantled leaving a ball valve which was found to be blocked but was cleared using steam. A mixture of butane and butylene gases started to escape. The vessel was depressurised via the flare line. The gas hit a slug of liquid and caused the flare line to dislodge from the supports and buckle but not rupture. The valve was blocked with scale and discarded welding rods.
[damage to equipment, maintenance, near miss]

Lessons

[None Reported]

3480 November 1991

Source : ICHEME
Location : ,

Injured : 1 **Dead :** 0

Abstract

Serious HF (hydrofluoric acid/hydrogen fluoride) burn at a refinery.
A metal burr on a blind being removed from pumps in the Alky Unit punctured a contractor employee's 'D' suit glove resulting in an HF burn to the finger. This accident was caused by wear and tear of protective equipment and insufficient maintenance procedures.
The cost of the investigation was $1,552 (1991).
[design or procedure error, burns, maintenance inadequate, refining]

Lessons

1. Personal protective equipment must be maintained and inspected thoroughly prior to use in hazardous area.
2. Consider using an HF resistant glove liner inside the alky glove.
3. Maintenance personnel should be trained on the hazards of HF and the need to follow
proper handling procedures of Alky tools and equipment.

1194415 October 1991

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

Abstract

A non-vital nitrogen reticulation was contaminated with 300 litres of an ethyl aluminium dichloride (EADC)/ heptane mixture. Some of this was released to atmosphere when the EADC reacted with moisture to release hydrogen chloride vapour.The flame arrestor on the vent line of a catalyst blowdown drum had blocked and the drum became pressurised by a vital nitrogen purge. The blockage mechanism was catalyst vapour reacting with water in the flame arrestor to form solid aluminium hydroxide. After the non-vital nitrogen system was isolated for maintenance, the non-vital nitrogen header pressure dropped through leaks. The bursting disc connecting this to the drum pressured in the reverse direction and burst. The pressure pushed liquid up into the non-vital nitrogen system.The vital nitrogen to the drum had a low flow alarm; insufficient attention was paid to this.
[unwanted chemical reaction, gas / vapour release, flow restriction, preparation for maintenance, flame arrestor, additional chemical present, cleaning inadequate]

Lessons

Root cause analysis identified the following:
1. Immediate causes:·
Over-riding/ ignoring safety devices: sounding of low flow alarm was not adequately investigated.
Defective equipment: blockage in flame arrestor.
Inadequate procedures: actions in the event of the alarm sounding not defined.
2. Basic causes:·
Inadequate maintenance: no programme for checking for blockage in the flame arrestor·Inadequate engineering: design of system did not fully take into account the potential for cross contamination of the nitrogen system arising from overpressure of the blowdown drum and failure of the bursting disc.
Inadequate work standards: procedures not adequate to arrive at correct interpretation of the cause of the alarm sounding.Lack of knowledge: causes and consequences of sounding low flow alarm were not appreciated.

12647 10 October 1991

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A large volume of liquid collected in a knock-out drum of a flare stack in an uncontrolled operation.
An investigation into the incident found that the root cause of the incident was due to the loss of 'pickling solution' from two butadiene towers via safety valves. This was caused by the combination of volume expansion of 'pickling solution' in the towers closed systems and relatively high temperatures promoting higher pressure in the vapour space.
[leak, high pressure, processing, plant / property / equipment]

Lessons

The report stated the following recommendations:
1. Operating instructions need to be reviews to take into account thermal expansion and process monitoring necessary to control the pickling operation on the tower.
2. Checks to be made for all towers to ensure that they are adequate for pickling operation, during which they may be hydraulically full with an overhead pressure at the safety valve set point.

5408 10 August 1991

Source : LLOYDS LIST, 1991, 13 AUG.
Location : Ekofisk Platform; North Sea, NORWEGIAN SECTOR

Injured : 0 **Dead :** 3

Abstract

Helicopter crashed when it neared a flare stack on an offshore platform. Fatality.

Lessons

[None Reported]

7914 16 July 1991

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

Abstract

A plant technician died and a second technician was injured during a flash fire on a Vacuum Distillation Unit (VDU) at a refinery.
The flash fire occurred as a result of naphtha discharging from the vent of the VDU reflux drum, when a drawoff pump failed during the recommissioning of the VDU following an emergency shutdown earlier in the day.
It is suspected that an adjacent hot pump was the source of the ignition. The deceased technician was drenched with naphtha during the overflow, and was engulfed in the subsequent flash fire.
Earlier in the same night the deceased and three other technicians had put out a small fire. Fatality.
[fire - consequence, pump failure, spill, plant shutdown, injury]

Lessons

[None Reported]

5375 10 July 1991

Source : HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1991, SEP
Location : Off Rio De Janeiro, BRAZIL

Injured : 2 **Dead :** 0

Abstract

An explosion occurred during maintenance on flare stack on self-elevating drilling platform.

Lessons

[None Reported]

7436 01 July 1991

Source : LOSS PREVENTION BULLETIN, 105, 15.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A fire occurred in the activated charcoal odour abatement system located on an outside loading dock. The building's fire detection and suppression systems worked as designed, alarming the building occupants and the gatehouse and then extinguishing the fire via the automatic sprinkler system. Because of the initial heavy smoke, the local fire department was called in. The fire department cooled down the carbon unit and inspected the dock area and roof for possible fire.

The fire was limited to some PVC pipes above the carbon unit. Damage was minimal and there were no injuries nor chemical exposures. There was no structural damage. Fire water was collected in the building detention basin, tested and released to the chemical sewer according to building emergency response procedures. Action has been taken to address site waste handling operations on an interim basis. No site laboratory operations were shut down as a result of this incident.

On 18 June 1991, a replacement unit containing 800kg of vapour phase granular carbon was installed to replace two smaller units. The unit was used under normal conditions for 9 days, and was then shut down after normal waste consolidation operations. On the morning of the incident the fan was turned on in preparation for solvent and monomer dispensing. Later a waterflow fire alarm sounded in the building and the gatehouse. The building personnel investigated and found smoke entering the loading duct and called the emergency sevices.

After investigation the following main causes were found:

1. Heat of absorption and high ambient temperatures caused local hot spots.
2. Slow oxidation of air reactive absorbed solvents continued to generate more heat.
3. The carbon acted as an insulator without air flow because the fan was turned OFF after each use, allowing further temperature rise.
4. When air flow was introduced by turning on the fan, a fire started and solvents began to burn.

[charcoal filter, fire - consequence, processing]

Lessons

[None Reported]

5285 18 March 1991

Source : THE INDEPENDENT, 1991, 19 MAR.
Location : Sullom Voe; Shetland, UK

Injured : 0 **Dead :** 0

Abstract

40 tonnes crude oil leaked from a vent into the sea.
[spill]

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]

1049103 March 1991

Source : ICHEME
Location : , UK

Injured : 1 **Dead :** 0

Abstract

An operator received serious burns when the bursting disc ruptured on a catalyst pot feeding a polyethylene glycol reaction vessel. The operators feet and lower legs were sprayed with caustic soda/ethylene oxide at about 140 degrees C discharged from a ground level vent. (The pressure rating of the disc was 10 bar, but it apparently failed below its design rating).
Following modifications to the reactor system some time before, it had been realised (late in the modification project) that under certain conditions it would be possible to overpressurise the catalyst pot. Operating procedures had been issued requiring the catalyst pot to be isolated (and valves padlocked) at a certain stage of the process. However these new procedures had not been formally authorised, and did not call for a signature to confirm that the isolation procedure had been completed. Other catalyst pots on the plant did not require these special isolation procedures.
An operator on the previous shift had set the reactor system up, but had failed to isolate the catalyst pot. This omission was noticed by the incoming operator, who was operating valves to remedy the situation when the bursting disc ruptured (although the catalyst pot appears not to have been overpressurised at this time).
[gas / vapour release, bursting disc failure, isolation inadequate, design or procedure error, safety procedures inadequate]

Lessons

The investigation team made the following comments/recommendations:
1. The modification project team failed to identify the possibility of over-pressurising the catalyst pot until just prior to commissioning.
2. The 'locking out' system introduced to overcome the problem was inadequately written up and controlled.
3. The location of the vent from the catalyst pot was not in a safe position.
4. The bursting disc failed below the design rating
5. The operator on the previous shift omitted to carry out the isolation of the catalyst pot
6. The incoming operator felt that corrective actions were within his competence and did not require help from supervision.
Specific changes to the system included eliminating the need to isolate the catalyst pot, either by uprating the current equipment or providing a new uprated pot.
More general recommendations focused on improvements to training, operating procedures and the conduct of technical safety reviews.

5267 26 February 1991

Source : EUROPEAN CHEMICAL NEWS, 1991, 56, (1461), 4 MAR., 1.0
Location : Thames Estuary; Essex, UK

Injured : 0 **Dead :** 0

Abstract

Two unconnected fires affected neighbouring refineries. One of the fire occured in the proximity of a flare unit.
[fire - consequence, refining]

Lessons

[None Reported]

5159 November 1990

Source : PROCESS ENGINEERING, 1992, JAN.
Location : Stanlow; Cheshire, UK

Injured : 0 **Dead :** 0

Abstract

The wrong valve was opened during routine maintenance causing a release of butane. An emergency valve was opened to burn the gas off through a flare stack. But a blockage in the pipework caused such a massive vibration that the whole piping system collapsed.
[gas / vapour release, excessive vibration, flow restriction, maintenance inadequate]

Lessons

[None Reported]

4986 15 May 1990

Source : HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1990, SEP.
Location : Tarragona, SPAIN

Injured : 0 **Dead :** 0

Abstract

A fire occurred at butane storage tank during replacement of emergency equipment. Blaze extinguished in 30 minutes, minor damage.
[fire - consequence, maintenance]

Lessons

[None Reported]

4782 28 November 1989

Source : HULL DAILY MAIL, 1989, 28 NOV.
Location : Hull, UK

Injured : 0 **Dead :** 0

Abstract

A violet cloud of iodine gas was released when methyl iodide vented into the flare stack.
[gas / vapour release]

Lessons

[None Reported]

1013208 August 1989

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

Early on the 8th of August one of three power boilers was taken out of service to repair a safety valve that had failed in the open position. The resultant steam escape caused significant noise. A second boiler was shutdown on the same day following failure of the power supply to the boiler instrumentation. All plants were taken offline. The lack of steam caused smoke problems from flaring. 55 telephone complaints were received during the evening and night.
Local media interest was high and a local Government representative insisted on a private meeting with the site management. On arrival with a camera crew the management requested a private meeting with the representative. Subsequent television coverage hinted at a cover-up. The plant was restarted 5 days after shutdown.
[shutdown, vent, flare system, power plant, plant shutdown, gas / vapour release, noise, power supply failure, valve failure]

Lessons

A 24 hour rota was set up to receive telephoned complaints, which were dealt with in a courteous manner and an apology and explanation give.
Proper and early contact was made with the relevant authorities.
The company placed an advert in the local paper explaining the situation and apologising to the local community.

4600 07 June 1989

Source : LOSS PREVENTION BULLETIN, 099, 13; CHEMICAL WEEK, 1989, 20 SEP.
Location : Morris; Illinois, USA

Injured : 0 **Dead :** 0

Abstract

While restoring operations on a plant, the vent valve for the depropaniser reflux drum was opened to reduce the pressure in the vessel. The vent line piping was routed to the flare system or the gas compressor. Since the vent line to the compressor was under maintenance, the excess propylene should have gone to the flare system. It was accidentally routed to the 2 inch compressor line where a vapour cloud formed and was ignited, possibly by a damaged light bulb. 40 acres of the plant was damaged.
[fire - consequence, pipe]

Lessons

[None Reported]

1019405 September 1988

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

At approximately 14.00 hours on 5th September 1988, an air supply hose on the discharge side of a portable breathing air receiver became detached whilst in use.
One individual was carrying out an internal inspection of the Solvent Recovery Column at the time. He was therefore immediately deprived of an air supply.
Very prompt action by the compressor attendant, with the assistance of a fireman enabled restoration of the air supply within a few seconds. An emergency call was made to the Fire Station for additional backup, but the individual concerned was able to make his own way out of the column, and suffered no physical effects.
On examination the crimping rings attaching the pressure hose to the bayonet connection were found to be loose and showed no signs of ever being compressed.
Following the incident, all work involving mobile breathing air systems was stopped. It turned out that all hoses arrived in vacuum sealed packs which were only opened at the work-site. No inspection or testing was therefore performed and no documentation accompanied the hose to indicate what Quality Assurance procedures had been followed.
[inspection, entry into confined space, near miss, breathing apparatus, air line, human causes, design fault]

Lessons

All hoses were examined and certified on site immediately.
Some hose lengths were found to have only one crimp-ring applied, rather than the usual two. Initially it was accepted that a second ring should be applied. However, the contractor subsequently discussed this matter with the supplier who advised against this course of action. Clamping is normally carried out whilst the hose is being heat-shrunk onto the fitting. Any attempt to add a second clamp 'cold' might affect the integrity of the original bond.
All such hoses were therefore withdrawn from service, and have been replaced by others, which incorporate an improved coupling design.
For vessel entry the statutory requirement is for an outside observer who is similarly clothed (and therefore has breathing apparatus (BA) at the ready) whose primary responsibility is to summon assistance in the event of a dangerous situation arising, and to then attempt a rescue. The shutdown arrangements require each party to make its own arrangements for observers. This could therefore involve personnel who had only limited BA training. This situation was revised.

4252 12 August 1988

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A marine transport vessel berthed with some tanks containing crude oil with 200ppm hydrogen sulphide. During the inspection of the tanks prior to filling a crew man collapsed but recovered later. Later complaints of a smell was found to be due to the venting of the tanks via the filling tank vents and the other tank vents. Loading was slowed down so that only the filling tank vents were used. Additionally the inert gas system allowed the hydrogen sulphide to spread through all tanks.
[gas / vapour release]

Lessons

1. Vessels arriving partly laden must give name and nature of part load.
2. If the part cargo has a characteristic greatly different to the cargo to be loaded or where a health hazard may exist, then:-
a) The vessel will require to isolate the venting system of the tanks containing the part cargo from that of the tank to be loaded.
b) The tanks to be loaded must not be contaminated with gasses from the part cargo.
c) Venting of a part cargo will not be permitted except in an emergency.
d) Ullaging and dipping of tanks containing a part cargo will only be permitted using either fixed gauging systems or sonic tapes using approved vapour locks.
e) Sampling of part cargo will not be permitted. If cargo inspectors require to take samples then they will have to make arrangements to do so either before the vessel berths or after the vessel sails.

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.

7281 11 June 1988

Source : LOSS PREVENTION BULLETIN, 086, 17-18.
Location : Houston, Texas, USA.

Injured : 1 **Dead :** 0

Abstract

A contract pipe fitter was splashed with liquid acetone cyanohydrin (CAN) while working on an CAN pipeline that had previously been opened, drained, de-pressurised and purged by process personnel.
After being splashed, he climbed down from the 7 m (25 ft) high scaffold and got into the back of a pick up truck. He was driven to the changeover shower, stripped of his clothes and showered.
Over the next 45 to 55 minutes, the contractor was observed by plant emergency medical personnel, he showed no symptoms of cyanide poisoning and as turned over to the contractors safety supervisor.
In the interim, he was given clean overalls and boots by the contractor. No one noticed that he put on his contaminated socks.
Shortly after, the contractor began to show symptoms of cyanide poisoning (trembling, reddening of eyes, respiratory difficulty). He was transferred to hospital and an intravenous antidote was started. The patient stabilised.
Several causes of the accident were put forward:
1. Even though the line had been opened, drained depressurised and purged, residual CAN remained in the pipeline.
2. The plumber's plug popped out of the CAN most likely because of the nitrogen purge pressure build-up. The nitrogen purge was introduced into the pipeline at the HT end of the pipeline (where the accident occurred) and the purge exited the pipeline through an open valve at the N-Area end was originally open at the start of the purge, but it was not tagged, "leave open". Apparently, it was later closed by an unknown person sometime during the purging process. When this valve was closed, it caused a pressure build-up in the pipeline. The pressure built up to such a level that it popped the plumber's plug out of the line and caused CAN to splash on the pipefitter. This is the most reasonable scenario possible, based on the evidence collected during the investigation and in the interviews.
3. The nearest emergency safety shower to the jobsite had not been identified, and a portable shower was not at the site.
4. The contract worker put on his contaminated socks after showering.
5. The contractor's safety supervisor did not recognise the symptoms of cyanide poisoning and had no knowledge of the availability of in-plant antidote kits.
[spill, high pressure, maintenance, injury]

Lessons

The job involved more than one shift, multiple production areas, multiple parties (contractor, maintenance, production, multiple activities and time pressure.
It was felt that the following elements need strengthening, job planning, communication, permits to work, preparation and job responsibilities.
It was strongly recommended that there should be a review of procedures and permits to work, with particular attention paid to contractors.

8780 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

During the start-up procedure after maintenance of the compressors at the feeding section of a polyethylene plant, the pressure primary compressor discharge reached a value of 310 bar, although the operator switched the compressor off manually in response to a high-pressure alarm signal activated at 265 bar. The safety valve at the compressor discharge started to open at 279 bar, but reached full capacity too slowly. The high-pressure switch, which was supposed to cut off the primary compressor at 279 bar, failed. Due to pressure build-up a bursting disc, located also at the compressor discharge, burst at a somewhat lower pressure than expected (possibly due to fatigue). The bursting disc discharge piping had not been designed for the resulting dynamic pressure and was torn from the collector release line. Releasing gas ignited, resulting in an explosion and a flash fire.
[leak, fire - consequence, instrumentation failure, damage to equipment]

Lessons

1. Redimensioning of the pressure safety valve and discharge lines of the safety devices; - improved testing of the performance of the high-pressure switch.
2. Practical tests of a new design with nitrogen.

12676October 1987

Source : ENDS REPORT 151, AUGUST 1987.
Location : Teeside, UK

Injured : 12 **Dead :** 1

Abstract

A release of nitrous oxide, hydraulic acid and ammonia occurred following the decomposition of nitrogen fertilisers at a blending plant.
The release occurred due to a fan failure that prevented the dispersal of fumes through a stack.
An employee was killed in the incident and at least twelve others were hospitalised.
[gas / vapour release/ mechanical equipment failure, fatality]

Lessons

[None Reported]

3949 17 July 1987

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A butadiene spill occurred at a flange at a flare stack when the flange was opened to clean out the water overflow line. There was no ignition.
[near miss, cleaning]

Lessons

[None Reported]

1048022 June 1987

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A fire started during a venting operation at the base of a reactor used for processing hydrocarbons on Monday 22 June 1987 at 1955 hours. It was fierce, but quickly extinguished by the sire fire service. There were no injuries. Damage was local and confined to instrument boxes and piping, cables and valve packing.
The reactor was being prepared for engineering work. In order to clear the contents and inert the vessel it was pressurised with nitrogen to 6 bar gauge and then vented to flare six time. The reactor was left sitting at 6 bar gauge pressure, and it was then decided to vent it again using a blanked off vent valve near the base. On opening the valve a small quantity of liquid emerged. The operator attempted to hose the spillage away. On contact with the water there was an immediate ignition.
Investigations suggested that a dead leg leading to the vent contained liquid hydrocarbon residues and fines of catalyst, which was metallic sodium. The water and sodium reacted violently and ignited the hydrocarbon.
[processing, maintenance, cleaning, reaction vessel, venting, vent, fire - consequence, sodium, water, hydrocarbon, catalyst, spill, cleaning procedure incorrect, cleaning inadequate, additional chemical present, competency lacking]

Lessons

1. Even apparently thorough purging of the reactor, hazardous materials can remain in dead spots within the reactor. The operators were to be reminded of this.
2. Venting to atmosphere of streams containing catalyst is always going to be a potentially hazardous operation. In future this should be done to open areas, and the vent line exit submerged in water to deactivate the catalyst.
3. Ways should be investigated for venting hazardous streams to a closed vessel.

3911 20 May 1987

Source : EVENING GAZETTE, 1987, 24 AUG.
Location : Wilton; Cleveland, UK

Injured : 0 **Dead :** 0

Abstract

A major leak caused a fireball when hydrocarbons leaked into a flare stack.
[fire - consequence]

Lessons

[None Reported]

3847 17 January 1987

Source : ICHEME
Location : Concord, USA

Injured : 0 **Dead :** 0

Abstract

An explosion occurred involving an exhaust at a cogeneration plant.

Lessons

[None Reported]

1835 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 : 2 **Dead :** 2

Abstract

The accident occurred on a 750 mm diameter elevated flare line around which a scaffold platform had been erected to assist in the removal of a gate valve. The flare line in the vicinity of the valve was supposedly isolated from other working parts of the flare system and supposedly drained and tested. As a ring spacer on the gate valve was pulled free, torrents of petroleum spirits gushed out, igniting on a nearby air compressor engine used to supply air for the breathing apparatus of the maintenance crew. The scaffold platform and persons on it were enveloped in flames.
The refinery fire brigade were quickly on the scene and soon afterwards the local fire brigade arrived. The fire was readily confined to the valve area. There was never a possibility of effects external to the refinery site. Fatality.
[hot surface, fire - consequence, spill, operator error, refining]

Lessons

1. Work on the flare system has to be authorised at senior management level, valves should have an indication of their position.
2. Changes in work methods are also needed, verify the performance of flare drainage.
3. Purge lines with inert nitrogen gas to clear residual flammable gases and to prevent air from reaching a pyrophoric scale inside.
4. Move flanges apart gradually with bolts still in position until the content of the line can be identified for certain; - use trays under the flanges as they are moved apart to collect liquids in a safe way.
5. Alternative escape routes from scaffold platforms or any work area must always be available.
6. Staff on the work must be equipped with flash fire suits, remove persons away when the final lift is carried out;
7. Drench the valve removal area and scaffold platforms with ground-level fire monitors as the lift is carried out.
8. Provide a refinery fire tender on stand-by at the scene.
9. Avoid diesel engine-operated compressors nearby, at locations to which the air system does not extend, mobile air storage tanks will be provided for breathing apparatus.

8764 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

The operation of this plant was organised in two shifts. Since this hydrogenation reaction would have taken at least 30 hours to complete, it was shut-down in the normal way (shutoff of hydrogen supply, turn-off of agitator). No nitrogen inerting was used. The control panel of the reactor showed a normal operating temperature and pressure after shut-down. 10 minutes later, as operators were changing in their locker room, an explosion occurred, followed by a fire around the reactor. A second explosion occurred a few minutes later and a fire with a characteristic black smoke resulted. The fire was extinguished by the automatically activated sprinkler system. One reactor and attachments were destroyed, glass apparatus on nearby reactors also damaged, windows up to 30 m away blown out. Investigations showed that the pressure relief line of the reactor did not operate, the bursting disc being found to be intact. The explosion was attributed to agitator malfunction (its maintenance records showed that it has malfunctioned on numerous occasions) allowing hydrogen to leak. The ignition source could have been any of the nearby located electric installations, not suitable in a hydrogen atmosphere.
[reactors and reaction equipment, electrical, operator error]

Lessons

1. To carry out hydrogenation in a separate dedicated process area with electric equipment suitable for use with hydrogen.
2. To provide adequate alarms to warn when there is a hydrogen leak. The company was also required to implement a more extensive preventive maintenance system.
3. Install appropriate pressure relief devices to ensure that emissions do not vent into the process area.
4. Review procedures to ensure that processes, which have to be left unattended overnight, are left in a safe state.
5. Provide nitrogen inerting in any reactor containing highly flammable solvents which have to be left unattended overnight.

123671987

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

An incident occurred during the shutdown of a chemical plant. A heating system operating on heating fluid was partly drained off. Upon restart, cracks developed in three of the twelve vertical heating coils in the radiant section. This resulted in the heating fluid leaking and burning on this section. While measures were being taken to remedy the situation, a complete tube burst of a fourth coil occurred. The suddenly increased outflow of heating fluid was partly transferred to the 100-metre high furnace stack. For about 10 minutes an approximately 30-meter high flame emerged from the top of the stack, accompanied by a large cloud of soot. The soot was carried away and deposited over populated areas several kilometres away from the plant.
[gas / vapour release]

Lessons

[None Reported]

8722 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 : 29 **Dead :** 0

Abstract

A fire occurred in a warehouse storing chemicals and fertilisers. Some smoke was noticed by the personnel who used, unsuccessfully, portable fire extinguishers, even if visible fire was never noticed. Fire fighting proceeded with difficulties due to the yellow/red smoke cloud which had developed. The movements of the cloud were monitored by means of a helicopter and the concentrations of the main pollutants measured. The emergency plan was put into operation and preparations for the evacuation of 73,000 persons started. About 5 hours after the starting of the smoke evolution, 25,000 persons had been evacuated. Fire fighting actions were required for about 20 hours. During the main fire fighting attempt, products on fire were soaked by a fire water flowrate of 700 m3/h. Contaminated fire water caused the pollution of a nearby river.

The precise ignition cause could not be identified but probably it was a combination of the following elements:

1. Storage of fertilizer at too high a temperature and with an excessive amount of organic material.
2. No monitoring of the temperature of the goods stored in the heap, the presence of wooden pallets in contact with the fertilizer.
3. The absence of any efficient fire fighting means.

[fire - consequence, gas / vapour release, storage, warehousing, unknown chemicals, injury]

Lessons

[None Reported]

1083713 August 1986

Source : FIRE PREVENTION NO. 198, APRIL 1987.
Location : , UK

Injured : 0 **Dead :** 0

Abstract

The hot exhaust of a diesel engine ignited diesel fuel from a nearby tank. A huge pall of thick black smoke hung over the area as a large quantity of diesel oil burned at a metal processors.
One of the main items of plant at the scrap metal processors was a fragmentizer machine. The machine incorporated a large static diesel engine and fuel tank containing 13,620 litres of diesel oil.
A leak occurred in the fuel line leading from the tank to the machine. The diesel oil ignited as it came into contact with the hot exhaust of the engine. The machine operator called the fire brigade and the yard was evacuated.
The fire brigade arrived and set about blanketing the diesel tank with foam and cooling the surrounding area with water. It required the efforts of twenty-six firemen using three foam branches and a main water jet 85 minutes to quench the fire. Over 1300 litres of foam compound were used in the operation.
A large quantity of diesel fuel was consumed in the fire and the diesel engine and fragmentizer machine were severely damaged by the fire and heat.
[fire - consequence, hot surface, damage to equipment]

Lessons

[None Reported]

7973 04 August 1986

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

Abstract

An incident occurred when the air supply to air line breathing apparatus being used by four contract employees working inside a tank totally failed. The four men had to remove their breathing masks and escape from the tank without respiratory protection. Fortunately no harmful effects were experienced.
Air line breathing apparatus being used during the application of a protective lining inside a storage tank was supplied by a diesel engine driven air compressor connected to a breathing air filtration (BAF) unit. This particular unit consists of water separation and filtration systems plus four high pressure emergency breathing air bottles all mounted as a two-wheeled trolley unit.
It is designed to supply four persons from individual hose connectors at a breathing air manifold.
The design of this BAF unit incorporates an automatic change-over between normal and emergency air supplies. Should the air compressor supply fail an alarm is provided to alert standby personnel that the change-over has taken place. The unit also has the facility to prevent air reaching the outlet manifold if an attempt is made to commission the BAF with the emergency breathing air bottles empty. Conversely, however, should the emergency breathing air bottles become exhausted while the unit is in use the control system would automatically stop the flow of air to the breathing masks even though the air compressor continues to run normally. No alarm is provided to warn of decaying pressure in the emergency breathing air bottles.
This BAF unit was delivered to site by a contractor as part of a package of equipment required for the tank lining work. When an attempt was made to commission the unit the incident occurred, but at that time no persons were actually using the air line breathing air equipment. On subsequent inspection the following faults were found:
1. Damaged air hose
2. On/off switch inoperable
3. Emergency air bottles empty
Following repairs by the equipment manufacturer the BAF unit was commissioned and entry made into the tank with air line breathing apparatus.
On the following day the incident occurred. Subsequent inspection of the BAF unit indicated that:
1. The air compressor was still running.
2. No audible alarm had sounded.
3. The emergency air bottles were empty In order to progress the work the breathing air system was reinstated using two independently running air compressors plus a standby compressor.
[entry into confined space, safety procedures inadequate]

Lessons

There was a design fault in the system:
1. Start up and normal operation, The unit cannot be brought into operation unless the emergency air bottles are pressurised and the valves open. This is acceptable.
2. Failure of air supply from the compressor. Audible alarm sounds and air is supplied from the emergency air bottles sufficient for about 30 minutes supply for 4 persons. This is acceptable.
3. Loss of air pressure in the emergency air bottles. Outlet from the BAF unit is automatically closed without warning even though the air can still be running. This completely unacceptable and has to be modified.
4. Air supply for breathing apparatus as used by contractors must always be checked for suitability.

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]

8753 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

The non-return valve on the line from a road tanker unloading to an ethylene oxide storage tank was under maintenance. The isolation valves were closed by the operator. The defective closure of one of these valves (probably due to a cold polymer of ethylene oxide) allowed ethylene oxide to be released when the non-return valve was dismantled. A gas detector alarm sounded and the water spray was activated, which largely contained the leak. Isolation valves were manually closed by the operator, who suffered extensive skin burns to the upper part of the body and who was hospitalised for 1 week.
[storage tanks]

Lessons

1. Better systems for tank isolation.
2. Use of appropriate clothing during operation.
3. Review of pipework at the installation to see if the system can be improved.

8751 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

During unloading of liquid chlorine from a road tanker to a storage tank, an operator left the vent valve on the transfer line open, which allowed chlorine into the vent main. Flash vaporisation occurred and the pressure surge caused damage to the absorption, bleach and hydrogen chloride columns. Then, the failure of liquid loop seals resulted in a leak of chlorine into the chlorination building. The leak was isolated and water sprays were used to minimise the effects.
[storage tanks, seal failure, damage to equipment, operator error]

Lessons

1. Check-list with supervision during unloading.
2. Installation of a system to control correct operation.
3. Orifice plates into vent lines to prevent overpressurisation of absorption column should the vent be open.
4. Design improvements are being evaluated.

8757 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

Due to corrosion in an isobutane recycle piping system, operating at 15 bar/84 degrees C, an emission of LPG containing traces of hydrogen fluoride occurred. Early identification of the leak was by gas detectors. The plant was taken through a controlled de-pressurisation sequence over the period of one hour so that a temporary repair could be made. Examination of the ASME A106 (8" bore) x 8 mm, grade 13 steel pipe revealed that a plug of rust and sludge containing 9.9% FeF_2, 8.1% FeF_3 and 37.59b Fe203 had accumulated in the base of a shallow bend. The retention of HF (hydrogen fluoride) in this plug had caused accelerated internal corrosion in a localised zone around the surface of the plug. The pipe formed part of the original installation which had been in use for about 5 years. Generally, the corrosion was uniform and within the tolerance allowed for the recycle circuits of the plant.
[processing]

Lessons

[None Reported]

3369 08 August 1985

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

Abstract

A large quantity of dense smoke was seen to be coming from the chimney of an acrylonitrile plant incinerator. Investigation showed that there was an accumulation of residues in the incinerator firebox. The plant was shutdown to test for hydrogen cyanide downwind but none were found.
[plant shutdown, heating]

Lessons

The following recommendations were made:
1. Provide a means of flow control and measurement, with provisions to ensure that this is maintained within the rated capability of the burners.
2. Provision should be made for circulating the residues storage drums in order to avoid layering.
3. A regular routine of inspection of the burner tips should be carried out.

8025 12 July 1985

Source : ICHEME
Location : ,

Injured : 1 **Dead :** 0

Abstract

A maintenance craftsman was sprayed on his face, arms and legs with hot bitumen as he attempted to remove a pump suction filter for cleaning. The positive displacement screw type bitumen pump, normally operating at 180 degrees C, had been shutdown about two hours earlier as it was suspected that the filter was blocked by coke. Although the pump had been valve isolated and the depressuring procedure carried out, the craftsman was sprayed by hot bitumen released under pressure as he attempted to remove the filter cover. Colleagues immediately helped remove contaminated clothing and placed him in a safety shower. Nevertheless the craftsman remained in hospital for 14 days for treatment to his burns and did not return to work for nearly 10 weeks. No other person was affected by this incident.

An investigation of this serious incident by the refinery has identified a number of contributory factors.

After the pump was valve isolated, the depressuring procedure was carried out which involved opening the discharge drain and running the pump for a short period. This technique had become common practice as the suction filter drain was difficult to access and was reportedly blocked. In this case, however, a number of factors are thought to have prevented the suction filter from being depressurised:

1. The pump discharge drain was blocked or restricted.
2. The relief valve protecting the pump discharge lifted.
3. The suction side of the pump was repressurised by reverse flow through the pump body (excessive clearances between the screws).

Following completion of the depressuring procedure the craftsman removed all bolts holding down the filter cover and then tried to break the joint by pulling on the handle of the cover. Bitumen sprayed out under pressure onto his unprotected face and forearms (as it was a hot day the craftsman had rolled up the sleeves of his overall) and over his thighs. The foreman subsequently noticed that the pump discharge pressure gauge was registering 4 bar g.

Although a work permit had been issued it did not, apparently, contain any specific protective clothing requirements for this job.

[flow restriction, spill, permit to work system inadequate]

Lessons

The following recommendations were made:

1. Relocation of the suction drain lines and valves to allow easy access.
2. Develop a method for removing the filter without the need for persons to be standing close by.
3. Flushing the filter with a cooler material.
4. Enforcing the wearing of the correct protective clothing, i.e. long gauntlets, face visors.

8027 02 July 1985

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

A fire occurred on a visbreaker charge pump shortly after it had been put on standby following a routine weekly change-over.
The fire was extinguished within four minutes by the fire fighting crew using dry powder chemicals, fire extinguishers and sea water.
No damage was caused to plant equipment or personnel, but it did result in the unit being shut down for a short duration to ensure that positive isolation of the standby pump was effected and the equipment inspected before recommissioning.
[cracking equipment, fire - consequence, heating, maintenance]

Lessons

The following recommendations were made:

1. The design of flushing oil systems and the associated mechanical seal arrangements for the pumps involved in the incident and of all refinery hot oil pumps should be reviewed.
2. Ensure written instructions on the refinery fire alarm system are displayed on the control panel and that all the appropriate operating personnel are familiar with and trained in its use
3. Introduce a routine for air testing of sprinkler systems
4. Modify engineering/maintenance procedures to ensure that the baffle plates in these seals are fitted when seals are replaced
5. Management to revise the site Emergency Procedures to improve site communications and highlight staff responsibilities and actions in a similar event
6. Management to instruct unit technicians to remain at hot oil pump installations, following any pump change-over, for sufficient time to confirm satisfactory operation of the newly commissioned pump and that there is no leakage from the seals of the pump which has been shut down .

9693 01 July 1985

Source : ICHEME
Location : , SWEDEN

Injured : 0 **Dead :** 0

Abstract

A flash fire occurred in a ground flare knock-out drum. The drum had been out of operation for some 18 months and was being opened up for inspection. Pyrophoric scale ignition of residual hydrocarbon the probable reason.
[fire - consequence]

Lessons

[None Reported]

3264 23 March 1985

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

Phenol and formaldehyde were added to a reactor but the agitator failed. Caustic was added and heating started safety valve and bursting disc blew and agitator flange blown out. A gas cloud formed which ignited and removed the walls of the plant.
[mechanical equipment failure, vapour cloud explosion]

Lessons

[None Reported]

3257 10 March 1985

Source : HET NIEUWSBLAD, 1985, 11 MAR.; LE SOIR, 1985, 11 MAR.
Location : Zelzate; Ghent, BELGIUM

Injured : 0 **Dead :** 3

Abstract

Off-gases containing mainly carbon monoxide were sent to a boiler of a local electicity generating station an incident tripped the boiler and stopped burning the carbon monoxide a flare system designed to take over did not ignite and a large vapour cloud was released and covered the site. Fatality.
[gas / vapour release, electrical]

Lessons

[None Reported]

1029727 January 1985

Source : ICHEME
Location : , WALES

Injured : 0 **Dead :** 0

Abstract

During commissioning of an Ethanol Plant, a leak became evident on a tell-tale (weepholes) vent, associated with the multi-layered reactor shell. The vent was fitted with a valve, which shut. Shortly after this valve shut, the outer lamination on the reactor bottom strake, ruptured along a weld. No loss of hydrocarbon, or personnel injury, occurred. The rupture was a result of pressure build-up, insulation of the tell-tale. The consequences of such insulation's were not well known to personnel. The practice of fitting tell-tale vents was not recognised as a plant modification by plant personnel.
[reactors and reaction equipment, weld failure]

Lessons

Recommendations were:-
1. Keep tell-tale holes clear and unobstructed.
2. Better communication of potential consequences of actions such as fitting of tell-tale vents on solid wall constructions. However, this practice can continue provided there is adequate monitoring and appropriate authorisation.
3. Improved recording of tell-tale surveys essential.
4. Reactor shell head girth joints to be inspected.

3198 07 January 1985

Source : THE GUARDIAN, 1985, 31 JAN.; ICHEME
Location : Mount Roskill; Auckland, NEW ZEALAND

Injured : 1 **Dead :** 0

Abstract

A service station assistant was seriously burnt when compressed natural gas (CNG) was released from a bursting disc while filling a car. He rapidly turned the gas off at the valve near the filling nozzle. As he did so it ignited. After investigation it was found that a spring-loaded pressure control valve had been incorrectly set to deliver gas above the maximum allowable pressure and it is thought that this caused the burst disc to blow.
[fire - consequence, installation inadequate, burns]

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]

8765 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

The reactor was used to oxidise a pyridine compound with hydrogen peroxide using a maleic anhydride catalyst to form a pyridine-n-oxide. The reaction was recognised to be exothermic, therefore, hydrogen peroxide was added at controlled rates. Safety features included, circulation of the reactor content through 2 heat exchangers, a 200 cm pressure relief line to the atmosphere with a 0.7 bar bursting disc, a water quench tank situated 3 m above the reactor, which should dump automatically its content into the reactor should a sudden rise of temperature occur.
The peroxide addition pump should not operate if the quench tank was not full, the circulation pump was not operating or the reactor vent was not open to the atmosphere.
Probably due to an error of the operator, an accelerated rate of hydrogen peroxide (estimated to be about one order of magnitude higher than the normal addition rate) through the manual by-pass led to a sudden temperature increase. Although the quench tank was automatically activated, an explosion occurred a short time later and the entire reactor content was emitted either to the process area through the reactor manway, which was covered with an aluminium foil disk which should burst at 0.14 bar, or to the atmosphere through the pressure relief line.
[reactors and reaction equipment, operator error, high temperature]

Lessons

1. The closure of the reactor manlid during oxidation.
2. The removal of the by-pass on the peroxide transfer line.
3. The provision of an emergency dump tank on the reactor 200 cm vent line.

8766 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

After a reaction, in which raney nickel was used as a catalyst, had been completed, the reactor was to be flushed out by ethanol decanted from an 8 m3 capacity vessel. When the reactor was full, the manway was closed and heating started. After a certain period of time, the control room operator discovered that the temperature was 87 degrees C, well above the pre-set level of 70 degrees C. He shut off the heating but shortly afterwards the fire alarm in the area and the sprinkler system were activated. The flash fire was extinguished by the sprinklers system.

Post-accident investigation showed that the temperature control loop failed (controller output failed to update control valve position) and that the reactor manhole clamps were not fully tightened.

In addition, an examination of the remaining content in the ethanol vessel showed that the reactor was slightly overfilled. Consequently, ethanol vapours must have been emitted through the loose reactor manhole. The most probable ignition source could have been pyrophoric nickel material forced out of the reactor by the boiling ethanol at the partially closed manhole (the investigation revealed that all electric equipment in the area was functioning correctly).

[reactors and reaction equipment, fire - consequence, operator error, runaway reaction]

Lessons

1. Provide that the post-campaign flush-out batch sheet gives a warning of potential overfilling of the reactor;
2. Introduce proper manhole bolting practices;
3. Ensure that control room attendants carefully review all non-standard operations with local operators;
4. Update preventive maintenance plans to ensure that steam control valves and associated control loops are regularly checked.

8767 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 : 4 **Dead :** 0

Abstract

While 2 operators were charging fibre drums of a penicillin material into a reactor containing a mixture of acetone and methanol, an explosion occurred at the reactor manhole. The 2 operators were blown back by the force of the explosion. They were covered with wet burnt powder. Two other operators, who were opening drums 2 m away, were also blown back and covered with wet powder. Subsequently, all 4 operators were drenched under emergency safety showers. They suffered superficial burns to the hands and face and spent one night in a local hospital. They suffered no side-effects. The local fire brigade arrived at the site within minutes but no intervention was required (fire had already been put out by company personnel using fire extinguishers).
The incident was initiated by the ignition of solvent vapours, which resulted in a dust explosion of the dry powder. The solvent mixture in the reactor did not ignite. Tests carried out on the polyethylene liners inside the fibre drums showed that they were earthed to the reactor at the time of the explosion but were of the non-conducting type. The most probable cause of the ignition is an electrostatic discharge from the polyethylene bags during reactor charging.
[reactors and reaction equipment, fire - consequence, lack of earthing, charging reactor]

Lessons

1. Where possible, use properly earthed metal scoops instead of polyethylene bags to transfer dry powders.
2. Use conductive polyethylene bags only.
3. Avoid pouring dry powders into flammable solvents.
3. Carry out an electrostatic review on the whole plant and all the processes.

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]

9440 01 October 1984

Source : ICHEME
Location : , FRANCE

Injured : 0 **Dead :** 0

Abstract

The failure of a 10 inch bursting disc on a polystyrene suspensing polymer reactor resulted in approximately 24 tonnes of reactor products, polystyrene and water, being ejected into the atmosphere. No one was injured in the incident, the bursting disc which failed had been in service for eleven months. The planed replacement frequency for such a disc is three years, with a visual inspection annually.
Investigation into the incident revealed that the bursting disc which had failed was one of a new type i.e. a single disc, quicksert type made of nickel with a rupture tolerance of 15.1-16.7 bars the normal discs were of composite disc, quicksert type made from stainless steel /PTFE/ stainless steel with a rupture tolerance of 14.8-16.4 bars.
No other bursting disc of the new type had failed under normal operating conditions since they were installed.
The investigation could not find the reason for the inadvertent failure of the bursting disc. All operating conditions were found to be normal. In addition the modification to change the rupture disc to the new uprated type, had been subjected to a modification procedure.
[bursting disc failure, reactors and reaction equipment, material of construction failure, gas / vapour release]

Lessons

[None Reported]

8042 08 August 1984

Source : ICHEME
Location : ,

Injured : 3 **Dead :** 0

Abstract

A fire occurred on the hydrocracker while three instrument mechanics were dismantling the bonnet and servo motor of an ESV valve in the high pressure reactor circuit. The plant had been shut-down on two days before the incident occurred, for repairs associated with the recycle gas compressor.
The reactor circuit had then been depressurised but not gas freed. The extent of the fire was limited and it was extinguished after 45 minutes when the lines were purged with nitrogen. The three men suffered first and second degree burns but fortunately their faces were largely protected by their breathing apparatus.
[fire - consequence, flare, reactors and reaction equipment, cracking]

Lessons

Working on a live flare header is always a hazardous operation and needs a very careful examination of each step.
Detailed planning and close control is essential for this type of work.

8563 27 July 1984

Source : ICHEME
Location : , UK

Injured : 0   **Dead :** 0

Abstract

A fire occurred in the reactor product extrusion room and within a thyristor cabinet, which houses the speed control gear for the extruder motor and pelleter motor. The fire was extinguished using initially carbon dioxide and later a water hose. The investigation found the cabinet completely destroyed but not any surrounding equipment. The cause of the fire was not established but could have been caused at a terminal connection.
[fire - consequence, damage to equipment, reactors and reaction equipment, fire extinguisher]

Lessons

1. Thyristor control cabinets to be removed from product rooms and placed in switch rooms.
2. The cabinet purge air fan remained in operation throughout the incident and contributed to the fire. It also made the use of carbon dioxide ineffective as a fire extinguisher.

3032 18 June 1984

Source : INSTITUTE OF INSURERS
Location : Sumatra, INDONESIA

Injured : 0 **Dead :** 0

Abstract

During the removal of production tubing of an old well, gas and oil expelled from tubing ignited on exhaust of nearby power unit.
[fire - consequence, hot surface]

Lessons

[None Reported]

8038 31 January 1984

Source : ICHEME

Location : ,

Injured : 1 **Dead :** 0

Abstract

An operator was splashed on the back of his head and neck with HF (hydrofluoric acid/hydrogen fluoride) containing material whilst preparing an orifice drainage system for modification during a major plant overhaul. First aid treatment including use of an emergency safety shower and application of calcium gluconate gel was carried out in accordance with standing instructions and the operator then transferred to hospital where he subsequently had to undergo a skin graft operation. The operator fully recovered and returned to work.

Lessons

[None Reported]

123031984

Source : ICHEME
Location : ,

Injured : 2 **Dead :** 0

Abstract

An explosion occurred during decommissioning of a flare stack.
Work had to be carried out on the seal vessel and the damper plate could not be relied upon as a gas seal, a spade was installed in the 900mm line into the seal vessel. The seal vessel was emptied and all lines into the vessel, the flare stack and to the pilots were spaded. At this time the control valve was removed for servicing.
Approximately five minutes after the valve had been removed a rumble followed by an explosion occurred. Thirty seconds later a second explosion occurred, not as loud as the first, but this time flames came out of the opening where the control valve had been removed. Two workers nearby suffered shock.
The work was carried out using breathing apparatus and with the site fire brigade standing by.
The report stated the following conclusions:
As soon as the opening was created into the empty seal vessel, air was pulled in by the chimney effect of the flare stack. The system had not been purged and the flammable mixture so formed was ignited either by the flame or the pilots on the adjacent flare stack.
[design or procedure error, injury]

Lessons

The following recommendations were stated in the report:
1. Making the system free by nitrogen purging both seal vessel and stack. The nitrogen flow must be high enough to cause turbulent flow in the 900mm line and thus ensure through dilution of the flare gas. The purging period must provide 25 volume changes, sufficient to reduce the hydrocarbon concentration to less than 10% of the lower flammable limit.
2. Filling the seal pot with water to make sure that flare gas is completely displaced from the vessel internals.
3. Confirming the gas freeing by a laboratory test.

2836 19 December 1983

Source : HAZARDOUS CARGO BULLETIN, 1984, JAN.
Location : Offshore; Isle Of Wight, UK

Injured : 2 **Dead :** 0

Abstract

A marine transportation incident. Leak of 30% ammonia solution from a tank on a container ship. Valve on the tanks air vent valve was not screwed down properly and the movement of the ship at sea had caused the product to leak.
[Spill]

Lessons

[None Reported]

2786 01 November 1983

Source : LLOYDS LIST, 1983, 4 NOV.; THE VICTORIA ADVOCATE, 1983, 2 NOV.; HAZARDOUS CARGO BULLETIN, 1984, JAN.
Location : Victoria; Texas, USA

Injured : 0 **Dead :** 0

Abstract

A river transportation incident. An explosion occurred in a river barge tank during loading of acrylonitrile.
The explosion occurred 30 minutes after the start of loading. Due to stringent atmospheric emission controls, and because of the distance from the on-shore storage to the loading jetty, vapour from the barge was vented to a flare system on shore, through 600 feet of pipe. The most probable cause was from this flare system due to low level in seal pot.
The initial explosion occurred in the front compartment with 2 subsequent explosions. The resulting fire burnt for 5 hours.
[fire - consequence]

Lessons

The following corrective action was taken. At the point of unloading nitrogen is to be put into the barge as the acrylonitrile is pumped out - nitrogen blanketting. In addition barges are to be checked for oxygen content.

2705 30 August 1983

Source : LOSS PREVENTION BULLETIN, 057, 1-6; 057, 7-10, LOSS PREVENTION BULLETIN, 088, 25-30; GOLEC R.A, TANK FIRE, HYDROCARBON PROCESSING, 1985, 64, OCT., 97-98; LLOYDS LIST, 1983, 31 AUG.; FIRE PREVENTION NO. 169, 36-38.

Location : South Wales, UK

Injured : 7 **Dead :** 0

Abstract

The most likely source of ignition of the 6000,000 barrel floating roof tank fire was incandescent carbon particles discharged from the top of a 250 foot high refinery flare stack situated 350 feet from the tank. The 256 foot diameter x 66 foot high tank, which contained 348,000 barrels of crude oil at the time of ignition, was arranged within a standard individual dike. It had a single mechanical seal and was equipped with a 12 inch high foam dam but no foam delivery lines or outlets. Reportedly, there were several cracks extending over 11 inches on the single plate floating roof. Inspections of the roof a few days before the fire revealed oil seepage onto the roof deck. There had been no oil transfer in the 24 hours preceding the fire.

When first noticed, the fire involved about half the tank roof area. It progressively spread to the entire surface. Cooling water streams were positioned to protect two 138 foot diameter, 142,000 barrel fixed roof vacuum gas oil and fuel oil tanks situated 200 feet away. Oils were being pumped out of the three tanks in preparation for major foam attack wen, 12 hours into the fire, a violent boilover occurred in the crude tank. The ensuing fire covered 4 acres and destroyed or damaged much of the fire fighting equipment including two foam trucks. This was followed two hours later by a second less violent boilover. The major foam attack, which commenced 21 hours after ignition, continued for fourteen and a half hours before extinguishment was complete. The crude tank was destroyed, two fixed roof tanks badly damaged and 132,000 barrels of crude oil consumed.

This fire involved the use of 44 pumpers, 6 elevating platforms and 14 foam trucks from four nearby refineries and the public fire service. In addition, 66 commercial tankers and vehicles transported the 201,599 U.S gallons of 30% and 6% foam.

[fire - consequence, damage to equipment, fluid cracker]

Lessons

[None Reported]

2571 14 April 1983

Source : HAZARDOUS MATERIALS INTELLIGENCE REPORT, 1983, 22 APR.
Location : Addyston; Ohio, USA

Injured : 0 **Dead :** 0

Abstract

450 kg phenol spillage from overflow through vent pipe.

Lessons

[None Reported]

1111015 February 1983

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

During recommissioning after repairs, gas detectors were activated. The plant was shutdown due to a gas leak which was found at a failed pressure gauge connection. This had failed by fracture at a fillet weld, in the three quarter inch pipe connected to a main six inch propylene line. The failed component had been replaced five years previously after a fire. The replacement met original plant standards but not the current plant practice. The cracks that led to the leak were attributed to poor fabrication techniques. The weld profile was poor and led to a high geometric stress concentration factor at the weld toe. The fillet weld toes were also too close together at less than one quarter inch.
[mechanical equipment failure, weld failure, gas / vapour release]

Lessons

[None Reported]

2486 24 January 1983

Source : EUROPEAN CHEMICAL NEWS, 1983, 14 FEB.; ICHEME.
Location : , NETHERLANDS

Injured : 0 **Dead :** 0

Abstract

Explosion at ethylene plant during a non-routine start-up knocked out 2 furnaces.
Two naphtha cracking furnaces were built next to each other, using a common stack. While one furnace was in operation some burners of the other furnace had to be lit for freezing precautions. Before the main fuel gas valve could be opened, two important checks were carried out to avoid an explosive mixture in the fire box:
1. An automatic leak test via the interlock system is provided to check whether all burner valves are closed.
2. All 112 burner valves had to be checked manually to be in the closed position.
On the day of the incident, the leak test via the interlock system was in bypassed mode, several valves stood in open position and were not checked. The interlock system allowed main fuel gas valve to be opened, introducing fuel gas into the fire box. Minutes later the fuel air mixture violently ignited. Due to the pressure wave, from the explosion, emergency reliefs opened, the firebox, refractory structures and foundations were all deformed.
The cause was due to misunderstanding, miscommunication in a non-routine job, partly bypassing of interlocks and incomplete following of standard start-up procedures.
[human causes, damage to equipment]

Lessons

[None Reported]

2446 1983

Source : HALL J, HAZARDS INVOLVED IN THE HANDLING AND USE OF DIMETHYL SULPHOXIDE (DMSO), LOSS PREVENTION BULLETIN, 114, 9-14.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Explosion in a process reactor due to auto-catalytic decomposition of a mixture of Dimethyl Sulphoxide (DMSO) and p-nitrotoluene sulphonic acid.
In anticipation of the return to service of the refrigeration system for a reactor following maintenance, the 2000 gallon (9090 litre) stainless steel reactor was charged with DMSO and p-nitrotoluene sulphuric acid. However, the needed repairs were found to be much more extensive than previously anticipated, and the downtime for repairs was expected to be several days. The batch was put on hold with the agitator running, cooling water on the jacket, and steam valve closed. The batch appeared to be holding a steady temperature of 60 degrees C. Operating personnel were reassigned to other tasks for the duration of the maintenance outage. The vessel was left unattended for 5 days with no routine checks.
On the day of the accident, a foreman in an adjacent office reported fumes, and they were subsequently traced to the reactor vent. When the building foreman checked the temperature recorder, he found the reactor temperature to be 160 degrees C and rising at a rate of 3 degrees C/5 minutes. The 24 hour circular chart on the temperature recorder had not been changed since the batch was charged, and the foreman noted that the pen had traced a line at 118 degrees C for 3-4 revolutions prior to the rapid rise to 160 degrees C. The manual steam valve was found to be partially open, although the controller on the downstream automatic valve was set at zero. The water supply valve was found to be only partially open and was now opened fully. The black, bubbling reaction mass began to overflow from the loose manway opening. As the temperature continued to steadily rise (the last observed vessel temperature was 190 degrees C), the foreman directed that the building be evacuated. The reactor exploded as the last person cleared the area. The reactor itself was separated into four major pieces, and damage to surrounding vessels, steelwork, and nearby buildings was substantial. Subsequent testing determined that the reaction mass would decompose violently at temperatures in excess of 200 degrees C. The most probable sequence of events determined by the investigation team was that the automatic steam valve was leaking through, slowly raising the reaction mass to boiling temperature and slowly driving off water. As the water was removed, the more concentrated acid accelerated the decomposition of the DMSO, and the degradation by-products further de-stabilised the reaction mass. With most of the water removed, self-heating of the reaction, mass began at 120 degrees C.
[reactors and reaction equipment, damage to equipment, batch reaction]

Lessons

[None Reported]

9892 1983

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A vent on a diesel fin fan cooler was left open at the end of a shutdown. The normal leak testing did not detect this for reasons unknown. The leak ignited on a hot surface before it was detected.
[diesel, start-up, vent, spill, fire - consequence, safety procedures inadequate, operator error]

Lessons

1. When air testing for all parts of the unit must be checked. This vent was in fairly remote location on the inlet header to a fin fan cooler above a high pipe rack.
2. During start-up it is important for the outside operator to be alert for leaks.

1266730 November 1982

Source : ICHEME
Location : Los Angeles, USA

Injured : 0 **Dead :** 0

Abstract

During a bad storm and high winds, a unicracker flare stack was observed swaying towards the north east with two upper guy cables on the south side broken near the top attachment points.
A refinery emergency was announced as the guy wire failure created the possibility of the stack falling impacting a local substation, pipe trench areas and nearby roads.
The maintenance team developed a plan to bring in the crane and make guy wire repairs by hoisting personnel up to the guy wire attachments. Personnel in the man basket were required to wear high temperature protective clothing to provide protection against a large flare at the north stack.
Jumpovers were installed to allow the stack to be removed from service and to reduce flaring. The unicracking unit was shut down but not blanked. The two broken guy wires were replaced and temporarily tensioned.
[weather effects, plant / property / equipment]

Lessons

As the entire guy wires showed corrosion, it was decided to replace all of them in spite of the adverse weather conditions. Six days later, all nine guy wires were properly tensioned and the operation completed.
An analysis showed that the failed cables had expanded their zinc coating with the top sections having very severe corrosion. Due its location, the cables are frequently in a wetted environment. The refinery has since decided to use a newer type of galvanised cable, impregnated and coated with PVC plastic on all future replacements. This should protect against corroding.

7267 17 November 1982

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

When an HCl (hydrochloric acid) plant was being started up after maintenance, an explosion occurred in the exhaust section of the plant. The plant had been lit normally and the lighting port then closed. About 10 seconds later, the explosion occurred, severely damaging the exhaust fan. The source of ignition, beyond all reasonable doubt, was within the fan, and the exhaust gas was in the explosive range (W.I - to Hydrogen) at the moment of detonation.
[hydrochloric acid, start-up, damage to equipment]

Lessons

1. Look for improved lighting techniques
2. There was no operator error
3. Start up procedure carried out normally and correctly.
4. Look for improved means of preventing spread (fall to ground) of explosion debris (although
5. no injuries).
6. Replace N2 purge system with one in which a short page purge, is used just after lighting of the plant. Considerably more cost effective on N2 usage and significantly reducing chance of this type of explosion.

7256 June 1982

Source : LOSS PREVENTION BULLETIN, 074, 21-22.
Location : ,

Injured : 0 **Dead :** 0

Abstract

At a text book binding facility an underground sprinkler main burst. Within minutes, over 18,000 gallons of water flowed through a 7 inch concrete floor and cascaded through the book assembly area. The water was shut off within eight minutes, but problems remained, a major clean up effort was made and the sprinkler system had been put out of service.
To make temporary protection efforts complete, constant watch service was provided in the impaired areas. The underground main was repaired within the week, and normal protection was put into service without incident.

Lessons

[None Reported]

1132226 May 1982

Source : ICHEME
Location : , BRAZIL

Injured : 0 **Dead :** 0

Abstract

An explosion in an effluent gas treatment plant caused considerable plant damage, including destruction of the effluent gas blower but fortunately, no injuries to personnel. Air and vent gas (flammable ex acrylonitrile plant) were mixed and ignited by heat from an incinerator. As a result of electrical power failure, the incinerator was shut down and, while operators were removing catalyst from the associated reactor, three explosions occurred. Flammable gas, remaining in the plant absorber was purged to the vent stack and leaked into the incinerator which was still at about 500 degrees C.
[damage to equipment, accidental mixing, processing,

Lessons

The following measures were installed:
1. Ensure complete purging of flammable reaction gas.
2. Prevention of air inflow into the system.
3. Isolate the incinerator from the vent gas system by mean of a remote operated valve.

9192 22 May 1982

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A fire was deliberately started in a small wooden hut adjacent to a chemical manufacturing site. Strong winds blew burning brands into the chemical works and set fire to stacks of finished product (expanded polyethylene stored in the open against the perimeter fence). The fire spread to the despatch department and this activated the sprinkler system.
The local fire brigade was summoned and arrived within 10 minutes. No one was hurt but loss of saleable product caused problems with meeting customers requirements.
The company estimated the loss at £20,000 - £25,000 (1982).
[fire - consequence, storage]

Lessons

[None Reported]

9418 20 April 1982

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A quantity of isobutane and polyethylene powder was inadvertently discharged to atmosphere through an open vent valve on the No.3 settling leg of No.4 loop when the actuating air lines were reconnected to the 200mm shut off valve and the valve moved to the open position. The open vent valve was quickly closed by the foreman with no adverse effect.
The incident occurred because of a malfunction in a solenoid valve in the air control system of the settling leg shut-off valve. However, the air lines to the shut-off valve would not have been reconnected at all if the instructions laid down in the factory permit to work procedures had been followed. In addition, the escape would no have occurred if the operating instruction had been followed.
[gas / vapour release, design or procedure error]

Lessons

[None Reported]

2357 18 April 1982

Source : 100 LARGEST LOSSES 9TH EDITION, MARSH & MCLENNAN PROTECTION ONSULTANTS, 1986.
Location : Edmonton; Alberta, CANADA

Injured : 6 **Dead :** 0

Abstract

High pressure ethylene released from small bore instrument tubing leading to a gauge from a main line on the interstage piping system of a secondary compressor caused extensive damage to a low density polyethylene plant and adjacent plant. The unmanned compressor building was equipped with a combustible gas detector but it failed to operate due to a fault in the control room. 450 to 11000 lbs of gas escaped. Explosion.
[safety equipment failure, control failure, processing]

Lessons

[None Reported]

2328 04 February 1982

Source : ICHEME
Location : , LIBYA

Injured : 0 **Dead :** 0

Abstract

Fire at a stabiliser plant involving a flare and methane, caused by weld failure.
[fire - consequence]

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.

2314 03 January 1982

Source : HAZARDOUS MATERIALS INTELLIGENCE REPORT, 1982, 8 JAN.
Location : Galveston; Texas, USA

Injured : 0 **Dead :** 0

Abstract

A river transportation incident. 2 river barges collided with railroad bridge in foggy conditions and acrylonitrile leaked from damaged air vents onto deck where it ignited.
[collision, fog, damage to equipment]

Lessons

[None Reported]

2312 1982

Source : ICHEME
Location : , SOUTH AFRICA

Injured : 0 **Dead :** 0

Abstract

A methanol storage tank ruptured, leading to a spill, at the base due to two simultaneous failures. One was failure of the purge nitrogen control loop DP cell which opened the valve fully and the second was failure of the mechanical pressure vacuum safety valve in the closed position. Also the base to shell weld failed as a result of improper anchoring and some corrosion in spite of the weak roof seam weld. The safety valve failed due to severe corrosion and blockage of the copper gauze protecting the pilot valve exhaust.
[purging, mechanical equipment failure, safety relief valve failure]

Lessons

[None Reported]

110181982

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

Vapours being emitted from two vents in a benzene unit were ignited by lightning. Both emissions were found to be due to passing valves which have since been serviced. An investigation into the benzene vent escape was carried out. (Report does not contain results of investigation).
[mechanical equipment failure, gas / vapour release]

Lessons

[None Reported]

2311 1982

Source : RICHES P.A, AFTER PIPER ALPHA - THE INSURANCE ASPECTS, IN: OFFSHORE OPERATIONS POST PIPER ALPHA SYMPOSIUM, 6-8 FEBRUARY 1991, LONDON, INSTITUTE OF MARINE ENGINEERS, 1991, 2/1-2/9.

Location : North Sea, NORWAY

Injured : 0 **Dead :** 0

Abstract

Hydrocarbon liquids discharged through flare leading to pool fire causing extensive damage. Offshore.
[fire - consequence, damage to equipment]

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]

9430 19 November 1981

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A lagging fire occurred on a19.4 bar G steam turbine exhaust pipework. Flames were seen to be coming from lagging immediately below the steam turbine adjacent to the pipe support. The lagging was also smouldering locally in this area. The fire brigade were called and a dry powder extinguisher was used, the smouldering lagging was removed.
It is thought that a flammable solvent was being used by contractors, this had contaminated the lagging, did not have sufficient time to evaporate out and ignited causing the fire.
[contamination]

Lessons

[None Reported]

2273 28 October 1981

Source : ICHEME
Location : , UK

Injured : 1 **Dead :** 0

Abstract

A steeplejack working in the power station stack was standing on a grating when it collapsed and he fell through. The investigation found the grating had not been replaced in the correct manner and that the triangular grating was too small resulting in it being supported on two sides only. Further accidents could have happened due to the poor housekeeping, damaged handrails and gratings.
[damage to equipment, design or procedure error]

Lessons

[None Reported]

2261 29 September 1981

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

Faulty temperature control led to bursting disc failure during vinyl chloride polymerisation.
[control failure]

Lessons

[None Reported]

2256 07 September 1981

Source : ICHEME
Location : , UK

Injured : 0   **Dead :** 0

Abstract

Vinyl chloride release when autoclave bursting disc failed due to fault on water rotameter to stirrer gland.
[bursting disc failure, instrumentation failure]

Lessons

[None Reported]

2247 19 August 1981

Source : ICHEME

Location : , UK

Injured : 0   **Dead :** 0

Abstract

Release of vinyl chloride from autoclave bursting disc due to failure of a control instrument. Instrumentation failure.

Lessons

[None Reported]

1048212 August 1981

Source : ICHEME
Location : , UK

Injured : 1 **Dead :** 0

Abstract

On 12 August 1981, a contractor working on the site of a large chemical company was overcome by chemical fumes whilst working inside a vessel. Fortunately he was rescued, but not without difficulty, and subsequently recovered.
The man was re-coating the inside of the vessel with a mixture of rubber and resin dissolved in toluene. A gas test on the vessel, a Vessel Entry Certificate and a Permit to Work had all been obtained. The safety requirements had been stipulated, and included the need to wear protective clothing, air supplied face mask, the provision of a fresh air line into the vessel to give forced ventilation, explosimeter tests, and the need for an observer outside the vessel.
A number of the safety conditions were broken. The man entered the drum without a mask (it was handed down to him, but there is doubt as to whether he put it on). A dedicated observer was not present. There was no air line into the vessel. Explosimeter tests were not conducted.
A colleague, alerted by the lack of activity in the vessel looked in and saw the collapsed contractor. He then entered the vessel without mask or harness, failed to lift the contractor, and had to leave the vessel because the fumes were overwhelming. The site emergency services were summoned, but their arrival was seriously delayed because the telephone was faulty and they did not hear the nature or location of the emergency. Finally, the rescue was made more difficult because the contractor was not wearing a harness. When he started to revive in the fresh air he became violent and abusive, and had to be physically restrained.
[maintenance, entry into confined space, repair, air line, breathing apparatus, tank, asphyxiation, operator error, shift change, competency lacking, maintenance procedure error, contractor error, atmosphere not tested, management system inadequate, permit to work system inadequate]

Lessons

The following recommendations were made:
The report:
1. Emphasises the need for implementing fully the requirements of the Permit to Work and related certificates.
2. Recommends a clear requirement to use harnesses.
3. Emphasises the need for a caller reporting an emergency to wait until the fireman on duty repeats any message.
4. Asks for the findings to be relayed to the contractors.
In addition, the main body of the report makes it clear that the supervision of the job was less than satisfactory. This was exacerbated by the timing of the work which was started just before a shift change-over.

2222 05 July 1981

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

Autoclave bursting disc ruptured at beginning of a vinyl chloride polymerisation due to instrument defect leading to cooling water supply failure. Instrumentation failure caused this release.
[bursting disc failure]

Lessons

[None Reported]

2197 15 May 1981

Source : ICHEME
Location : , UK

Injured : 0   **Dead :** 0

Abstract

Autoclave bursting disc ruptured at the beginning of a vinyl chloride polymerisation due to premature failure of the disc. Bursting disc failure. Leak.
[bursting disc fails prematurely]

Lessons

[None Reported]

2190 29 April 1981

Source : ICHEME
Location : , ITALY

Injured : 0 **Dead :** 0

Abstract

Explosion at a refinery plant involving a chimney and propane.
[refining]

Lessons

[None Reported]

7338 13 March 1981

Source : LOSS PREVENTION BULLETIN, 054, 25.
Location : Arkansas, USA

Injured : 0 **Dead :** 1

Abstract

A worker died after being burned by monochloracetic acid. Attempts to wash the substance off in an emergency safety shower failed. Fatality.
[burns]

Lessons

[None Reported]

2973 1981

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

Emission of dense black smoke from the pre-heater stack was noted by a unit operator during routine checks. Similar emissions had occurred previously due to hydrocarbon liquid carry over from the effluent water feed vessel on the deodoriser.
However, when it was realised that flue gas was not opened to the stripper tower and thus foul gas was not passing over to the feed vessel and pre-heater, the possibility of liquid being carried over into the pre-heater was discounted. This assumption was supported by level checks in both stripper tower and effluent feed vessel proving normal.
Closer investigation of the furnace revealed flames coming from the heater gables and header boxes, and from the firing fronts at both ends. Muffled explosions were heard from within the furnace and the smoke from the stack changed to a yellowish brown colour indicative of waxy distillate (feedstock) burning. It was decided that a furnace tube had failed and the emergency procedure for this event was put into effect.
Fuel supplies were isolated, the feed was isolated at the feed pumps and at the inlet to the risers, and the diversion valves to the main fractionator opened. No attempt was made to open up the pre-heater to the blowdown system or to commission blowdown steam. The base level in the main fractionator had risen and the feed diversion valves to this vessel were closed to prevent a possible back flow into the pre-heater. The intensity of the fire had subsided and the situation was regarded as being under control. Senior operations and day staff `on-call' officers were notified of the incident and arrived at site shortly afterwards.
[tube failure, fire - consequence, processing]

Lessons

1. A suitable system modification to eliminate carryover of light hydrocarbon liquid with foul water from the LP separator to the deodoriser is required. In the meantime, it is recommended that the foul water be directed to closed drain.
2. The equipment associated with the blowdown system should be over hauled to produce a reliable system in which the operators may place confidence.
3. An in-depth study should be carried out into the selection procedure for air operated valves.
4. Aspects to be considered should include the means of driving the valves, the means of protecting their operating mechanisms, routine maintenance procedures, on-stream checks, testing and accessibility.
5. The development of operations personnel with intimate unit knowledge and long experience should be a recognised and implemented objective.
6. The snuffing steam system should be clearly identified and all operations personnel instructed in its purpose and use.

117 1981

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

Abstract

About three and a half hours after taking feed out, a number of explosions occurred in the main fractionator reflux drum and flare system.
There were no injuries and only minor damage was caused to equipment.
Feed to the unit had been stopped, the gas compressor taken out of commission and catalyst unloading from the regenerator to hoppers was in hand.
The plant manager noticed a long vapour plume on the flare and arranged for the waste gas stripper overhead disposal to be changed from the flare to the CO boiler.
The vapour discharge from the flare ceased and was replaced by yellowish smoke. There was a short blast with a large amount of vapour formed, followed a few seconds later by a second blast from the direction of the main fractionator reflux drum. A large volume of blackish-yellow fumes was emitted from the flare stack.
These explosions happened immediately after the waste gas stripper exhaust gas changeover was made. No flames were observed. Some pieces of fireproofing fell from the reflux drum structure.
Fuel gas make-up to the flare and to the reflux drum were increased and two further short blasts were heard from the flare. Catalyst unloading was stopped and the air compressor taken out of commission.

Lessons

[None Reported]

1018012 February 1980

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

At approximately 01.15 hours, an explosion protection system on a No.1 unit detonated. A yellowish-blue flame was seen from the No.1 Pulsaire box vent and a dull explosion was heard by two operators. The site alarm was raised. An initial examination of the Pulsaire box showed that the supressant, chlorobromomethane, had coated the filter bags. No external damage to the unit was observed and no personnel were injured.
Damage to mill hammers, the mill cover ('washboard') and one mill feed screw flight was caused by extraneous material in the system. Although no metallic object was found, it was suggested that such material was present and provided the spark which caused the explosion. The explosion protection system activated as designed and no damage to the unit was sustained.
[metal, grinding/milling, grinder, vent, explosion, spark, solids processing equipment, dust, damage to equipment]

Lessons

The following was recommended:

1. The importance of magnet checks, currently carried out once per shift, should be re-emphasised to supervisory staff and all operating personnel.
2. Routine cleaning of the blender vent should be carried out weeklyrefitting after a recalibration exercise.

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]

5653 1980

Source : ICHEME

Location : ,

Injured : 1 **Dead :** 0

Abstract

A heavily fouled heat exchanger tube bundle was being cleaned by a specialist contractor using a water/sand mixture at a jet pressure of 400 atmospheres.
The spray gun was held under the right arm and guided with the left hand. The discharge valve lever was operated by the right hand.
The contractor got his protective glove caught between the valve lever and the top of the gun when he released it. At that moment with the jet not shut off, the contractor was forced by the counter pressure to turn through an angle of 180 degrees and stumbled; the jet hit him on the upper part of the right thigh. The contractor was seriously injured and remained off work for many months.
The area was surrounded with sheet steel screens which prevented the jet from hitting other personnel.
[cleaning, operator error, near miss, injury]

Lessons

High pressure jetting is potentially very dangerous. Facilities should be safe by design and operators should not do this type of work alone.

1367 1980

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 1

Abstract

A man was heating a hollow aluminium piston without first drilling a vent hole in it. The piston exploded, killing the man. In this case tests on a similar piston showed that the gas was propane. The piston had been used to compress propane and some of the gas is believed to have diffused through the casting which must have been slightly porous. Fatality.
[explosion]

Lessons

Carefully vent hollow pistons before cutting or heating them.

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.

4426 1980

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

Fitters working on a flare line system wearing air-line breathing apparatus reported that insufficient air was reaching their masks.
The breathing air supply was taken from an octafiner instrument air system and investigations showed that the air supply feeding the masks had been accidentally switched off.
Isolation and venting of instrument air was carried out from the control room and the wrong lever was inadvertently operated when it was decided to carry out instrument maintenance work on another unit thereby cutting off the instrument air supply to the octafiner.
[operator error]

Lessons

5798 1980

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

The pressure in the flare system rose during a period when one of two flare stacks had been shut-down for maintenance.
The drain from the molecular seal was found blocked and flushed free but this only partially reduced the back pressure on the system.
Examination of the shutdown flare revealed that the passage through the seal was virtually choked with dirt, rust and iron sulphide.
Similar deposits were found in the other molecular seal when the flare was taken out of service.

Lessons

It is important to ensure that the drain from the seal is kept free at all times.

7474 1980

Source : ICHEME
Location : ,

Injured : 1 **Dead :** 0

Abstract

A steeplejack fell 80/90 m inside a stack. Fortunately his fall was cushioned by coke and dust in the bottom of the chimney otherwise it would have been fatal. Nevertheless he received serious injuries and one leg was amputated.
The man was employed by a specialist firm of stack builders and repairers, considered to be the most reputable available for this particular work.
The accident occurred when two men were working on a platform suspended within the stack from two 'I' beams across the top. One of the 'I' beams overturned and tilted the platform. One man fell off but the other managed to grab a cable and pull himself to safety.
[injury]

Lessons

[None Reported]

7416 1980

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

Two contractors were working on the tip of a new flare which had recently been erected. An upset on the adjacent hydrocracker complex resulted in a heavy discharge from the sulphur unit stack.
The fumes were carried by the wind straight onto the top of the new flare. The contractors suffered physical reaction to the fumes and had to use the emergency escape breathing apparatus and make their descent in the safety basket held in position adjacent to their work level by a standby crane. In this case a degree of pre-thought and planned attendance avoided a more serious incident.
[weather effects, construction]

Lessons

The consequences of process upsets must be taken into consideration when adjacent work is in progress.

8079 1980

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

Operators were alerted by the high level of noise coming from the compressor house. This was caused by excessive vibration from a reciprocating hydrogen compressor and from gas escaping from a broken 0.75 inch relief line to flare. The damaged compressor was immediately shut down and the fire brigade was called to stand by until the equipment was made safe. No-one was injured in the incident.
After being shut down, the compressor was dismantled and checked by maintenance department. Investigations showed that five of the eight bolts in the connecting flange between the cylinder and the intermediate piece (joining the cylinder with the crankcase) were broken.
The collar in the cylinder clearance volume adjustment arrangement was cracked and several broken `O' rings were found within the assembly.
The compressor cylinder support foot bracket was also loose on its foundation block.
Similar problems had occurred before, small cracks and a pipe fracture had been found during the past year and a cylinder flange bolt failure had been reported only one month previously.
Investigations indicated that the bolt fractures were due to metal fatigue. New bolts (all of a type with cut threads) drawn from stores were found with small cracks in the threaded section. It appears that these small cracks initiated the metal fatigue fracture that led to the compressor breakdown.
The damage to the cylinder clearance volume adjustment arrangement had probably occurred when liquid had been carried over into the compressor at some earlier date since the liquid level in the separator and filter drum were found to be normal after the incident. Examination of the instrumentation associated with the liquid knock-out system however showed that the high level trip would not have functioned due to an instrument fault and there is some doubt as to whether the high level alarm would have operated also.
The investigation also noted how important it was to ensure that the steam tracing on suction side piping was functioning properly to prevent the formation of liquid droplets in cold weather.
[material of construction failure]

Lessons

The compressors have been fitted with bolts that have a rolled thread. These do not have the small cracks associated with cut threads which give starting points for a metal fatigue crack.
Pipework and vessels associated with the compressor must be closely monitored to determine if crack formation is still arising.

9711 21 December 1979

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

An explosion occurred in a styrene plant flare stack, splitting the stack in three places. Two further explosions took place while the plant was being shut down.
Bursting discs, protected the relief systems on the associated main condensers, had failed and two condenser relief valves were passing. Air had, therefore been pulled into the stack. The oxygen analyser did not fully respond to this condition and an explosive mixture was formed at and around the flare tip.
The first explosion damaged the flare base and air sucked in via this damage led to the subsequent two.
[damage to equipment]

Lessons

The report contains a range of recommendations useful for their general applicability to flare stack operations. Only the most significant (in relation to this incident) are summarised as follows:
1. Ensure integrity of safety valves , associated pneumatics and bursting discs.
2. Implement pressure test procedures for use before start-ups.
3. Ensure integrity and sufficient numbers of oxygen analysers.
4. Provide positive purge gas supply.
5. Review philosophy of having vacuum and flare systems interconnected.

1932 30 November 1979

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 1

Abstract

While trying to remove a plug from a pipeline containing hydrofluoric acid under pressure, sufficient pressure was applied to a wrench that the pipe ruptured. Investigation showed that the pipe had suffered corrosion by acid. The release of hydrofluoric acid caused the victim's protective hat and face shield to fall off. He failed to reach a safety shower immediately and also did not remain under the shower for a sufficient time.
[maintenance, hand tools, fatality]

Lessons

MEDICAL CARE
1. Hospitals and ambulance units in the area to be made aware of the risk of hazardous substances and their treatment.
2. Flip files to be maintained in Emergency Departments of hospitals containing above information and to include names and telephone numbers of industrial physicians and to be regularly updated.
3. Emergency room doctors be provided with full details of industrial accidents including time, treatment given, and person to contact, to accompany treatment kit in ambulance.
4. Doctors involved in care of this victim ensure that details of the case be disseminated in popular medical literature.

OCCUPATIONAL SAFETY
1. An immediate survey and ongoing inspection of all acid bearing equipment at refinery to assess state of corrosion and warn workers of damaged areas.
2. Joint management/worker programme to alert other users of HF acid to circumstances of this accident.
3. It is incumbent upon both management and workers to improve communication with intention of maintaining safe working conditions.
4. Safety regulations as already laid down to be prominently displayed at refinery.
5. All employees to prove knowledge of relevant safety regulations within one month of commencing employment.
6. Protective clothing regulations to be enforced.
7. Regular accident drills similar to fire drills be carried out routinely.
8. Pipes containing acid to be identified.
9. Shower locations to be prominently posted with suitable lighting, fluorescent paint, etc. and be no further than 6 metres from any acid work area.
10. Daily check of shower alarms, radio telephones and stock of neutralising solution.
11. Medical officer or plant nurse to be a member of the safety committee.
12. Control room to be staffed whenever work of any kind is being performed, at all times and on all shifts.
13. Safety regulations in Operator's Manual to be placed at the beginning of the book.
14. Complete written and verbal communication of shift changeover to be maintained in duplicate.

OCCUPATIONAL HEALTH
1. Every employee to prove to medical department that he knows how to respond to acid exposure to himself and others.
2. Protocol on First Aid be placed prominently at key locations.
3. Supplies of HF neutralising solution be kept at key locations.
4. Wallet cards' similar to that used by others, to be issued to every employee, and to include name and phone number of physician contact.
5. Medical Officers in refinery and manufacturing industries to pool their knowledge and standardise treatment.
6. Ministry of Labour, Occupational Health Branch to supervise health and safety procedures in industrial areas and assist co-ordination with medical facilities.
7.Treatment kit available 24 hours a day to accompany victim to the hospital.

9443 27 November 1979

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

The failure of a bursting disc on a polyvinyl chloride reactor resulted in the emission of reaction products.
An investigation into the incident revealed that:
1. The bursting disc which had failed at 135 psig had a burst pressure of 145 psig.
2. The bursting disc which had failed was an incorrect one for the duty. The normal bursting discs for such a duty would have had a burst pressure of 235 psig.
The incorrect bursting disc had been installed four weeks earlier as part of a planned preventative maintenance programme. The maintenance technicians involved had followed the prescribed maintenance check list for such an activity but unfortunately there was inadequate information on the check list regarding the bursting disc requirements i.e. size, type, pressure rating, securing both torque loading etc., as a result of the inadequate of the importance on the check list and a lack of supervision the technicians installed the incorrect bursting disc.
[bursting disc failure, gas / vapour release, installation inadequate, reactors and reaction equipment, polyvinyl chloride (PVC)]

Lessons

1. Bursting discs for differing duties must have appropriate identification tags attached.
2. Maintenance check lists for such activities are to give adequate information on the bursting disc which is to be installed.
3. Prior to installing any bursting discs, supervisors and technicians are required to ensure that bursting discs are checked to ensure that they are the correct one for the duty and free from damage.

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]

9396 08 November 1979

Source : ICHEME
Location : , UK

Injured : 1 **Dead :** 0

Abstract

A bursting disc and reactor seal failed on a PFTE-lined autoclave in an autoclave room. The autoclave was being used to investigate the dimerisation of vinyl acetate. A cloud of sooty material escaped, filling the room. The works fire brigade were called but no fire fighting equipment was required. Only one person was present at the time of the incident.
The autoclave seal and bursting disc failed probably because of the dynamic shock of a rapid pressure and temperature rise resulting from a runaway reaction.
[seal failure, reactors and reaction equipment, spill, bursting disc failure]

Lessons

[None Reported]

1906 08 September 1979

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

Explosion occurred in the flare stack and was attributed to polymerisation of unstabilized liquid hydrogen cyanide in a small balance line, near the hydrogen cyaniden flare. Small pipeline of about 2 inch in diameter was split open.

Lessons

[None Reported]

1341 01 June 1979

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A carriage air line (supplied from large cylinders) was prepared for fitter's preparatory to entry on a floating roof tank. A new hosereel had been made up and a new male coupling installed into the air line. The female coupling attached to the valve assembly on the cylinder was an older variety. The set was tested by taking the pressure before and after the reducing valve and finally physically donned and worn for a short while before final issue. The carriage breathing apparatus set was taken to the site of the tank and the facepiece, belt assembly etc., taken to the tank top platform. The valve was opened and the fitter put on the mask. As he was about to descend the stairway to the roof the air supply cut off suddenly. The carriage breathing apparatus set was taken back to the Fire Station and again tested satisfactorily and a new facemask fitted by the Fire Station staff and returned to the tank. Once again, the sudden air loss occurred. At this stage, the carriage breathing apparatus set was returned to the Fire Station and a thorough investigation instigated.

Examination of the internals of the female coupling revealed that the internal spring operated plunger could slide through the new coupling, thus shutting off the air supply. In some cases, tests showed that the plunger could be depressed allowing air flow. However, a shock or jar easily allowed the valve to close. The main cause of the problem was the increase in the internal diameter of the new male coupling from 5.1mm to 6.0mm. Checks were made on all couplings in the refinery and it was noticed that the internal coupling had changed on some four occasions, in both shape and materials of construction. It was found that the older male coupling was perfectly safe to use in either old or new female couplings.

The refinery concluded that the incident occurred due to a change in design of the bayonet type couplings, which are sold individually, male or female, or as matching pairs. The design change at fault was the increase in the internal diameter of the male half of coupling which might initially mate sufficiently with the female half but could be shaken slightly resulting in a sudden shutting off at the valve.

[entry into confined space, design fault]

Lessons

The refinery carried out an immediate survey of all breathing apparatus outlets throughout the refinery, and except in situations where only matching pairs are concerned it withdrew all offending overbored male connections until such a time as new female couplings could be obtained and installed, the later being placed on immediate order.

1832 02 March 1979

Source : RAMADORAI, R, EXPLOSIONS IN THE FLARE SYSTEM OF AMMONIA PLANT DURING COMMISSIONING PERIOD, LOSS PREVENTION AND SAFETY PROMOTION IN THE PROCESS INDUSTRIES, 3RD INTERNATIONAL SYMPOSIUM, BASLE, SWITZERLAND, 15-19 SEPT, 1980, 1/161-1/173.

Location : Sindri, INDIA

Injured : 0 **Dead :** 0

Abstract

Two explosions occurred in the flare system of an ammonia plant. The seal pot and flare main near the compressor were ripped open at welded points. Cause due to air entering nitrogen system and a passing valve caused an explosive mixture to form.
[unwanted chemical reaction]

Lessons

[None Reported]

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.

1800 1979

Source : LOSS PREVENTION BULLETIN, 117, 18.
Location : ,

Injured : 1 **Dead :** 0

Abstract

A runaway reaction occurred in a batch reactor. Although the over pressure was safely vented through a bursting disc, a bellows in the vent line burst.
The process was normally operated at 100 degrees C and atmospheric pressure with phosphorus trichloride as one of the reactants. For the batch in question, the ratio of phosphorus trichloride to the other reactants became incorrect and resulted in the formation of "lower oxides of phosphorus" (LOOP).
The LOOP was inadvertently heated to 110 degrees C and resulted in a runaway reaction. The temperature in the reactor increased to 200 degrees C and beyond, phosphine gas was formed, the pressure rose, and the bursting disc ruptured. The bursting disc pipework discharged into the atmosphere to a high level via a liquid catchtank. However, very soon after the disc rupture the vent pipe bellows burst, resulting in a spray of material and a pillar of fume and flame. An operator making an escape was burned by corrosive chemicals but not seriously injured.
[batch reaction, emergency vent, burns, injury]

Lessons

An intensive investigation looked into the causes of the accident, but at the same time studied a number of associated factors including the bellows failure. The bellows were found to have completely disintegrated. Pieces of PTFE recovered were examined, and it was considered that the failure was due to over pressure rather than thermal degradation. Because the reactor emergency vent was not specifically designed for the events that actually occurred, it was considered likely that a pressure of several bars had been reached upstream of the disc.
Although not a cause of the accident, the bellows failure exacerbated its results. It highlights the importance of correct specifications and positioning of bellows to prevent them from being a weak link in a piping system.

1776 14 November 1978

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

Under high wind conditions a flare stack collapsed due to all guy ropes being severely corroded and those on the south side failing. The flare stack fell partly over a roadway. The relatively rapid corrosion, they had been in use for only ten years, was attributed to the use of ungalvanised wire rope in a corrosive environment. The flare stack was isolated at the time when the plant was decommissioned.
[strong winds, corrosion]

Lessons

The following recommendations were made:
1. Galvanised steel wire rope should be used for guying.
2. Guy ropes should be greased to protect them from the environment.
3. P.I.D and contract inspection and maintenance of guy ropes and associated equipment should be carried out at regular intervals. 4-5 years suggested. Initially, re-greasing should be carried out on a similar time scale, but varied in the light of experience.
4. Guy ropes should be renewed when there is evidence that the galvanising is starting to deteriorate.
5. Guy rope anchor points should be kept clear of pools of water and debris.

1094618 September 1978

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A three feet long hydrogen flame was observed at the top of the vent stack of a hydrochloric acid plant, about five minutes after the plant had been put on work. The flame extinguished itself once the plant was tripped. After being checked over and given a routine wash, the plant was put back on work and ran steadily until the next morning, when it was taken off work to remake a leaking joint below the bursting disc. The next start up of the plant was routine, and no flame was observed. The vent stack was not damaged by the fire. On investigation, no evidence was found of any internal explosion in the plant, and the bursting disc remained intact. The failure of the joint below the bursting disc was not found to be related to the flame incident.
[fire - consequence, start-up]

Lessons

Investigators concluded that a flame was propagated through the plant from the combustion chamber to the vent stack during the transition from excess air to excess hydrogen conditions in the plant vent gas stream.
It was recommended that excess hydrogen be kept as low as possible at the start up of the plant. Action should therefore be taken to improve the accuracy of the hydrogen and chlorine flow meters.

1655 03 June 1978

Source : EVENING GAZETTE, 1978, 3 JUN.
Location : Teesport; Cleveland, UK

Injured : 0   **Dead :** 0

Abstract

Naphtha spillage and fire. Pipework and lagging round flare stacks damaged but fire brought under control in 1 hour.
[fire - consequence, damage to equipment]

Lessons

[None Reported]

1633 01 May 1978

Source : ICHEME
Location : , INDONESIA

Injured : 0 **Dead :** 0

Abstract

An explosion and fire occurred on a gas stabilisation unit involving natural gas liquids (NGL), LPG and cone roof tank. Source of ignition was the flare.
[fire - consequence, storage tanks]

Lessons

[None Reported]

1602 16 March 1978

Source : ICHEME
Location : , SWEDEN

Injured : 0   **Dead :** 0

Abstract

A fire occurred involving a flare and naphtha at a refinery utilities area which was caused by valve leak. Source of ignition was flare.
[fire - consequence, refining, valve failure]

Lessons

[None Reported]

1582 11 February 1978

Source : ICHEME
Location : , SPAIN

Injured : 0   **Dead :** 0

Abstract

An explosion occurred on a petrochemical plant. Source of ignition was flare.
[operator error, processing]

Lessons

[None Reported]

9375 30 November 1977

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

An explosion occurred in the knock-out drum at the base of the toxic vent header flare stack of the acrylonitrile plant. The explosion blew a hole approx. 9x4 ft in the knock-out drum. The flare stack was damaged extensively.
A fire followed consistent with the combustion of a pool of liquid lying in the base of the drum. The fire was contained by the works fire brigade but allowed to burn itself out because of the toxic nature of the material involved. At the time of the explosion the main nitrogen purge to the toxic vent header had been shut off in error. This allowed back diffusion of atmospheric oxygen from the flare tip. A contributory was the low level of plant production prior to the incident. Some hydrogen cyanide was vented to the toxic vent header through a ruptured bursting disc or a tank and displaced a mixture along the flare line. On mixing with some atmospheric oxygen the mixture was ignited by the flare tip. The flame front travelled back to the knock-out drum causing an explosion. No major toxic leak occurred.
[high pressure, spill, hydrogen cyanide, nitrogen, venting, flaring, flare, explosion, flammable atmosphere, design or procedure error]

Lessons

1. Closer adherence to plant operating procedures was required. 2. Training of plant staff to be improved.
3. An effective low flow alarm was to be installed in the nitrogen purge line.
4. When the plant was in normal operation further information was to be obtained on the typical oxygen concentrations through the flare system under various conditions.

7225 12 October 1977

Source : LOSS PREVENTION BULLETIN, 057, 23-24.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A catalytic cracker compressor tripped out and a large volume of gas/liquid was discharged to a flare. This flare had no condensate knock-out facilities and a very, large flare was produced initially. With a fairly strong winds blowing, the flames and smoke were projected over the tank farm to the immediate north. Immediately following this incident a tank rim seal fire was reported on an adjacent tank, in which a blend of 2.5 million gallons of petrol was being made. The tank was almost full, with the tank mixers still in operation.
A passing tank dipper heard a small bang from the tank and then noticed flames appearing above the rim of the tank. He immediately summoned the fire service who quickly extinguished the fire with foam. As no foam dam was present on the tank a liberal application of foam compound was required to extinguish the fire.
The cause of the fire was either:
1. A small quantity of burning liquid landing on the tank roof and igniting the vapours at the rim.
2. Vapours from the tank being ignited from the flame or heat of the flare giving rise to a flash back effect.
The quick discovery of this fire allowed firemen to go on the tank roof and tackle it before it got out of control.
[fire - consequence, storage, cracking, gasoline]

Lessons

The incident has reinforced the need for two requirements:
1. Knock-out facilities and disposal facilities for large slugs of hydrocarbon condensate being discharged to the flare.
2. Foam dams on all floating roofs containing Class 1 products.

9478 03 October 1977

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

An operator had just replaced the ignition port cover on a hydrochloric acid plant burner. Normal start-up was continued by closing the drain valve in the product run off line and opening the combustion chamber condensate line. At this point a passing mechanic noted that a three foot hydrogen flame was burning from the vent stack. The plant was shut down. No evidence of an explosion or internal burning was identified. No source of ignition was identified for the flame. A small amount of charring occurred on the UPVC stack.
[fire - consequence]

Lessons

[None Reported]

4301 30 June 1977

Source : ICHEME
Location : ,

Injured : 1 **Dead :** 0

Abstract

Two operators went to check for liquid carryover in the condensate drum at a No. 2 flare. One of the operators opened the drain valve, and it is assumed that the sour gas released overcame him since he collapsed, and in falling struck the back of his head and sustained concussion.
Shortly before the incident a temporary enclosed drainage system had been installed, consisting of a 1' line between the condensate drum and the No. 2 flare knockout drum. With the installation of this drainage system it had been assumed by the refinery fire service that there was no further need for airline masks at this location, and the equipment was therefore removed.
The airline masks have now been returned to the location, supplied by a permanent air supply line.
A permanent enclosed drainage system is to be installed, estimated at costing £15,000 (1977).
[leak, personal protective equipment, processing]

Lessons

[None Reported]

98 13 April 1977

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

No. 1 stack on a boiler house was taken out of commission for repairs to its top section. To facilitate these repairs scaffold was erected around the top section of the stack by a contractor.
A strong wind was blowing and consequently no one was working at the top of the stack. At approximately 11.50 hours, a scaffolding plank, size 10' x 1", fell approximately 280' from the scaffolding, and landed in a car park 75 feet from the base of the stack. The plank broke into two main pieces on impact, but fortunately there was no injury to persons or equipment.
[strong winds, near miss]

Lessons

[None Reported]

2138 02 March 1977

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A large fire broke out in the vicinity of a crude oil desalter feed pump. The fire was extinguished in less than 2 minutes by unit operators using three 150 kg dry powder fire extinguishers. A commendable fire attack and indicative of the power of dry powder when properly used.
The failure of the pump bearing caused a fracture of the pump's mechanical seal, with leakage of crude oil at a temperature of 130 degrees C. The friction heat generated by the pump shaft on the failed bearing caused the ignition of the oil. Damage is estimated within the £25,000-£50,000 (1977) range which includes that for the pump and electric motor, and electric cables and instrumentation cables damage from the flames of the fires drawn up by the fin fan air coolers sited above the pump.
[fire - consequence, bearing failure, damage to equipment, processing]

Lessons

[None Reported]

5904 1977

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A runaway reaction occurred in a batch polymerisation reactor.
The bursting disc failed to burst and the polymer escaped through some of the reactor flanged joints, covering the reactor in brown sticky polymer.
The bursting disc failed to burst because it had been fitted on the wrong side of the vacuum support, thus raising the effective bursting pressure of the disc from 150 psig to 400 psig.
Calculation showed that for the class 150 flanges fitted to the reactor branches, their bolts would stretch and the flanges leak before the reactor or associated pipes burst. However this gratuitous pressure relief cannot obviously be relied on for flanges with a higher pressure rating.
[polymerisation, reactors and reaction equipment, bursting disc, flange, runaway reaction, installation inadequate, spill]

Lessons

Consequently new designs for bursting disc assemblies have been developed which will be harder to install incorrectly and easier to check after assembly.
This entails permanently attaching the disc to the vacuum support during manufacture, identification tags and arrows, and where possible so designed that inversion is not physically feasible.

1287 12 December 1976

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

An oil storage tank collapsed by vacuum after transfer and cooling to atmosphere. Vent of the tank was blocked by ice.
[flow restriction]

Lessons

[None Reported]

8048 October 1976

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

Abstract

It was believed that a can of gasoline was left open after use and that the escaping vapour percolated to an adjacent room in which there was electrical equipment. The electrical equipment came on under the control of a thermostat, and ignited the vapour/air mixture.
The fire was rapidly extinguished by the use of five fire extinguishers, which were located within or in the neighbourhood of the laboratory.
The company revised of its methods of storing flammable liquids and control of ignition sources within the laboratory.
[fire - consequence, laboratory work, gas / vapour release, near miss]

Lessons

Laboratories are particularly vulnerable in many companies as the containment of hydrocarbons and use of intrinsically safe or flameproof equipment do not apply because of the nature of the work. Laboratories must be aware of the following safe practices:
1. Limitation of sample sizes to the minimum.
2. Correct segregation and disposal of flammable samples.
3. Careful zoning and control of ignition sources.
4. Use of high flashpoint cleaning fluids; and
5. The training and expertise of the laboratory personnel.

1253 27 September 1976

Source : ICHEME
Location : ,

Injured : 0   **Dead :** 0

Abstract

Rupture of a 20 psig bursting disc on a calandria of a continuous glycol plant. The rupture was caused by either bursting disc failure after exposure to pressure fluctuations as a result of poor operating conditions or due to a development of a hole in the methanol/water take off line causing a loss of vacuum. Flooding the reboiler and then rapid evolution of vapour rupturing the disc.
[gas / vapour release, continuous reaction]

Lessons

[None Reported]

1248 13 September 1976

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A bursting disc failure on a reactor was suspected when fumes were seen coming from the vent. The reasons for failure are not known but deterioration due to repeated inversion due to policy of operating at a vacuum to reduce leaks in the reaction area weakened the disc. The vacuum support failed due to abnormally negative pressure in the reactors.
[reactors and reaction equipment]

Lessons

[None Reported]

1214 10 July 1976

Source : MARSHALL VC, MAJOR CHEMICAL HAZARDS, ELLIS HORWOOD LTD 1987;
MARSHALL V.C, THE SEVESO DISASTER AN APPRAISAL OF ITS CAUSES AND CIRCUMSTANCES, LOSS PREVENTION BULLETIN, 104, 15-26. ENVIRONMENTAL PROTECTION BULLETIN, 035, 16.

Location : Seveso, ITALY

Injured : 1000 **Dead :** 0

Abstract

On a Saturday afternoon there was an emission of a plume of aerosol from the vent of an unattended reactor at an Italian chemical works. The emission, which lasted some twenty minutes, discharged a complex mixture of several tonnes of chemicals. These included the sodium salts of trichlorophenol, sodium hydroxide, sodium glyoxides and sodium oxalate. The propelling gas was probably hydrogen. There was also present in the plume approximately 0.25 kg of highly toxic 2,3,7,8-tetrachlorodibenzo-p-dioxin, commonly called dioxin or TCDD. The immediate effect was for over 400 local inhabits to require treatment for chemical burns, the deaths of local small animals, and damage to vegetation. Twenty days later chloracne, a characteristic of dioxin poisoning, developed in those who had received chemical burns, and several weeks later further numerous chloracne symptoms were reported. Over 17 km2 was contaminated, with 1 km2 being most severely affected.

2,4,5 - trichlorophenol was produced at this plant by reacting 1,2,4,5-tetrachlorobenzene with sodium hydroxide in the presence of ethylene glycol. The reaction operated below 180 degrees C using steam heating at 12 bar, in preference to oil as the heating medium.

On the day of the incident at around 5 am the process was shut-down half way through the vacuum distillation of the solvent when the batch temperature was 158 degrees C. The vessel was left unattended and at 12:37 a bursting disc ruptured releasing the plume of chemicals. A foreman entered the building and applied cooling water to the coils which eventually caused the plume to cease. The maximum temperature achieved was 450-500 degrees C which clearly established that an exotherm had occured. This would have evolved a permanent gas, hydrogen, which would have rapidly pressurised the system and ruptured the bursting disc. The bursting disc was rated at 3.5 bar, but was installed not to relieve excess pressure during reaction, but to prevent dangerous overpressure when using compressed air for transferring the contents of the reactor to another vessel.

[gas / vapour release, exothermic reaction, design inadequate, operation inadequate, agitator]

Lessons

Some conclusions/recommendations made include:

The reactor used steam at 12 bar, and had neither automatic controls nor alarms. It was believed that as the vessel of the reactor was heated by 12 bar steam, the temperature of the reactor walls could not exceed 180-183 degrees C, and therefore prevent an exotherm occurring. However, it was later reported that it was common for the steam to be superheated to 300 degrees C. The vessel had an agitator, which was shut off during the shut-down. It was believed that even with the vessel walls at 300 degrees C, the reactor contents would not be subjected to a significant temperature rise. However, as organic liquids are poor conductors of heat and as the reactor contents were stagnant, a theory for the onset of the exotherm has been put forward and generally accepted. It involved the vessel walls conducting heat to a thin top layer, which could have then reached temperatures of 220-230 degrees C, sufficient to set up the exotherm. This reaction would then evolve a permanent gas, hydrogen, which would have rapidly pressurised the system, and ruptured the bursting disc.

The agitator should not have been shut-down, and instead left running so that excess heat would have been absorbed into the bulk of the material.

There was no system for trapping or scrubbing any material emitted if the bursting disc failed. This is obviously an unsatisfactory situation when toxic chemicals are used, or are likely to be present in any reaction (process or runaway).

The steam used was at 12 bar, but superheated to 300 degrees C. If the reactor had been provided with a guaranteed source of saturated steam at an appropriate and automatically controlled pressure, the vessel could have been safely left at 158 degrees C.

The reactor was periodically inspected though no hydraulic test was carried out as the Company management claimed that the vessel was only operated at atmospheric conditions. Further the bursting disc had not been inspected.

The reactor was housed in a building originally used to manufacture another product and therefore the reactor is unlikely to have been custom built for the process. Hazops, which were in their infancy at the time, would have highlighted the dangers and should be used, particularly when converting plant to other processes.

4069 06 June 1976

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

The primary, and secondary, bursting discs, at the outlet of an ethylene production furnace, ruptured. A mixture of cracked gas and quench oil was carried as a spray, by the wind, about 700 yards from the plant. There were no injuries, but a number of vehicles were hit by the spray. Possible causes of the bursting disc failure were:
1. Premature rupture - not likely unless mechanical defects in the B/Ds existed.
2. Impingement - considered unlikely.
3. Overpressuring - the likely cause.

Lessons

1. Install drain line on furnace bursting disc vent "weep" holes, and valves on these drain lines.
2. Install independent high level alarm on naphtha surge tank
3. Ensure integrity of non return valves in feed system from naphtha surge tanks.
4. Install motorised shut off of quench oil injection valves
5. Ensure water-washing of furnaces that are seriously "coked" prior to re-commissioning.
These were the recommendations for implementation.

1265715 May 1976

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A bursting disc failure occurred on a 7000-gallon polymeriser resulting in the loss of approximately 4000 kg to atmosphere.
The following conclusions were stated:
1. The poly contents were lost through failure of a 6 inch 225 psi-bursting disc caused by a pressure rise.
2. As the pressure drop was taking place, indicating a slowing down of the reaction rate, it is improbable that the pressure rise was due to an uncontrolled reaction.
3. It is thought that the pressure rise was due to a purely physical effect, i.e. the vinyl chloride monomer (VCM) approaching saturation vapour pressure at jacket temperature.
[product loss, polymerisation]

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]

1043123 March 1976

Source : LOSS PREVENTION BULLETIN, 135, 18-20.
Location : , UK

Injured : 0 **Dead :** 0

Abstract

An explosion occurred in a knock-out drum at the base of a TVH flare stack and blew a hole approximately 3 m by 1.2 m in the knockout drum. The flare stack itself was also extensively damaged and the first part of the vertical ladder on the stack was knocked some 18 metres down the pipe track serving the flare. A fire following the explosion was consistent with the combustion of a pool of liquid lying in the bottom of the knock-out drum. The fire was contained by the Works fire brigade, but allowed to burn itself out because of the toxic nature of the material involved. There were no injuries to personnel nor damage to any equipment other than that adjacent to the flare stack itself. Monitoring for environmental hydrogen cyanide in air concentrations showed no levels above 2 ppm except for one reading slightly above the threshold limit valve of 10 ppm, for less than five minutes, due to a small spillage into the TVH during plant shut down after the fire had been extinguished.

The causes of the incident:

The prime cause was a very low nitrogen gas purge to the TVH flare stack, allowing back diffusion of air down the stack. A contributory factor was the low level of plant production one reactor pair rather than two for some hours during the day prior to the accident. This resulted, in gases from the stripper overheads drum to the TVH being oxygen-rich to an estimated level of 16-18% oxygen, compared to the normal 2% brought about by an efficient nitrogen purge. These gases normally also contained 5-10% organics, AN and HCN, so the gases, filling the TVH from the plant end, were close to the limit of flammability.

Then, when the HCN railcar was vented to the HCN flare, nitrogen, saturated with HCN vapour from the railcar, passed via the bursting disc on the HCN storage drum, into the toxic vent header. The consequent increase in the concentration of organics, together with the high level of oxygen already present, resulted in a flammable mixture which was ignited by the flare pilots, causing the explosion.

The fortuitous venting, without incident, of the previous railcar, some hours before the explosion, was attributed to the possible slower venting, or venting from a lower pressure.

Thus, in summary, the sequence of events was:

1. Failure of the nitrogen purge due to closure, some time before the incident, of a valve in the purge system.
2. Failure of a bursting disc which created an interconnection between TVH and HCN, flare systems.
3. The inadvertent introduction of an oxygen-rich atmosphere into the TVH, due to the absence of an adequate purge.
4. The inadequate introduction of an abnormally high level of organics into the TVH via the failed bursting disc created a flammable / explosion mixture.

The following recommendations were made:

1. Closer adherence to plant operating procedure and improvement of training of plant operating staff, were required. This related to an unproved, but likely, supposition that the nitrogen purge valve was closed by an inexperience operator a few days before the incident.
2. An effective low nitrogen flow alarm should be installed in the purge line to the TVH to replace the (then) existing ineffective alarm.
3. Further information should be obtained, under operational conditions, on typical oxygen concentrations throughout the flare system.

[fire - consequence, damage to equipment, bursting disc failure, operation inadequate, reactors and reaction equipment]

Lessons

1. Further to installing low nitrogen purge alarms, they should be subject to proof testing and the actions required, on alarm sounding, defined.
2. If the TVH was ignited from the flare this seems to be another short coming in the design, since it proved a source of ignition.
3. This incident indicates the importance of using Hazops on complex systems. The demands of environmental protection are increasing the complexity of vent systems but they are often difficult to study. Frequently the vent system will appear as a part of many drawings. In these cases it is essential to produce an extra drawing of the vent system showing its connections to all main process units. This should then be used in the Hazard Study. The cost involved in producing an extra drawing, are likely to be small in relation to the cost of any incident.

1134 26 February 1976

Source : ICHEME
Location : ,

Injured : 0   **Dead :** 0

Abstract

Fire after contamination at a production crude oil well. Source of ignition was flare.
[fire - consequence]

Lessons

[None Reported]

4109 17 September 1975

Source : ICHEME
Location : ,

Injured : 2 **Dead :** 0

Abstract

Rupture of an 8" bursting disc, on a hopper, whilst the hopper was being used to receive powder fines from a pair of cyclones. Gas then leaked, ethylene and hydrogen, followed by a flash and explosion. Two men received 2nd degree burns over 25% body surface.
[loading]

Lessons

1. Fit a "stack" to the disc stub, to direct any emission away from personnel (but protect from "the elements").
2. Automate operations as far as practicable to minimise operator/equipment interaction.

9507 11 September 1975

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A 500ft high, flue chimney at a power station sustained a direct hit by lightning. Damage was caused to the brickwork of the flue and quantity of brick fell to the ground at the foot of the chimney.
[damage to equipment]

Lessons

1. The existing air terminations on the four flues comprising 6ft long vertical rods should be replaced by coronal rings at the top and base of each flue.
2. The reinforced ring cemented into the top course of bricks should be bonded to the coronal ring.
3. Two down conductors should be installed on each flue to connect the top coronal ring conductors to the coronal conductors at the base of each flue and bond the stainless steel reinforced rings on each flue.
4. The lower coronal ring on each flue should be connected to the existing coronal ring at the top of the concrete windshield.

8053 March 1975

Source : ICHEME
Location : , FRANCE

Injured : 0 **Dead :** 1

Abstract

A chemist was working on a vacuum distillation of a mixture of liquid hydrocarbons (samples from the paraffin cracker) when his clothing caught fire. There were no eye witnesses to the incident, but as the victim ran from the room into the corridor and past other laboratory rooms a considerable number of staff attempted to extinguish his burning clothing using carbon dioxide extinguishers, a fire blanket, laboratory overalls and by holding the victim under the laboratory safety showers which were sited along the corridor.
The victim's burning clothing was extinguished in about a minute from the time he left his workbench, and although he remained conscious to hospital he died 8 days later. Fatality.
[fire - consequence, laboratory work]

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]

1256715 January 1974

Source : ICHEME

Location : Kurashiki City, JAPAN

Injured : 0 **Dead :** 0

Abstract

A rupture disc failed on a polyethylene reactor of a production train. No fire occurred as a result.
The cause of the incident was due to a broken support for the roller bearing of the agitator on the reactor. Heat produced by friction on the broken bearing caused decomposition of ethylene. No one was injured in the incident.
[bursting disc failure, mechanical equipment failure, near miss]

Lessons

[None Reported]

1256526 October 1973

Source : ICHEME

Location : Yokohama City, JAPAN

Injured : 0 **Dead :** 0

Abstract

A fire occurred in the chimney of the heater on a gas desulphurisation plant. The fire was extinguished soon after the stoppage of gas oil feeding.
The cause of the fire was due to deformation of the heater tubes on the furnace due to being locally super-heated. No one was injured in the incident.
[fire - consequence, high temperature

Lessons

[None Reported]

9569 06 October 1973

Source : ICHEME
Location : , UK

Injured : 0   **Dead :** 1

Abstract

Liquid ammonia released from a ships vent line during discharging operations. One person was killed.
[marine transport, unloading, fatality, spill]

Lessons

[None Reported]

1181 1973

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A small fire occurred in an excavation providing access for the welding of a branch on to a pipeline.
The excavation had been tested with a combustible gas detector and as no gas had been detected, a fire permit had been issued. The fire occurred a short time after welding operations had commenced when a hydrocarbon liquid, seeping from the ground into the excavation, ignited.
[fire - consequence, excavation damage]

Lessons

Obviously, under such conditions, spot checks for combustible gases are not adequate and a continuous monitoring should be carried out. Portable alarms are available which give an audible warning of dangerous concentrations of combustible gases. These should be placed in the excavation and not on the ground nearby. If it is necessary to place a tent over an excavation into which oil may seep, then the tent must be force-ventilated to prevent vapour accumulating.

1281 1973

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A contractor's employee working on top of a 1200 ton chemical storage tank placed a polythene bag over the vent to reduce fumes causing him some discomfort. This bag was not removed on completion of his work.
Loading of vehicles from the tank was resumed and some time later a rumbling noise was heard.
The tank top was found to have been distorted with considerable damage to walkways and adjoining pipes and pipe supports.
It was estimated that the vacuum applied to the tank was in the order of 2 p.s.i.
[storage tanks, damage to equipment]

Lessons

[None Reported]

106501973

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A near miss incident occurred in an oil refinery during inspection of a reactor vessel.
In order to improve the ventilation for an inspector to enter the vessel, an air line was connected to one of two unmarked lines because of the length of the sampling hose the check was only valid for the top 1.5m of the tank.
The inspector entered the vessel with caution, and carried out further oxygen checks as he descended. He found that at 3m below the top there was only about 10% oxygen: he left the vessel. It was later found that the unmarked line was a nitrogen supply.
[entry into confined space, incorrect chemical present, identification inadequate, atmosphere not tested, near miss, air line, reactors and reaction equipment, nitrogen]

Lessons

The following changes were made:
1. Line markings were improved and a colour code introduced.
2. A rule was made that only clearly marked air lines must be used for purging.

112241973

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A 90,000 jet fuel tank partially collapsed some 30 seconds after product withdrawal had stopped, due, it was subsequently discovered, to blockage in the vent system which had caused a slight internal vacuum. Fortunately, there was no other damage and the buckled plates sprang back when the tank was filled with water.
The venting arrangement consisted of a 10 inch 'swan-neck' open vent fitted with a 200 mesh gauze. On examination, the gauze, which had not been checked for nearly a year, was found to be choked with sand and corrosion products. Just before the incident occurred, product withdrawal, which was taking place at a high rate, was switched to another tank for operational reasons. But for this, the damage would probably have been worse.
[material transfer, tank, vent, vent blocked, vacuum, flame arrestor, collapse]

Lessons

The use of fine gauze flame arrestors is not recommended for tanks because of their tendency to block. A coarse gauze may be fitted if required to keep out debris and prevent birds nesting.

112101973

Source : ICHEME

Location : ,

Injured : 1 **Dead :** 0

Abstract

A man was overcome whilst working inside a reaction vessel that had been used for the manufacture of polyvinyl chloride (PVC). He was wearing a breathing apparatus consisting of a face piece and line attached to a waist belt. Air was supplied from a fixed installation outside the vessel. The work was covered by an entry permit in the normal way. The man on watch seeing that he was in difficulty plugged in his own breathing set and entered the vessel, having first called the supervisor who initiated the rescue procedure. It could be seen that the affected man was being deprived of air since his mask pulled towards his face when he attempted to inhale. He was brought out of the vessel, resuscitated, and subsequently taken to hospital. It was apparent that his condition was due to lack of oxygen rather than exposure to vinyl chloride fumes.

The subsequent investigation showed that the air mask was in working order, but breathing was restricted by a kink in the nylon reinforced plastic air hose at a point close to where it connected to the waistband.

[entry into confined space, breathing apparatus, air line, incorrect equipment installed, asphyxiation]

Lessons

[None Reported]

801 04 October 1972

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A road transportation incident. A fire occurred on a road tanker outside a refinery fence and spread into the refinery via the drainage system. There were no injuries to personnel and no damage to refinery plant but the road tanker was severely damaged.
Subsequent investigation revealed that the tanker was being filled illegally, using fire hoses connected from the motor spirit transfer pump situated about 50 feet from the boundary fence. During this operation, the tanker was overfilled and spirit entered the open drain running alongside the roadway. The refinery drainage system, which discharges into this drain, also became contaminated. When the spillage ignited, either from the vehicle's ignition system or a naked light, the fire traveled back through the drainage system into the refinery.
The fires were extinguished by about 07.30 hours, the initial attack being concentrated on the drain fires within the refinery using the permanent foam system and 150 lb. dry chemical fire extinguishers.
[fire - consequence, human causes, damage to equipment, deliberate acts]

Lessons

Disciplinary action was taken against those involved.
Improve security precautions and communications.
Make modifications to isolate the refinery drainage system from that of the road.

4686 09 May 1972

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

Abstract

A severe and prolonged fire broke out on a crude oil heater of a crude distillation unit at 3.57 hours on 9th May. At this time the unit was in the preparatory stages for handing over to maintenance. Crude feed had been taken out two days earlier, the unit circulated down, desalters pumped out and a gas oil wash introduced.

The gas oil circulation was commenced at 07.00 hours on 8th May and the heater outlet temperatures raised to 250 degrees C and held for 5 hours. Circulation continued whilst the heater outlet was cooled back to 38 degrees C -50 degrees C (100 degrees F -125 degrees F) and at 20.00 hours a programme of clearing oil from the exchangers, vessels and lines was started, the oil to be displaced via the heater into the column using nitrogen. This was only partially successful and oil had to be drained to the ground from exchangers and vessels whilst it was decided that steam should be used to blow through the residual oil in the furnace.

At 03.00 hours on 9th May dry steam was admitted into the four main heater inlet passes serving the two cells of the furnace; six pilot burners were maintained in commission in each cell. Some steam hammer was noted at this time and the steam flow was reduced but at 03.30 hours there was no sign of anything untoward and the passes were being blown in turn. At 3.55 hours heavy black smoke was noticed coming from the stack and it was then seen that there was a fire underneath and around the furnace, internal and external fire assistance was requested. Eye-witnesses from neighbouring plants reported that the fire reached maximum intensity in a very short space of time, burning oil was draining from the west section of one of the cells and the flames reached up and over the south face of the heater licking the side of the concrete stack.

It was decided not to blow through the remaining passes in case this spread the fire. After about half an hour the fire was contained within the fire-box and burned fiercely here, the fire fighting effort being directed at cooling down structures and preventing heat damage from fire and flames.

There was some risk of fire spread to other areas within the plant and to an adjoining major pipe track because of insufficient drainage but this risk rapidly disappeared as the fire became centred inside the firebox.

By 05.30 hours the fire was relatively small but continued to burn as isolated minor fires until about 10.00 hours at which time it was considered extinguished.

No-one was injured in this incident but the furnace was extensively damaged and complete re-tubing of one cell and much of the other cell was necessary. It was expected that the plant would be off-stream for about four months.

The fire was caused, it is believed, by steam hammer on one of the tubes which was thin due to overheating at an earlier stage in the run-life of that plant.

The history of this unit had revealed some design faults and there were difficulties in operating the heater both in pass balance and heat input control. Uneven firing was occurring and overheating of tubes was known to have occurred, in fact some tubes had been replaced at an earlier, unscheduled shutdown.

The ignition source was assumed to be the pilot burners which had remained alight in the furnace during the steam blow-through stage in anticipation of later spalling of the tubes. Steam hammer which is thought to have caused the actual break in the tube was probably a result of the low temperature oil in the furnace being contacted by the much hotter steam.

For part of its operation, the furnace was being dual fired with gas and oil burners in the same port.

On some occasions, due to wrongly sized burner tips, high L.P. gas flows from the fractionation column overheads, and blocked burners, the heat release at certain ports was greater than the design figure, and together with uneven pass flows contributed in a large degree to the local overheating and tube thinning.

[fire - consequence, damage to equipment]

Lessons

[None Reported]

649 27 April 1972

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

Abstract

A cracked gas compressor on an ethylene plant tripped. This caused an increase in the bursting discs on one furnace failed, resulting in the release of cracked gas and quench oil to atmosphere. The quench oil caught fire at ground level near a transfer line exchanger and spread up the structure. Then the hydrocarbon escaping from the bursting disc vent caught fire. The vent fire was extinguished in about 10 minutes and the main ground level fires about 15 minutes later. The primary cause of the fire was the failure of the bursting discs on the furnace due to incorrect fitting.
[bursting disk failure, installation inadequate, fire - consequence, processing]

Lessons

The main recommendations were:
1. A call for a revised procedure for installation of bursting discs.
2. The installation of an alarm to indicate bursting disc failure.
3. The modification of quench oil control valves and alterations to the weep hole drain on the bursting vent line.
It is also advised that steps should be taken to obtain improved isolation of hydrocarbons from the vent line, and that alternative methods for furnace protection other than bursting discs should be considered.

646   21 April 1972

Source : ICHEME
Location : ,

Injured : 0   **Dead :** 0

Abstract

A fire occurred on a polyethylene plant when liquid cyclohexane showered from a vent stack on to the main pipe gantry feeding the plant. Ignition was from a 500 psig steam pipe at the north end of this gantry. The fire was extinguished in about 90 minutes. Damage was mainly confined to lagging, thermocouple cables, and instrument air pipes. The plant was upset prior to the incident and high levels and pressures had built up in parts of the flash system. A high level developed in the relief stack knock out drum. It appears to that liquid entered the main plant relief header from a safety valve, filled the drum and stack, and then spilled over on to the plant feed gantry.
[fire - consequence, maintenance inadequate, processing]

Lessons

Plant safety could be improved by attention to the relief and blowdown drum appears to have been inadequate for the circumstances prevailing prior to the incident.

642 06 April 1972

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A 2 inch pilot line to an acrylonitrile plant and ethylene plant flares pulled away from the main 10 inch fuel gas export line. Damage was confined to an almost complete fracture of the 2 inch line, together with a one and a half inch crack in the 10 inch line extending circumferentially from the nozzle. The failure occurred when an ethylene tower de-flooded and dumped a large quantity of liquid into the base of the column. The level control valve on the ethane/ethylene overloaded the vaporiser train and cold liquid passed into the fuel gas system. The bulk of the liquid was held up in the knock-out drum at the battery limits but the fuel gas export was cooled. This passed along the pilot gas line, cooling it and causing it to contract. The resulting tension pulled the line away from the 10 inch export line and cause the failure.
[damage to equipment, processing]

Lessons

The following recommendations were made:
1. The procedure for routing products on the Ethylene Plant to fuel gas should be revised to incorporate safeguards to prevent liquid being carried over into the main.
2. A line should be installed on the Ethylene Plant to allow fuel gas to be vented directly to flare in an emergency.
3. A pipe anchor should be installed at the Ethylene Plant end of the pilot gas line to prevent the stress being concentrated on the connection to the fuel gas main.
4. If the Ethylene Plant has to be shut down rapidly and the dehydrators partially de-pressurised, methanol should be washed slowly down an ethylene tower, re-commissioning the tower to remove the water carried forward on start-up.
5. Greater attention should be paid in future to the provision of expansion pieces and pipe anchors in long lengths of line.
6. Engineering Department should be contacted regarding anomalies found in the material of construction in some parts of the towers, with a view to improving future ethylene plants.

236 14 January 1972

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A small fire occurred at the end of a barge jetty. No one was injured nor any damage suffered, but it was a near miss.
Welding work begun on 11th January had been stopped on 13th to allow a barge to be filled with white spirit.
On the morning of the 14th, after a check of the area by one of the safety department staff, the work restarted. It consisted of welding some access ladder fittings at the jetty head. The hot work permit laid down certain conditions:
1. The work area should be clean with a fire extinguisher in place
2. No loading or discharging of motor spirit to be allowed within 30 metres of the welding site
3. Gas tests to be made, pipelines to be full to the shutoff valves, safety belts to be worn by workers, notification of the work to the port authorities.
The safety worker left the area at 09.30 hours. At 10.30 hours the work began and a fire developed on the surface of the water caused by light hydrocarbon material igniting from weld sparks. The welder who was wearing his safety harness was suspended for an instant in the flames. He managed to move away quickly and helped with the fire fighting. All loading/unloading operations on the jetty were stopped until the fire was finally extinguished after 3 re-ignitions by the use of 6 x 10 kg. and 1 x 40 kg. dry powder extinguishers and 1 x 50 litre foam extinguisher.
[fire - consequence]

Lessons

[None Reported]

675 January 1972

Source : ICHEME
Location : ,

Injured : 2 **Dead :** 0

Abstract

A road transportation incident. A 2,000 gallon road tanker was loading diesel oil under gravity at 75 gal/min at an installation when a serious explosion occurred followed by fire. The fire spread rapidly, due in part to some valves which leaked when exposed to the heat, and completely engulfed the gantry. It was extinguished after some three hours. Two people suffered minor injuries but the material damage amounted to an estimated £60,000 (1972).
The tanker had carried a previous cargo of motor spirit and the compartment in question was a 15th full at the time of the incident. All normal precautions appeared to have been taken except that the fill arm consisted of a short length of hose terminating in a copper pipe. It was said that the fill arm, hose and copper pipe were all electrically bonded together. The weather was humid but fine and the loading operatives wore ordinary cotton clothing but their shoes were rubber soled.
The results of the official investigation are not yet known but it seems the accident is being attributed to electrostatic inside the tanker during switch loading, there being no other known sources of ignition.
In the absence of any other source of ignition it is difficult to refute the belief that static electricity caused a spark from the product to some part of the vehicle or fill arm. However the very low loading rate would seem to mitigate against this possibility.
It is also remotely possible that a charge was built up on an operative's body since they were wearing rubber soled shoes.
[injury]

Lessons

[None Reported]

4922 1972

Source : ICHEME
Location : ,
Injured : 2 **Dead :** 0

Abstract

An operator on a sulphur recovery unit noticed a drop off in the air flow to the main H2S (hydrogen sulphide) furnace and shortly afterwards yellow smoke was observed coming from the incinerator stack.
He took certain corrective action but there was no improvement and toxic gases blew out of the seals of the sulphur pit in reverse flow through the suction filters of the air blower. The plant was crash shutdown using the emergency button in the control room but in this period some of the escaping gas penetrated an area of the unit including the control room. Two men were seriously affected by the gas and lost consciousness. There were other people in the area at the time and the affected men were quickly removed to the Medical Centre and later transferred to hospital where they made a full recovery. One of the men had put on a H2S cartridge mask as soon as he noticed the strong smell of gas on the plant, but he was either too late in taking this action or the cartridge mask was ineffective.
[gas / vapour release, plant shutdown]

Lessons

1. It is extremely important that unit operators and maintenance workers are aware of the hazards of H2S and that they know what and where the protective facilities are on plants containing this gas at toxic levels.
2. Because of the high toxic risk, if there is a break-out of H2S on one of these plants it has been recommended that an alarm should be installed to warn other units in the vicinity that a serious gas leak has occurred.

6642 1972

Source : ICHEME
Location : , GREECE

Injured : 0 **Dead :** 0

Abstract

Road transportation. After a road tanker had completed unloading motor spirit to a service station, the dealer placed a container under the hose connection to collect any drips when the hoses were uncoupled. At that moment vapour ignited causing a small flash fire which was immediately put out with a portable fire extinguisher.
The accident was caused by the metal container shorting the wiring to the red (stop) lights. These have now been repositioned.
[fire - consequence]

Lessons

The incident highlights the value of fire fighting training since it is clear that prompt and correct action by the employees concerned prevented what might have been a major fire. They also illustrate the importance of checking design from a safety point of view before equipment is put into service, and the necessity for good housekeeping and vehicle maintenance.

5211 1972

Source : ICHEME
Location : ,

Injured : 1 **Dead :** 0

Abstract

A fitter and helper were carrying out work in a flare drum pit which necessitated the use of self contained breathing apparatus. After working for approximately 3-4 minutes, the helper, who was working in a squatting position, was seen to be slumped on the ground. Immediate reaction by persons present was that he had been gassed, but the Assistant Plant Manager who was observing this operation, noticed that the flanges had not been opened and that it was improbable that the man was gassed.
The helper's lips and face were blue and the Assistant Plant Manager realised that the helper was suffering from the lack of oxygen. He removed the face mask and moved the man away from the area preparatory to giving mouth to mouth resuscitation. Fortunately the man's lung action had not ceased and he regained consciousness within a few seconds.
Investigation of the breathing set revealed no faults. A gas chromatograph test of the air in the cylinder revealed an oxygen content of 4.9%. This was further confirmed by two orsat tests which gave a result of 5.0% and 4.2% oxygen deficiency.
The cylinder in question had been recently refilled by a local supplier and investigations showed that the breathing air was actually a synthetic mixture of oxygen and nitrogen. The method used by one supplier in the area is to fill about 79% of the cylinder's capacity with nitrogen and complete the filling with oxygen presumably on a pressure basis. Obviously compressed atmospheric air is far superior to reconstituted mixtures due to the inherent problems in assuring a proper mixture.

Lessons

The following corrective measures have been established to avoid a similar occurrence:
1. Require all suppliers of breathing air to provide a certificate which certifies the purity of the air and a 21% oxygen content.
2. Individual plants are to make spot checks on breathing apparatus cylinders to verify the certified oxygen content.

148 1972

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

Abstract

An assistant operator on a hydrocarbon treatment unit plant was splashed on the face with caustic while working at a catalyst mixing pot. He suffered some irritation to his eyes and face which forced him to remain off work for two days.
Although an emergency safety shower was located outside within 50 ft. of the pot, the injured man attempted to use a drinking fountain inside the control room to wash off the caustic and only prompt action by another operator, who took him to the shower in the changing room, probably saved him from more serious burns.
There is no doubt that the operator's eyesight was saved from permanent damage by the use of the safety goggles he was wearing at the time.
A number of contributing factors led to the incident:
1. The wrong method of mixing the catalyst was used, i.e., instead of using water, as instructed in the manual, caustic from the disulphide system was used.
2. The line to the disulphide system was steam traced causing the caustic to heat up and, when released into the mixing pot, to expand and blow caustic from the hatch; in this instance the hatch had been left open to relieve any build-up of pressure.
3. A check valve, originally installed in the caustic line, had been removed because of plugging problems.
[operator error, caustic soda, injury]

Lessons

1. Make all operators aware of the correct procedure and protective equipment necessary for mixing the catalyst.
2. Modify the steam tracing together with a check-out of the caustic line itself so that overheating of caustic soda will be avoided.

5600 19 August 1971

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

Abstract

A small fire broke out at a flange on a motor spirit line on the 19th August 1971. The 8 inch motor spirit header at the adjoining pumphouse was to be dismantled for modification and had been water flushed 10 days earlier but when the flanges were being broken a mixture of water and spirit emerged. A hose was turned on to flush away this material while the remaining bolts in the flange were undone. The last of these bolts was rusty in places and considerable force was required to move the nut, space was restricted and a cut-away ring spanner was used with a 4 ft. piece of piping to give extra leverage. This bar slipped as force was being applied and immediately a small quantity of motor spirit on the ground caught fire. Dry powder fire extinguishers were fetched from the nearby pumphouse and quickly put out the fire. No-body was injured and there was no damage.
In this case, it is most likely that the iron extension bar struck an aluminium painted pipe as it fell and initiated a thermite reaction. Much less energy is required to produce an incendive spark by this means than by iron-to-iron contact.
[fire - consequence, maintenance]

Lessons

Where `strong force' has to be applied in a situation where flammable material is present, then it is advisable to wet the flanges and bolts first.

5700 June 1971

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

Abstract

In June 1971 there were two explosions in the drains of a Crude/Vacuum unit. The first explosion originated at the hotwell sump of the vacuum distillation, while the second, less severe one occurred at the outlet of the unit's oily water sump. Both resulted from escape of flammable hydrocarbon vapour from the drainage system which was ignited by welding work in the vicinity whilst the unit was shutdown.
It is thought that the sumps were not effectively isolated from other drains in the plant and that the sump covers may have been leaking around the bitumen sealed joints. In any event, migration of hydrocarbon vapour occurred to the work area.
[isolation inadequate, gas detector]

Lessons

Improve methods of isolation and regular monitoring of the area by combustible gas indicators should be adopted.
The use of portable audible/visual alarm type gas detectors can reduce the risk of fire/ explosion where welding work is taking place near sumps, oil/water separators etc.
even though the first action should always be to avoid the presence of hydrocarbon by standard techniques.

9516 22 April 1971

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A bursting disc blew, releasing ammonia (NH_3) for five hours before isolation achieved.

Lessons

[None Reported]

9965 16 January 1971

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A short circuit developed in the wiring of a fire eye system on one of two 600 psig boilers serving a refinery. This triggered a rapid sequence of events that resulted in a one week shutdown of much of the refinery. Fortunately no one was injured and equipment damage was negligible.
When the hydrocracker make-up compressor started slowing down, the control system at the reformer released the excess hydrogen to the flare. However, no increase flame was observed at the flare and the crude unit pressure went over 50 psig. The trouble was quickly diagnosed as a blockage in the flare system. The hydrocracker units were shutdown. Quick action by operating personnel prevented potentially catastrophic failures to the flare system and other operating equipment.
No major leak occurred and within two hours, it was concluded that the molecular seal was plugged. Witnesses at the time of the upset observed debris flying out of the flare. A search revealed five or six ice boulders, each weighing 50 to 60 pounds at the base of the flare. Also the 3 inch centre steam pipe and nozzle was found in the area.
[plant shutdown, damage to equipment]

Lessons

[None Reported]

581 1971

Source : ICHEME
Location : ,

Injured : 1 **Dead :** 0

Abstract

A fitter received chemical burns during the swinging of a blank in the flare line. Although warned about and protected against any possibility of gas, he disregarded liquid which ran out of the flange This was a mixture of steam condensate, caustic soda and amine.
[scalding]

Lessons

[None Reported]

4228 1971

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 3

Abstract

Two company engineers and one contractor's foreman were killed whilst inspecting the interior of a 150 m (490 ft.) high chimney stack, when the platform they were using fell 130m (426 ft.).
The platform was suspended by a steel rope over the lip of the chimney and connected to a winch.
The winch, manually operated by contractor's personnel, was equipped with two gear speeds, a ratchet locking device (unlocked with a descending load) and two braking systems, one a main brake and the other an auxiliary brake on the winch drum. Communication between the personnel on the winch and the men on the platform was by radio.
The platform and men had been raised to the top of the stack and shortly afterwards the contractor's foreman requested the winch team to lower them slowly. After the platform had descended 15 - 20m (50 - 65 ft.) the contractor's foreman requested the winch team to increase descent speed. To enable this to be done the ratchet should have been engaged. Some difficulties arose whilst changing gear and apparently the ratchet device was lifted, there was a jolt and the platform started falling. Attempts to arrest the fall by using the brakes failed and the platform fell approximately 130m (426) ft. killing the occupants. Fatality.
[inspection]

Lessons

[None Reported]

4632 1971

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 1

Abstract

An incident occurred at a refinery when a man was killed by a hand held fire extinguisher (20 lb. dry chemical) which exploded in his face when he activated the unit whilst instructing employees in the proper use of the equipment. The cause of the failure was excessive external corrosion which resulted in the rupturing of the body of the extinguisher when it was subjected to 275 psig (approximately) pressure from the discharge CO_2 cylinder (carbon dioxide).
Fatality.
[explosion, refining]

Lessons

Fire extinguishers must be inspected and tested in accordance with local mandatory requirements.
Dry powder (gas cartridge) extinguishers should be opened up quarterly, thoroughly examined, and that if any extinguisher is seen to be showing signs of corrosion or damage either internally or externally, it should be taken out of service.

498 16 November 1970

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A fire occurred on the distillation section of the ethylene oxide plant. A mixture of ethylene oxide and water leaked from a relief valve vent line saturating the surrounding lagging. Source of ignition thought to be the steam tracing line causing a reaction within the lagging which may also have had a catalytic effect. Steam tracing leak below lagging had corroded the vent line.
[fire - consequence, safety relief valve, corrosion]

Lessons

[None Reported]

495   01 November 1970

Source : ICHEME
Location : ,

Injured : 0   **Dead :** 0

Abstract

Whilst filling ethlyene oxide road tanker, operator noticed that the vent line was frosted. On opening the vent line drain, liquid came out. It was found that the filling line and the vent line had been connected the wrong way round so that the vent line was filled from pressurising ethlyene oxide up the dip pipe.
[loading]

Lessons

[None Reported]

Source : ICHEME
Location : ,

Injured : 1 **Dead :** 0

Abstract

On 9th October, 1970 at 10.50 hours waxy oil was projected from a vent and caught fire when it dropped down onto hot material.
From 06.00 hours to 10.20 hours, diverse operations were in progress on the plant, to increase the hydrogen feed, raise the reactor pressure and to check that there was no wax in various knock-out vessels.
The unit operator progressively opened the valves around the back pressure controller downstream of the reactor at 09.10 hours but the pressure in the upstream vessel fell rapidly and he shut them in again. At 10.20 hours the vent emitted paraffinic oil so the unit feed was stopped and the furnace fires cut back.
The levels in the 5 and 6 seemed normal. Suddenly the hydrogen feed rate increased rapidly and paraffin was drained from the knockout drum 5.
At 10.30 hours, furnace fires were extinguished and fuel gas isolated at the battery limits. At 10.50 hours, hot paraffin at 200 degrees C was projected over the unit from the vent and shortly after was ignited from hot metal work. The fire was tackled and extinguished by unit personnel but one operator was burned on the feet with hot oil. Damage was not extensive and although the unit was out of commission for 5 days for repairs, no production losses were sustained.
The causes of the accident are attributed to:
deposits of wax on the compressor valves; and faulty level indications in certain vessels.
[fire - consequence, high pressure, burns, hot surface]

Lessons

1. Re-examination of the unit Control System and also of the level alarms.
2. Check on the vessel capacities.
3. Consider re-siting of the unit vent.

9974 28 July 1970

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 1

Abstract

A fire extinguisher exploded as a foreman was actuating it. The force of the explosion propelled the extinguisher upward striking the man in the face killing him instantly.
The extinguisher involved was a twenty pound dry powder extinguisher, the powder being essentially bicarbonate of soda. Attached to the side was a five and a half ounce cartridge of carbon dioxide.
The cause of the explosion appeared to be due to corrosion of the extinguisher barrel. The corrosion was at the point where the cylindrical part was welded to the bottom that ruptured.
An investigation into the incident found that there was excessive external corrosion over the entire extinguisher. The hanger bracket was corroded to the clip on the extinguisher and the extinguisher was lifted down, the hanger pulled away from the building.
[fatality]

Lessons

[None Reported]

9515 23 April 1970

Source : ICHEME
Location : , UK

Injured : 1 **Dead :** 0

Abstract

Two tonnes of ammonia (NH_3) was released through defective valves to 150ft high stack. One person was injured.
[spill, injury]

Lessons

[None Reported]

1075007 January 1970

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

Abstract

A split tube occurred on a main boiler in a refinery causing shutdown of the catalytic cracker.
The back pressure controller controlling a butterfly valve in the flue gas stack from the catalytic cracker began to malfunction. This resulted in a pressure surge back through the unit, all the way to the air blower.
A catalyst circulation hold-up was experienced, but circulation was soon re-established after the differential across the unit was correct.
About fifteen minutes later the air blower began to go through extremely heavy surges. During one of these surges an explosion occurred which blew out a large section of the blower case and opened a crack almost completely around the circumference of the case. The force of the explosion shattered the glass window of the building housing the blower, as well as those in the central control room located some 75 feet away. The blower building is of cement block construction and some of the mortar joints were even cracked by the blast. Fortunately, no-one was injured and all personnel reacted properly to the emergency condition.
[control failure, damage to equipment, process control & instrumentation]

Lessons

[None Reported]

Source : ANNUAL REPORT OF HM CHIEF INSPECTOR OF FACTORIES REPORT, 1970, 69-70.

Location : ,

Injured : 0 **Dead :** 1

Abstract

A technical assistant had been employed for two years in a chemical engineering division of a company. Pure phenol is delivered to the factory in crystalline form and is heated in storage tanks to its melting point of 41 degrees C and piped through insulated and heated pipes to the next part of the process. The pipes are heated partly by steam and partly by electric elements and trouble had recently been experienced due to the phenol solidifying in the pipeline. Each pipeline has a pump and two filters and the technical assistant had the responsibility of reviewing the phenol distribution and suggesting modifications. After a long period of closure, partly due to holidays and partly to a maintenance dispute, on recommencing production it was found that blockages were present in the phenol distribution system and the technical assistant was asked to check the location of the blockages. After testing the pump and making various other inquiries, and having decided where the probable cause of the blockage lay, he climbed nineteen stairs to the filter house. Although he closed the valve to the filter, he omitted to isolate it by turning off the valve on the other side and so when he loosened the cover of the filter, phenol splashed out soaking the trousers on both thighs. He was not wearing special protective clothing other than rubber gloves. Aided by a supervisor, he ran down the stairs and about thirty yards to a cold safety shower, but it was found that this did not work because the main valve had been turned off. Another supervisor then joined them and the injured person was taken to an adjacent cold tap where the trousers where removed and the legs washed with water. An attempt was then made to go 180 yards to the first-aid centre but on the way the injured person became confused, pale and when only a few yards from the first-aid centre he collapsed. He was carried in and oxygen was administered. The safety officer was summoned and a doctor and ambulance called by telephone. Despite treatment by the factory nursing sister his pulse ceased.
[isolation inadequate, maintenance, flow restriction]

Lessons

Recent studies on the cutaneous absorption of phenol have led the British Chemical Industry Safety Council of the Chemical Industries Association to publish a broad sheet entitled 'First Aid Treatment of Phenol Splashes on the Skin - A New Approach'. All contaminated clothing should be promptly removed, all contaminated skin should be rubbed with swabs soaked in glycerol, polyethylene glycol (P.E.G.), or a 70:30 P.E.G./methylated spirit mixture for at least ten minutes. Or if these solvents are not immediately available, the skin should be rubbed with swabs in water. Medical advice should be sought. A warning suitable for exhibiting on factories is being prepared. No change is, at present, suggested for the first aid treatment of phenol splashes in the eye; copious flushing with water for at least ten minutes should be carried out.

1017311 June 1969

Source : ICHEME
Location : Mississippi, USA

Injured : 0 **Dead :** 0

Abstract

A fire occurred on a desalter in the refinery. The fire was brought under control within an hour and it was completely extinguished within 3 hours after the crude oil was pumped out of the desalter. The desalter was being put back on the line after it had been by-passed to make repairs to the electrodes. When the desalter was filled with crude oil, the operator standing by closed the vent valve. As the pressure built up, the operator observed a leaking flange which sprayed crude oil on a bare portion of a steam line. The oil flashed almost immediately. All sources of crude oil supply were blocked in very quickly and all refinery units apart from the fluid coker, platformer and gulfiner were shut down at the start of the fire.
[crude oil, processing, flange, gasket, vent line, fire - consequence, gasket failure, flange leak]

Lessons

Although the inspection of the gasket used showed that it was of correct standard, the company plans to use spiral wound metal gaskets in the future and will change out other asbestos sheet gaskets in this service as they become available to prevent future gasket failure. The system was also hydrostatically tested for leaks after repairs were completed.

1014311 April 1968

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A vent fire occurred on a crude oil unit desalter surge drum.
Over a period of time the atmospheric and vacuum crude still had been raised from a design charge rate of 20,000 B/SD to 38,000 B/SD by changing burners on heaters, increasing rpm of the pumps, adding additional exchangers for preheat and enlarging regulators. As a result the residence time in the crude surge drum was halved and the rpm of certain pumps approached the overspeed trip setting.
On the day of the accident the vacuum tower overhead pump kicked off, and the exhaust steam pressure dropped, allowing the atmospheric heater charge pump to overspeed and trip off. The desalter crude charge pump was pumping into the surge drum at a rate which would fill the drum in three minutes - half as long as the original design rate. The surge drum was equipped with a 6 inch vent in which a 3 inch back pressure regulator vented to the flash section of the atmospheric tower, a 4 inch vacuum relief valve and a 6 inch relief valve venting to the atmosphere 10 feet above the surge drum.
When the drum became full and the safety released, oil sprayed in the immediate area and was ignited either when in came in contact with a hot vapour line or by vapours reaching the furnace. The fire was brought under control in a short time.
[crude oil, separation, still, vent, fire - consequence, safety relief valve failure, leak]

Lessons

The report stated the following recommendations:
1. Install a high level alarm on the crude surge drum.
2. Change the 3 inch back pressure regulator valve on the vent line to the flash section of the atmospheric tower to a 6 inch regulator valve to handle the increased charge rate more efficiently.
3. Extend the vent from the safety valve into the desalter water sewer system at ground level away from probable ignition sources.

370 13 July 1967

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A vapour cloud explosion occurred on an ethylene plant involving a flare which was caused by low temperature. Substance involved: ethylene.
[processing]

Lessons

[None Reported]

355   1967

Source : VERVALIN C.H, HPI LOSS INCIDENT CASE HISTORIES, HYDROCARBON PROCESSING, 1978, 57, FEB., 183-201; DAVENPORT J.A, A SURVEY OF VAPOUR CLOUD INCIDENTS, CHEMICAL ENGINEERING PROGRESS, 1977, 73, SEP., 54-63.

Location : Texas, USA

Injured : 0   **Dead :** 0

Abstract

Pilot on 16 in (400 mm) flare failed allowing release of 4000 lbs (1500 kg) of ethylene in a 100 ft (30 m) deep cloud. Wind was 12 to 15 mph (5 to 7 ms). No ignition occurred.
[processing, safety equipment failure, gas / vapour release]

Lessons

[None Reported]

9798 19 October 1966

Source : LOSS PREVENTION, VOL. 3.

Location : ,

Injured : 0 **Dead :** 0

Abstract

Ether escaped from loosely stoppered bottles of collodion type corm remover awaiting subdivision and was ignited by the pilot light of a nearby hot water heater. Damage was mostly from smoke and water to paten medicine type materials.
[leak, damage to equipment, fire - consequence]

Lessons

[None Reported]

9797 13 October 1966

Source : LOSS PREVENTION, VOL. 3.

Location : ,

Injured : 0   **Dead :** 0

Abstract

Flare composition ignited in the catch pan under a flare press and this ignited other in the catch pan under a flare press and this ignited other flares on the conveyor. Hot gases from the cubicle ignited flares in other cubicles, flares rocketed and other buildings caught fire.
[fire - consequence, damage to equipment]

Lessons

[None Reported]

340 16 January 1966

Source : GUGAN K, UNCONFINED VAPOUR CLOUD EXPLOSIONS, ICHEME, 1979.
Location : , GERMANY

Injured : 0 **Dead :** 1

Abstract

Liquid methane vented at high level subsequently formed a low lying dispersion. Blast damage to plant not particularly severe. Extensive glass damage at 400 m, minor breakage at 1200 m. Suction piping of compressor had brittle fracture. Alternative view was liquid methane was drained from condenser into a cold vent system. Fatality.
[vapour cloud explosion]

Lessons

[None Reported]

9783 03 August 1965

Source : LOSS PREVENTION, VOL. 3.

Location : ,

Injured : 0 **Dead :** 0

Abstract

Soon after changing a detergent formulation, accumulation built up on the inside of a spray drying tower and ignited spontaneously. The fire spread into the dust collecting equipment. Small hose lines and manual deluge sprinklers effected control. The high susceptibility of detergent powders to water damage was again demonstrated.

[fire - consequence

Lessons

[None Reported]

9535 20 July 1965

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

A fire occurred when ammonia escaped from an ice manufacturing plant and was ignited by the exhaust of a diesel engine.
[fire - consequence, gas / vapour release, hot surface]

Lessons

[None Reported]

316 13 July 1965

Source : GUGAN K, UNCONFINED VAPOUR CLOUD EXPLOSIONS, ICHEME, 1979; CHEMICAL ENGINEERING, 1965, 72, 30 AUG, 45; KEVIL C.G, FLARE LINE RUPTURE IN AN ETHYLENE PLANT, AMMONIA PLANT SAFETY, VOL9, AICHE, 1967, 37-41.

Location : , USA

Injured : 12 **Dead :** 0

Abstract

A flare line of an ethylene plant split and hydrocarbons were spilt into the process area. Attempts were being made to shut down the plant when ignition occurred causing a general explosion followed by several smaller ones. Prior to the explosion the plant had been modified slightly. After coming on stream until the explosion considerable difficulty was experienced in operating the revamped demethaniser system This is the coldest system in the plant. As a result of upsets the warmup exchanger had almost daily use. The day previous to the explosion an operator went to the exchanger when the methane compressor was overloading to open the hand valve and put in propylene. He noted that the shell of the exchanger was completely frosted, although it operated satisfactorily on this occasion. The accident occurred when the six-inch carbon steel pipeline out of the exchanger, going to the flare system, ruptured and split cleanly. A subsequent investigation showed that the valve which should have been open to allow propylene into the shell side of the warmup exchanger was essentially cold. However according to two witnesses, the pipeline ruptured prior to the exchanger frosting. Even though the temperature at this time had not dropped greatly, it is presumed that repeated chilling and warming of this line had caused the carbon steel to crystallise or fatigue. Previous pipeline failures indicated that the carbon steel flare line in this service was a hazard.
[processing, metal fatigue, pipeline failure]

Lessons

1. The flare line will be stainless steel
2. The warmup exchanger and propylene system has been re-designed so that all of the gas from the discharge of the propylene compressor will always go through the exchanger.
3. The entire warmup exchanger itself is being made out of stainless steel.
4. A complete re-analysis of the demethanizer system has been made.
5. Remotely operated, quick closing valves are to be put in the gas headers to the two furnace areas.
6. From the same coveniently located remote station, quick opening valves are being installed to put snuffing steam into the fire box of all the furnaces.

9775 02 March 1965

Source : LOSS PREVENTION, VOL. 3.

Location : ,

Injured : 0 **Dead :** 0

Abstract

Three solvent extraction units had valved vent connections to a common vent header. When one unit was open for removal of fat free solids, the connection to the vent line was left open by error. Solvent vapours filled the building and ignited explosively.
[gas / vapour release, human causes, explosion]

Lessons

[None Reported]

9601 1965

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

Cold liquid propane was vented into a carbon steel flare header. Extensive explosion damage was caused.
[damage to equipment]

Lessons

[None Reported]

9773 28 December 1964

Source : LOSS PREVENTION, VOL. 3.

Location : ,

Injured : 0 **Dead :** 0

Abstract

The first time a new solid propellant rocket engine was being moved into a test building its unusual height caused it to catch the manual release on a deluge sprinkler system. About 100 rocket motors, in various stages, were damaged by moisture.
[damage to equipment, sprinklers, human causes]

Lessons

[None Reported]

9770 10 July 1964

Source : LOSS PREVENTION, VOL. 3.

Location : ,

Injured : 0 **Dead :** 0

Abstract

An indoors transformer failed and caught fire when lightning struck external power lines. The fire was controlled by sprinklers but there was much water damage to high value finished stock.
[electrical equipment failure, damage to equipment, fire - consequence]

Lessons

[None Reported]

1007119 June 1964

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A flare stack serving a major group of units collapsed during a wind storm. The stack was 200 feet high and supported by 2 sets of 3 guy wires 120 degrees apart and secured by 4 standard clips each end. It was a standard guyed flare stack. At the time of failure, records indicated the average wind velocity to be about 35 mph with gusts of 57 mph from a SW direction. The lower guy failed and distorted elastically. In snapping back, a high reaction force was given to the upper guy which then had to carry the total wind force. The upper guy failed and caused it to fail as a column.
The collapse could have resulted in power failures to the system serving the refinery which would have released large volumes of gas to the broken flare.
[strong winds, near miss]

Lessons

It was concluded that the flare collapsed as a result of a guy wire slipping out of the clamped end sector. This was probably caused by insufficient tightening of the clips.
Since the event, a check of the torque on the U-bolt claps was arranged. Ground splices were tightened to between 80 and 100 foot pounds whereas stack connections were tightened non-uniformly and with torques as low as 30 foot pounds. Instead of the 4 U-clamps used on the arranged design, 6 cable lamps were attached to every guy wire end. Tightening of nuts on the cable clamps was by torque wrench. The arrangement of ladders on the new stack will permit inspection of the guy connection to ensure they remain tight.

252 1963

Source : LOSS PREVENTION BULLETIN, 067, 19.
Location : Mold; North Wales, UK

Injured : 0 **Dead :** 0

Abstract

An explosion and fire occurred in a formaldehyde plant. The raw material, methanol, was stored in three tanks. A common vent line led to a vapour recovery unit some distance away. There was a flame trap in this line, about 25m from the recovery unit. Some old piping near the recovery unit was being dismantled by burning off the bolts. One of the hot bolts fell near the end of the vent pipe and ignited the vapour. It is not clear why the vent line was disconnected from the recovery unit. The flame travelled back up the vent line, splitting it open halfway along, passed through the flame trap and blew the tops off the three storage tanks.
[fire - consequence, maintenance inadequate, fire protection equipment, hot work]

Lessons

1. Flame traps must be placed near the ends of pipelines. As a flame travels along a pipeline its speed increases and it will pass through a flame trap.
2. Common vent lines should be avoided as they ensure that an explosion in one tank will spread to all the other tanks.
3. Nitrogen blanketing would have prevented the incident but is not usually recommended for conducting liquids such as methanol as there is little or no chance of a static electricity spark igniting the vapour (provided equipment is earthed). However it should be considered if several tanks have to be connected to a common vent system.

209 04 January 1961

Source : LANG A, AIR FRACTIONATION PLANT EXPLOSION, AMMONIA PLANT SAFETY 1962, VOL 4, 72-80.
Location : Dortmund, GERMANY

Injured : 0 **Dead :** 15

Abstract

An explosion in an air fractionation plant caused extensive damage. The oxygen plant was a low-pressure process plant. Some maintenance work had been carried out on the plant due to evidence of a leak in the lower section of the nitrogen regenerators. Shortly before the explosion, it was noticed that the gasket of the coldbox shell at the foundation, in the area of the nitrogen regenerators, had caught fire. An attempt was made to put out the fire with portable fire extinguishers but there was a sudden explosion. After extensive investigation it was decided that the explosion took place due to :

1. The plant having a wooden floor.
2. Leakage of the apparatus resulting in a considerable amount of liquid oxygen escaping, completely soaking certain parts of the floor.
3. Certain welding operations that took place within the cold box shell prior to the starting-up of the plant which may have been responsible for smouldering fires at some parts of the wooden floor. This smoldering at first remained unnoticed owing to the fact that the insulation was immediately replaced after the repair work had been completed. The smoldering sections may well have been responsible for the final detonation of the explosion. Fatality.

[damage to equipment, fire - consequence separation equipment]

Lessons

[None Reported]

182   29 January 1959

Source : ICHEME
Location : ,

Injured : 0   **Dead :** 0

Abstract

High pressure cylinder of electrically driven compressor blown out due to naphtha getting into cylinder via a vent line on a propane dewaxing plant. Propane gas escaped out of building but was not ignited even though a vehicle stalled in the cloud and was not restarted.
[gas / vapour release, processing]

Lessons

[None Reported]

181 22 January 1959

Source : PIPKIN O.A, DETONATION - OLD PROCESSES ARE NOT IMMUNE, PROCEEDINGS OF THE AMERICAN PETROLEUM INSTITUTE, 1959, 39, (III), 21-33.

Location : Ponca City; Oklahoma, USA

Injured : 0 **Dead :** 0

Abstract

Refinery coker plant explosion was caused by spontaneous ignition of ram oil vapours in the dephlegmator. During the filling operation, the vent line from the top of the dephlegmator is open to allow the air to escape from the unit as oil displaces it. On this occasion the vent valve was not opened when lining up the unit. Operator error caused this accident.
[refining, separation equipment, unwanted chemical reaction]

Lessons

1. Detonation can occur in any process where air is present, through faulty purge procedure or any other cause, assuming the existence of other contributory conditions.
2. Startups continue to be the most vulnerable period of any unit operation.
3. Startup procedures of old units should be reviewed with reflection on latest technology. Each addition or deletion to a startup procedure should be studied thoroughly for even the remote combination of circumstances which might result in hazardous conditions.
4. The problems of human error, even with the most experienced operator, still exist. This offers a challenge for better training techniques.
5. Side-by-side operating units are undesirable.
6. Grating for platforms probably makes less destructive missiles than floor plate.

143 1956

Source : HYDROCARBON PROCESSING, 1978, 57, FEB, 190.
Location : New York, USA

Injured : 0 **Dead :** 0

Abstract

1100 cum (cubic metre) of ethylene were released from polyethylene reactor vent at 20000 psi. Aerial explosion created 0.5 psi overpressures.
[processing]

Lessons

[None Reported]

142 19 December 1955

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

Location : Tonawanda; New York, USA

Injured : 0 **Dead :** 0

Abstract

Aerial explosion due to rupture disc operation. Widespread window damage within 1.6 km radius, maximum overpressure 3.4 kpa, 1133 cum (cubic metre) cloud. Substance involved: ethylene.
[bursting disc failure]

Lessons

[None Reported]

135   04 April 1955

Source : FIRE NEWS, 1955 MAY-JUNE, 445, 13
Location : Lewiston; Minnesota, USA

Injured : 0   **Dead :** 1

Abstract

Prior to removal of underground gasoline tank that had been abandoned for 20 years the tank was inerted by the use of a carbon dioxide fire extinguisher in the fill pipe of the tank. The most probable cause of the explosion was ignition of gasoline vapours in the tank by static discharge when the extinguisher nozzle came in contact with the fill opening. Fatality.

Lessons

[None Reported]

122 1954

Source : VERVALIN C.H, HPI LOSS INCIDENT CASE HISTORIES, HYDROCARBON PROCESSING, 1978, 57, FEB, 183-190; DAVENPORT J.A, A SURVEY OF VAPOUR CLOUD INCIDENTS, CHEMICAL ENGINEERING PROGRESS, 1977, 73, SEPT, 54-63.

Location : West Virginia, USA

Injured : 44 **Dead :** 0

Abstract

A rail transportation incident. 6000 US gal (23m3) of acrolein explosively dispersed into a vapour cloud when rail tanker car ruptured. Acrolein was contaminated causing a runaway polymerization which overtaxed car relief vent.
[gas / vapour release, explosion / pressure release]

Lessons

[None Reported]

9848 1954

Source : ICHEME
Location : , WEST INDIES

Injured : 0 **Dead :** 1

Abstract

A simple compression system was designed to permit recover low pressure wet gas from flare into a flue gas system. This consisted of a long suction line, a knockout drum to remove liquid and a reciprocating compressor. The safety provision against liquid carryover was a level alarm which was the standard at that time although it would certainly not meet today's standards.
The project department failed to order one item of the level alarm system. The operations department decided to start-up without it. As always the outside operator was busy during the period of start-up. For this reason he did not check the level often enough. The long suction line was warming up and so the flow of condensing liquid to the knockout drum was high. Liquid carried over to the compressor and the top blew off the cylinder. The gas drifted to a process heated and ignited. One maintenance man running to get off the unit was engulfed in flames and killed.
[settling, mechanical equipment failure, fire - consequence, fatality, design inadequate, operator error, gas / vapour release, burns]

Lessons

1. No safety system to be disarmed or dispensed with unless alternative provisions are made which are agreed to be equally effective.
2. The current standards which include a high level shutdown as well as a high level alarm in compressor suction knockout drums are fully justified.

120 06 August 1953

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

Location : , ARGENTINA

Injured : 0 **Dead :** 2

Abstract

Vent discharge from the overpressurisation of this process led to the formation of a gasoline cloud. Ignition occurred in adjacent unit. Three explosions. Fatality.
[processing]

Lessons

[None Reported]

92 16 February 1950

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A styrene butadiene latex making plant inside a building normally had the reactor vents taken up through the roof. At the time of this incident, they had been disconnected for maintenance. A reactor bursting disc failed and filled the building with just over 1 tonne of vapour which caused an explosion. Damage to the building and up to 300 m was considerable. The long range TNT equivalent was 1 tonne TNT.
[reactors and reaction equipment, gas / vapour release]

Lessons

[None Reported]

2944 Date Unknown

Source : LOSS PREVENTION BULLETIN, 111, 1.
Location : ,

Injured : 0   **Dead :** 0

Abstract

A flare stack explosion. This was due to the direct effect of low molecular weight gases. The design of the flare system required a cyclonic knock-out at the base of the flare stack. The section of the entry to the cyclone was rectangular and as the flare header was of course circular the transition from circular to rectangular required some elegant fabrication which was solved by a flange joint. Over the years either the joint had slackened or the joint degraded and air was drawn into the stack. On the day in question the resulting mixture of air and gas within the flare must have been close to stoichiometry as the ignition of the mix by the pilot resulted in a violent explosion which split the rectangular section. It follows that the flow must have been so low that the flame on the tip must have blown out at some time before the explosion.
[flow rate too low]

Lessons

[None Reported]

4496 Date Unknown

Source : LOSS PREVENTION BULLETIN, 023, 131.
Location : ,

Injured : 1 **Dead :** 0

Abstract

A man was severely injured when a plant vessel burst and sprayed him with a corrosive chemical. The vessel was leaking and the material in it was being blown into another with compressed air. The leaking vessel was protected by a bursting disc designed to burst at 5 p.s.i.g and the operator was told to watch the pressure in the vessel and not let it reach 5 p.s.i.g. Nevertheless, he opened the air valve too far and the vessel burst. A valve below the bursting disc was closed.

A number of things were wrong:

1. It is bad practice (and sometimes illegal) to fit a valve between a vessel and its bursting disc. This valve had probably been closed for some time. The valve had been fitted to stop escapes of gas into the plant after the disc blows and while it is being changed. The correct way is to fit two bursting discs, each with its own isolation valve, the valves being interlocked so that one is always open.
2. The process operator, who was a lone-worker had worked on the plant for only seven months, and during this time had received five warnings for lack of attention to safety on plant operation.
3. When air or nitrogen has to be blown into a vessel which cannot stand full pressure of air or nitrogen supply, then it is good practice to fit a reducing valve and relief valve on the gas supply, set below the safe working pressure of the vessel. This is not always possible, sometimes air or nitrogen has to be used to blow liquids into a vessel and if their pressure were reduced it would not be sufficient to move the liquid and in these cases the relief device on the vessel must be sized to take full rate of air or nitrogen.

[competency lacking, reaction vessel, rupture, operator error, preparation for maintenance, injury]

Lessons

[None Reported]

4513 Date Unknown

Source : LOSS PREVENTION BULLETIN, 023, 132.
Location : ,

Injured : 0 **Dead :** 0

Abstract

The manufacturer of liquefied gases was in a position where he was purchasing a large number of bursting discs from different suppliers. These were all stocked in the same area. Two problems arose on the plant. In one instance, two discs of the same diameter, but set at different pressures, were confused and a disc set to burst at 30 p.s.i. was out in a line where it was exposed to a higher working pressure (the correct disk was set to burst at 50 p.s.i.). It burst immediately the plant was started up. It was extremely fortunate this inadvertent substitution did not occur the other way round.
On the same plant, one supplier was providing discs bulk packed, and two 1 inch metal discs were inserted between one holder, having rested in such a manner as to appear to the fitter as one disc. This effectively raised the burst pressure on the vessel, a small cryogenic storage installation, from 50 p.s.i. to 100 p.s.i, where the design pressure of the vessel was only 55 p.s.i. Again, fortunately, the vessel was not subject to over pressure conditions and the double disc was detected and removed during a routine maintenance check six months later.
The manufacturer concerned now insists that all discs are either coded or tagged, to prevent their being installed in the wrong line and also that all discs are individually boxed to eliminate the risk of doubling.
[operation inadequate]

Lessons

[None Reported]

4576 Date Unknown

Source : LOSS PREVENTION BULLETIN, 023, 132-133.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A large polystyrene plant was protected on one part of the installation by a 8" monobloc graphite bursting disc. These discs can be significantly affected by torque values and for that reason the installation instructions, including torque charts, should be carefully read. The fitter concerned, however, had to fit the disc at an awkward point in the site and was unsupervised, so that for a variety of reasons he over-torqued the disc. This produced a crack in the annulus of the disc and when the vessel started up, the cracked section was forced out by working pressure and exited laterally from between the pipe flanges. As a result, the pressure cap on the medium in the vessel was lost and a runaway reaction occurred. An expanding mass of polymer was discharged on to the site, coating the surrounding plant with a hard deposit that proved expensive to remove.
[operational activities, gas / vapour release]

Lessons

The company concerned, in this instance, needed to considerably tighten up supervisory and checking procedures. But in order to avoid repetition of the accident under any circumstances, they replaced the graphite disc with a non-torque sensitive metal disc (from a material selection point-of view, less suitable than graphite) which has increased their spare disc costs. An alternative solution might have been to adopt, if they did not feel confident in their fitting routines, a non-torque sensitive graphite disc known as an armoured disc where the graphite carrier is encased in a steel ring.

3107 Date Unknown

Source : LOSS PREVENTION BULLETIN, 111, 1.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A flare stack to header connection was a flanged joint in the horizontal section of the header. The steam assistance had been left on after a flare of propane gases. The flame followed down inside the flare and burnt at the flange, this in turn heated the section to a dull red heat clearly visible to the naked eye. It was fortunate that the flange was in the lightly stressed horizontal section. Had it been in the vertical section, the stack could have suffered systematic collapse. If this had happened it may have been impossible to shut down the plant safely. Near miss.
[fire - consequence, processing]

Lessons

[None Reported]

7735 Date Unknown

Source : CONTROL OF CHEMICAL EXOTHERMIC REACTIONS, ICHEME, SAFETY TRAINING PACKAGE, 023, 3.35.
Location : ,

Injured : 0 **Dead :** 0

Abstract

An exothermic reaction in the batch polymerisation of vinyl acetate did not moderate as expected. A substantial amount of reactants were ejected into the building and surrounding atmosphere, fortunately without ignition of the highly flammable liquid vapours. The venting arrangements on the catchpot were not sufficient, and led to the rupture of the vessel.
The incident was caused by a valve being closed on a reflux return line on the reactor. This reduced cooling, leading to an increased reaction temperature and therefore reaction rate. The damage was increased by insufficient sizing of the catchpot and vent pipe.
[high temperature, design inadequate]

Lessons

The following recommendations were made:
1. Vent pipework (bursting disc pipework, overflow vapour pipework of the condenser and catchpot vent pipework) should be as straight as possible.
2. Where bends are inevitable, the radius of curvature should be large.
3. Visual inspection of the flanges and pressure actuated by-passes to bursting discs will only give indirect warning of polymer coating. There is no substitute for frequent dismantling and inspection of the bursting disc.
4. Highly exothermic polymerisation solutions of this type and scale warrant a relief vent area of 0.018 m and pipe diameter of 0.15 m.
5. Emergency communication systems should be improved.

7680 Date Unknown

Source : FURNACE FIRES AND EXPLOSIONS, ICHEME, TRAINING PACKAGE, 005, 5.
Location : ,

Injured : 1 **Dead :** 0

Abstract

A furnace tripped out on flame failure as the result of a reduction in fuel oil pressure. The operator closed the two isolation valves and opened the bleed. When the oil supply pressure had been restored the supervisor tested the inside of the furnace with a combustible gas detector. He got no response and, therefore, inserted a lighted poker, a bang occurred, damaging the brickwork and slightly injuring the supervisor.
[explosion, injury]

Lessons

The following recommendations were made:
1. Before relighting a hot furnace it should be swept out for a long enough period of time to be certain that any unburnt oil has evaporated.
2. Operators should be aware of the reason for purging so that they are less likely to reduce the purge time to avoid delay.
3. Furnaces need time to purge, if a delay is unacceptable then permanent pilot burners, supplied from a separate fuel supply, may be used.
4. To keep the purge time as short as possible, the solenoid valve should close quickly, it should be closed to the burner and the line in between should be run so that it does not drain into the furnace.
5. Develop a gas detector which can detect vapour which is explosive when hot but safe at atmospheric temperature, e.g. a detector with a heated sample tube.
6. For many years furnaces burning this type of oil had been tested with detectors which were incapable of detecting the vapour.

7823 Date Unknown

Source : BARTON J AND ROGERS R, CHEMICAL REACTION HAZARDS, 2ND EDITION, ICHEME, 1997, APPENDIX 1, 191.

Location : ,

Injured : 0 **Dead :** 0

Abstract

Ethylbezylaniline (EBA) had to be charged to a stainless steel measuring vessel before beginning the first batch of a product campaign. Immediately after the pumped transfer of EBA started, a violent reaction occurred in the measuring vessel. The pressure in the vessel rose, resulting in rupture of the glass vent line. The measuring vessel was normally used for holding nitrating acid. Apparently the vessel was not cleaned before use, so that it still contained residual mixed acid which reacted with the EBA.
[batch reaction, additional chemical present, cleaning inadequate, unwanted chemical reaction]

Lessons

[None Reported]

8032 Date Unknown

Source : ICHEME
Location : ,

Injured : 1 **Dead :** 0

Abstract

The phenol line between two jetty tank farms was being purged to return line contents to storage. Purging was carried out by connecting the nitrogen line on the jetty head to the phenol line. The connection was made by a rubber hose fitted with bayonet type connections. Problems had been experienced on this occasion with lack of flow, as indicated by the line pressure of 120 psi. Action had then been taken to melt the assumed phenol plug in the line.
The vessel berthed at one of the jetties and was being prepared for the discharge of butadiene raffinate. Following connection of the discharge hose to the ship and shore, the normal pressure test to ensure no leaks were present was about to start using nitrogen pressure.
The nitrogen hose at this time was connected to the phenol line and the isolating valve on the phenol line purge point was closed by hand. The nitrogen hose was disconnected by separating the bayonet fitting at the phenol purge point. Phenol was ejected from the purge point, and struck the person who made the disconnection on his face, right shoulder, lower body and legs.
He immediately made his way to the jetty head safety shower, where he removed contaminated clothing. He remained in the shower for twenty minutes. First Aid assistance was called and the recommended phenol treatment was initiated following extensive water washing. The patient was transported to hospital where he was detained for treatment.
It has been concluded that a phenol plug had formed under the valve on the phenol purge point and prevented its complete closure.
Had the hose been depressurised from 120 psi, the phenol would possibly not have been emitted with such force and the extent of the injury might have been considerably less severe.
[flow rate too low, spill, injury]

Lessons

[None Reported]

8419 Date Unknown

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

Hot graphite fragments fell on to processing plant from a vent stack. Resulting in the unit being shut down as a precautionary measure.
No personnel were injured. Damaged was restricted to a small roofed section of the plant.
[damage to equipment]

Lessons

The hot graphite fragments has resulted from the failure of the top section of the vent stack (i.e. which has been constructed from impregnated grade graphite.
The damage section was replaced with unimpregnated graphite.

7856 Date Unknown

Source : DUST EXPLOSION HAZARDS, ICHEME, TRAINING PACKAGES, 022, 4.17.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A large sanding machine in a plant manufacturing wood based boards, was draughted by a fan with two dust collectors attached. The dust collected by these filters fell under gravity into screw conveyors, through a rotary valve and was then blown to a cyclone. Clean air from the cyclone was recycled and the fines were discharged via a rotary valve to a silo.

During routine operation, an explosion occurred damaging duct work, both filters and the cyclone. The filter units were fitted with relief but the casing was found to be distorted after the event. The cyclone was also fitted with an explosion vent but this was either poorly designed or assembled and failed to open. The rotary valve below the filters was fitted with plastic edges to the blades and it appeared that the blades had allowed the explosion to propagate to the cyclone.

It was very fortunate that unburnt dust emitted from the ducting (during the explosion) did not ignite.

The following conclusions were made:

It seemed clear that the ignition source had arisen at the sander unit. However, it was questionable whether there was sufficient dust generated during the conveying operation to form a flammable atmosphere in the ducting. However, even if there was no flammable atmosphere present in the ducting, a smouldering particle could pass through igniting dust clouds in downstream units.

The damage to the ducting could have arisen from pressure developed from the flammable mixture within or blow-back from the filter units. The rotary valve did not provide effective explosion isolation. This may have been due to the plastic edged blades or the fact that the rotary valve was not stopped. Interlocking devices such as this, which prevent the transfer of burning material in the event of ignition, are an essential part of the protection system.

[design inadequate, solids processing, explosion suppression]

Lessons

The following recommendations were made:

1. On rebuilding the plant, additional features included explosion relief on the ductwork.
2. Explosion relief is essential if the concentration of fines within the ducting lies within the flammable range during normal operation. Explosion relief must vent outside the building.
3. Temperature monitoring of the sander bearings was recommended although this was for warning purposes only. However, temperature monitoring could not prevent an explosion occurring due to immediate bearing failure. The design of the relief systems for both filters and cyclone was also improved, together with the rotary valves.
4. Additional features that were considered included interlocks to the screw feeders and rotary valves which stopped when the explosion vents opened. Strengthening of the conveying pipework and fan casing from the filters to the silo to withstand the possible explosion pressure and a rapid action valve on the clean air outlet from the cyclone were also required.

7658 Date Unknown

Source : HAZARDS OF OVER AND UNDER PRESSURING OF VESSELS, ICHEME, SAFTEY TRAINING PACKAGE, 001, 10.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A storage tank was sucked in. At the time, a flex was attached to the vent pipe and taken down to ground level as welding had to take place on the roof of a neighbouring tank.
The cause of the incident was immersion of the end of the flex in a drum of water. The material in the tank was soluble in water and the supervisor thought it would be safer to absorb the vapour in this way. The operator did not realise that when liquid was pumped out of the tank, water would rise up the flex and a partial vacuum would be developed in the tank. Most storage tanks are designed to stand on 65 mm of water vacuum or 200 mm water pressure. The tank could have burst by overpressuring if the depth of water in the drum was much more than 200 mm.
[overpressurisation, storage tanks]

Lessons

[None Reported]

7633 Date Unknown

Source : LOSS PREVENTION BULLETIN, 132, 15.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A decision was made to have sprinklers installed in a warehouse. While they were being fitted a spark from the welding equipment being used landed on a bale of paper and set the whole warehouse alight, causing half a million pounds worth of damage.
[fire - consequence, warehousing, storage, damage to equipment]

Lessons

[None Reported]

12679Date Unknown

Source : ENDS REPORT 151, AUGUST 1987.
Location : , UK

Injured : 8 **Dead :** 0

Abstract

A release of pyridine-laden steam occurred at a herbicide plant. The incident occurred during reactor cleaning operations when all vents through which such emissions could have taken place should have been sealed off. At least eight members of the public were affected by the release.
[reactors and reaction equipment, operation inadequate, gas / vapour release, people]

Lessons

[None Reported]

7574 Date Unknown

Source : LOSS PREVENTION BULLETIN, 098, 25-29.
Location : ,

Injured : 0 **Dead :** 0

Abstract

On a plant chlorine storage module, a 50 mm chlorine vapour padding line was being stress relieved when the pipe failed due to an iron/chlorine fire. A half metre section of pipe was burnt away.
The chlorine module was on line and there was a significant release of chlorine at 8 barg for a period judged to be in the region of three minutes. It was estimated that up to 350 kgs chlorine may have been released during the incident.
The "chlorine in atmosphere" alarm was initiated during start-up in the plant control room. An operator immediately went to investigate. He saw that the chlorine padding line on No 2 chlorine module had ruptured with chlorine gas and flames being emitted from the pipe. He called for the lead operator to press the gas alarm and to put on a breathing apparatus set. He also put on a breathing apparatus set and closed the automated emergency valve in the chlorine vapour padding line, which isolated that line from the chlorine storage tank. He then ran to the first floor of the chlorine module and manually isolated the liquid chlorine inlet to the vaporiser. At this stage the leak rate rapidly decreased and further isolations, including stopping the chlorine pump, were carried out.
The site emergency services responded rapidly to the gas alarm and were in position setting up water curtains within 3 minutes. However, by this time the leak had stopped and water curtains were not required.
After investigation it was found that the consequences of the incident could have been worse, but due to the provisions made for mitigation of the effects of loss of containment were effective.
[fire - consequence, pipeline failure, gas / vapour release, gas detector]

Lessons

The effects were minimal because:-
1. Gas detectors around the chlorine handling area gave rapid indication that a release had occurred and its location
2. Valves for isolating the main inventory of chlorine from the point of release were installed
3. Staff were thoroughly trained in emergency response which had been well practised so that they had good knowledge of the plant, the hazards and how to act.

9407 Date Unknown

Source : ICHEME

Location : , UK

Injured : 0 **Dead :** 0

Abstract

A fire was discovered in a locker in the locker room. Attempts to tackle the fire with a portable fire extinguisher were abandoned because of the smoke produced, the works fire service was called. The building was evacuated.
[fire - consequence, evacuation]

Lessons

[None Reported]

29 Date Unknown

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

An explosion occurred while a sulphur recovery unit was down for maintenance. Operators were shutting down two utility steam boilers that share a common stack with the unit when a rumble and explosion occurred in the tail gas plant.
The cause of the explosion was traced to an explosive mixture igniting from phyrophoric iron sulphide in the stack common to the sulphur plant and the two utility boilers. Fuel gas was leaking through closed block valves from the amine flash drum cross-tie into the thermal oxidiser. As the utility boilers were shut down a large flow of inert gas to the stack was not present. As a result, the small fuel - containing gas stream educted from the tail gas plant by the hot stack was no longer heavily diluted by boiler flue gases. Although the sulphur unit was under a nitrogen purge this was found to be inadequate and the nitrogen bottle trailer was found empty at the time of the explosion.
[separation equipment, incinerator, isolation inadequate]

Lessons

The following recommendations were made as a result of this incident:
1. Review and revise blinding requirements during the various possible shutdown conditions to ensure proper isolation of cross-connected systems.
2. Re-evaluate the nitrogen purge system design and modify it as necessary to ensure that it is capable of providing an adequate supply of nitrogen.
3. Develop procedures covering the establishment and monitoring of nitrogen blankets including regular testing for oxygen content.
4. Process plant cross-connections of the type between the flash drum and the thermal oxidiser should be designed out of these facilities.

4136 Date Unknown

Source : LOSS PREVENTION BULLETIN, 137, 8.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A temperature recorder/controller on a kettle reactor failed, resulting in the polyester batch being raised to too high a temperature. This led to the pressure in the kettle rising causing the bursting disc to blow. The polyester resin discharged and blocked the line, which caused the pressure in the kettle to rise resulting in the manlid being blown off and the contents of the kettle being ejected to atmosphere, via the manway. No personnel were injured as a result of the incident.
The kettle involved in the incident had been out of commission for an extended period of time. It had been inspected and passed fit for service and prior to recommissioning the kettle and instrumentation had been overhauled.
Since this was the first batch of polyester to be made after a long period of time, a relatively slow reacting general grade of polyester, was being made to condition the kettle. The kettle was charged with the raw materials, propylene glycol, phthalic anhydride and maleic anhydride.
A normal temperature profile was established, and the final hold temperature of 220 degrees C reached, at which temperature hourly samples were taken. The first three hourly samples showed the normal drop in acid value and increase in viscosity, with later samples appearing to indicate that the reaction had slowed down. However after seven hours the sample taken had a high viscosity indicating the reaction had increased. Half an hour later the viscosity was up to 5.3 poise (0.53 Nsm<+>-2<+>) which was in excess of the higher specification limit of 5.1 poise (0.51 Ns<+>m-2<+>). Full cooling was applied to the internal water cooling coil in the kettle and the temperature controller set to zero. It was then observed that the temperature on the recorder/controller had jumped from 218 degrees C to 270 degrees C, and that the reactor contents were frothing and that the agitator had cut out, and could not be restarted. The bursting disc was heard to blow and approximately forty minutes later the manlid blew off and a large amount of the reactor contents were ejected through the manway.
The ejected material had the appearance of brown granulated sugar. The ejected manlid hit the water main and activated the sprinkler system. Cooling was applied to the adjacent reactors, incoming and outgoing lines isolated and all electrical equipment isolated. No personnel were injured during the course of this incident.
[reactors and reaction equipment, high temperature, overpressurisation, charging reactor]

Lessons

It had not been appreciated that polyesters could froth because of decomposition at high temperature.
1. A separate temperature indicator/recorder with an alarm should be provided to alert personnel if the temperature rises unduly above set point.
2. A more reliable temperature/recorder controller should be installed.
3. The 7.5 cm bursting disc line was blocked with solid resin. Thus the system failed to relieve the kettle pressure. When low boiling materials which can cause frothing of reaction mixture are used, consideration should be given to providing a better means of pressure relief that can cope with the frothing semi-solid polyesters produced accidentally at high temperatures.

5416 Date Unknown

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

An explosion blew a hole approximately 9ft. x 4ft. in a knock-out drum situated at the base of a flare stack. The flare stack itself was also extensively damaged and the first part of the vertical ladder on the stack was knocked some 20 yards down the pipe track serving the flare. A fire followed the explosion consistent with the combustion of a pool of liquid lying in the bottom of the knock-out drum. The fire was contained by the Site Fire Brigade but allowed to burn itself out because of the toxic nature of the material involved. There were no injuries to personnel or damage to any equipment other than that adjacent to the flare stack itself.

At the time of the explosion, the main nitrogen purge to the flare stack header had been shut off in error. This was a major factor in this incident as lack of a sufficient positive inert purge to the flare stack header allowed back-diffusion of atmospheric oxygen from the flare tip. In addition there was a low level of plant production prior to the incident. This resulted in a stripper overheads vent gas having a relatively high oxygen content and this gas, which was close to the limits of flammability, slowly filled the header from the plant end.

A combustible mixture reached the flare tip where it was ignited by the pilot burner. The flame front then went back into the knock out pot causing the explosion.

[damage to equipment, fire - consequence, operator error, processing, toxic chemical, gas - flammable]

Lessons

[None Reported]

4001 Date Unknown

Source : ICHEME
Location : ,

Injured : 1 **Dead :** 0

Abstract

An operators finger was badly burned whilst handling a fluoroelastomer 'O' ring which had been exposed to a high temperature.
The burn was the result of chemical contamination of the skin caused by the decomposition of the flurooelastomer. It was necessary to amputate part of the finger to remove the contamination.
A fluoroelastomer is a synthetic rubber like material containing fluorine. It is commonly used in industry for gaskets, 'O' rings and seals of various kinds.
When used under their design conditions, they are perfectly satisfactory and safe. However, if exposed to a temperature in the region of 400 degrees C or higher, the material decomposes and one of the products formed is hydrofluoric acid.
Fluoroelastomers which have been subjected to very high temperatures through equipment failures or fires should therefore be handled with considerable care. Suitable precautions include the wearing of neoprene gauntlet gloves.
[burns, processing]

Lessons

In the event of skin contact first aid actions are:
1. Drench with water at 20-35 degrees C to remove excess HF (hydrofluoric acid), removing affected clothing at the same time.
2. Apply calcium gluconate gel to the burns as soon as possible after drenching.
3. Massage gel into burns and continue to apply fresh gel to the burn surface until pain has ceased for at least fifteen minutes or until professional medical attention is to hand.

3100 Date Unknown

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 1

Abstract

A laboratory technician had fatal contact with reactive chemicals. The safety shower was found to have an inadequate spray pattern which did not conform to standards.
[fatality, standards inadequate, laboratory work, unknown chemicals]

Lessons

1. Safety showers should be checked on a regular basis to ensure they are functioning properly and that output is adequate, including indoor showers.
2. Safety show positions be readily identifiable within plants and buildings.

2974 Date Unknown

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A grass fire covering an area of approximately 1,200 m2 at the foot of a flare occurred when liquid hydrocarbons were ejected from the top of a flare.
The incident happened when an upset occurred during the start-up of the propane deasphalting unit. A large quantity of propane was suddenly released to flare which carried over liquid hydrocarbons trapped at low points in the main flare system.
[fire - consequence]

Lessons

The refinery has recommended a systematic check of all drains and knock out pots in the main flare system prior to unit start-ups to prevent a recurrence.

5407 Date Unknown

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

An 80m length of 24 inch diameter flare line fell down due to the failure of four support hangers.
Serious damage was avoided since the pipe came to rest on a horizontal support structure situated a short distance immediately below the flare line.
The flare line is supported by hangers every 20m about 4m above ground level.
The hanger supports in this case consisted of a frame assembly around the pipe fitted with a roller to allow for longitudinal movement.
The frame assembly was connected to the top structure beam by a steel rod and swivel device.
The swivel construction was designed to take up any transverse movement of the pipe
An investigation into the incident revealed that the support rods had failed due to fatigue fractures caused by alternating bending loads. The presence of corrosion, rust and dirt prevented any movement of the hemispherical swivel device and the roller bars in the support frame. Calculations have indicated however, that frictional forces alone (without the presence of rust etc.) may have been sufficient to exceed the critical bending stresses for the support hanger rod.
[material of construction failure, near miss]

Lessons

[None Reported]

1542 Date Unknown

Source : ICHEME
Location : ,

Injured : 0   **Dead :** 0

Abstract

During severe weather conditions with temperatures below freezing and strong icy winds, small amounts of water froze in a filter arrangement connected to a breathing air line. A contractor was inside a tank wearing breathing apparatus connected to the supply at the time. He began to feel unwell and immediately climbed out of the tank.
[cold weather, entry into confined space]

Lessons

Breathing air supplied from compressors should not contain free water that can accumulate and freeze in the system. There has also been reports of ice forming in the pressure reducing valve of self-contained breathing apparatus. Where necessary the relative humidity of the air should be checked.
British Standard B.S. 4275 recommends that the relative humidity should not exceed 85%

11809Date Unknown

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

During a catalytic cracker shutdown several pressure relief valves discharging to flare were removed for servicing whilst the diethanolamine treater connected to the flare header was still operating. The valves were removed under controlled conditions and the connections to flare immediately blinded. However, in one case where the blind was in place and the gasket was being installed, ignition occurred. It was determined that this was due to the presence of pyrophoric iron sulphide.
On many previous occasions, although, some vapour hydrocarbon had been released there had been no ignition.
[blowout, fire - consequence, spontaneous combustion, safety procedures inadequate]

Lessons

[None Reported]

11029Date Unknown

Source : CHEMICAL HAZARDS IN INDUSTRY, JUNE, 1999, ISSN 0265-5271,; LOSS PREVENTION BULLETIN, FEB 1999, (145), 18.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A fire-ball estimated at 14 m erupted from the tip of a flare stack at an olefin plant during shutdown for routine inspection. The system was being purged by fuel gas and the pilot lights were lit at the time of the incident. Fluid dynamic analysis showed that, under the prevailing low wind and still weather conditions, normal purge rates of low molecular weight gases can generate a bi-directional flow air and flammable gas within the flare stack. If the purge rate was high enough the mixture would be rich and flammable. Therefore purge rates must take account of the molecular weight of the purge and process gases, the presence of a molecular seal, flare stack diameter and height, diffusion, and flammability envelope of the fluids.
[fire - consequence, purging]

Lessons

[None Reported]

12764Date Unknown

Source : CHEMICAL HAZARDS IN INDUSTRY, JUNE 2000,; FISHWICK, T. LOSS PREVENTION BULLETIN, FEB 2000, (151), 11-12.

Location : ,

Injured : 0 **Dead :** 0

Abstract

An explosion occurred at a hydrogen chloride plant in the exhaust section during start-up after maintenance.
The force of the explosion shattered the exhaust fan and fractured the PVC piping at the joint between the normal running and start-up stacks. The exhaust gas composition passed through the explosive range between the lighting up procedure and closure of the lighting port. A possible source of ignition is thought to have come from inside the exhaust fan.

Lessons

The report stated the following recommendations:
A nitrogen purge to be introduced into the gas outlet to or from the final scrubber for one minute after the lighting port is closed.

12002Date Unknown

Source : LOSS PREVENTION BULLETIN, 070, 1-6.
Location : ,

Injured : 0 **Dead :** 0

Abstract

During an upset on a plant separating hydrogen and light hydrocarbons, liquefied product at sub-zero temperatures entered the carbon steel section of the flare line. The metal became brittle and with the uneven stresses on the pipe, it ruptured, resulting in a release of a large amount of light hydrocarbons at low temperature. A vapour cloud occurred. The situation was handled safely.
The plant was taken off line and all hydrogen and hydrocarbons were flared and replaced with nitrogen to allow repair work on the flare line. Safeguarding of all plants and systems and the repair programme were done under close supervision, using pre-planned procedures.
Effective application of water sprays proved to be very effective in fighting the hydrogen vapour cloud.
[brittle fracture, gas / vapour release, separation]

Lessons

The following recommendations were made:
1. When planning for handling vapour clouds, identify all ignition sources to be eliminated during an emergency.
2. Provide central shutdown facilities for all equipment.
3. Portable electrical equipment which is unsuitable for use in a vapour cloud environment must be identified and excluded from the emergency procedures.

12996Date Unknown

Source : LOSS PREVENTION BULLETIN, 147, 15-16.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A fire occurred on an offshore compressor stations. The incident occurred when purge gas was ignited by static caused by a snowstorm; the vent stack had been alight all morning.
During mid-morning, a total shutdown of the generators, gas compressors, turbine enclosure cooling fans and compressor auxiliaries etc (seal oil pumps) occurred. The operating staff had established that the cause of the shutdown was low fuel gas pressure.
Half and hour later there was a general alarm and all personnel went to their muster station. Two members were dispatched to investigate the cause of the alarm. They reported back that it had been instigated by the presence of gas at the compressor station.
It was decided to investigate whether the alarm was genuine or false by using a portable gas detector.
While making their way to the compressor station there was a further general alarm followed by a muffled explosion. A fire was seen at the unit power turbine exhaust and power turbine drive shaft coupling.
One member of staff proceeded to the control room to set the auto mode to vent down the compressor units as a result of the venting the stack flame increased considerably and the noise and radiation became unbearable; this resulted in personnel leaving the muster area and away from the vent stack.
The vent was inhibited to halt the worsening main vent stack fire. With the vent stack fire reduced to its original intensity it was decided to fight the fires in the compressor area.
The vent stack fire was extinguished using CO2 and eventually the fires at the power turbine drive shaft and turbine exhaust stack were extinguished.
When all the fires were out, the remaining gas was vented by inhibiting the platform vent, station vent and unit vent, removing the total vent inhibit and then removing the unit vents inhibits one at a time and depressurising the units.
The Investigation.
The shutdown of power followed by the shutdown of compression was caused by liquids in the fuel gas system.
This resulted in the instrument air compressor tripping out on loss of power, which resulted in the loss of fuel gas supply to the compression units. Automatic venting of the units did not occur as the extreme cold had led to failure. The seal oil to both units became depleted leading to gas in the compressor units escaping via the oil drains and seals. The gas release was automatically detected and the audible alarm initiated; the gas then ignited by static generated by the snowstorm. The venting of te compressor units and platform was initiated after the platform had been switched to auto mode by 75% LEL on the gas detectors. This resulted in a very large vent tip fire with excessively high radiation levels at ground level, requiring the crew to seek shelter; this was exacerbated by the wind direction. Due to the high radiation levels the crew had to inhibit the vent and fight the fires.
[fire - consequence, leak, explosion / pressure release]

Lessons

The following recommendations were made:
1. Investigate the reliability of the fuel gas supply and implement any actions arising.
2. Improve reliability of instrument air supply by:
· Lagging vulnerable sections
· Installing pressure switches
· Relocating impulse line tapping points
· Changing to different dryers
3. Carry out a study of the reliability of unit vent valves (install upstream lock open block valve to allow them to be tested). Relocate solenoid valves. Change hydraulic fluid (existing fluid may freeze in subzero temperature conditions).
4. Investigate choice and reliability of existing actuators and location of all lines and systems with regard to winter conditions.
5. Take reasonable fire precautions such as:
· Construct a fire wall at lube oil skid
· Install a fixed fire-fighting system at lube oil skid
· Improve the trigger initiation system for the built-in continuous flow system and draw up a regular testing schedule
· Improve oil drainage removal beneath skids
· Review existing fire-fighting equipment for its suitability/effectiveness, reliability, position
· Review fire/gas philosophy.
6. Consider the following venting issues:
· Reposition auxiliary vents from turbine exhausts
· Check purge gas rates and fit appropriate restriction orifice plates. Relocate thermocouples for tip fire detection and improve snuffing systems
· Consider the installation of a fluidic tip with snuffing arrangements
· Study the wider implications of re-siting the vent stack
· Consider the installation of a timer in the vent inhibit system
7. For staffing issues: review the experience and training requirements for compressor station crews.

12883Date Unknown

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A failure of a high pressure quick disconnect coupling occurred whilst depressurising a well annulus to flare.
The failed coupling was found to contain a large amount of corrosion product and solids contamination around the working parts also a whipcheck attached to the two halves of the coupling was sheared in two. Fortunately no one was injured in the incident.
[offshore, coupling failure, near miss]

Lessons

The following lessons were learnt:
1. Cleanliness and fitting integrity are critical to the safe function of such quick-disconnect hose fittings.
2. Regular maintenance must ensure suitability for use.
3. Whipchecks of the correct rating for the duty must be used.

10437Date Unknown

Source : LOSS PREVENTION BULLETIN, 142, 7-9.
Location : ,

Injured : **Dead :**

Abstract

An explosion occurred in a flare stack, causing damage to the flare tip and some deformation of the base. The following summaries the investigation into the cause of the incident and concludes that there were three possible causes, with all of these three having general relevance to flare stack operations.
A number of witnesses described hearing a 'sharp bang' or a 'prolonged noise' and saw large amounts of black smoke, possibly containing solids, coming from the flare. Two diffuser sections were blown off the flare tip and found at least 45m from the stack and there was distortion observed. Damage to the molecular seal was considered to be quite likely, but was not the subject of these investigations.
The following conclusions were made:
The most likely cause of the explosion was considered to be ingress of air at the flare tip due to opening of the off-gas compressor pressure control valves, A and B, under vacuum conditions leading to a flammable mixture of off-gas and/or fuel gas and air within the flare system. However, steps to guard against the other possible causes, as well as against the other possible causes, as well as against this one, were pursued by the organisation concerned.
[damage to equipment, operation inadequate]

Lessons

[None Reported]

10424Date Unknown

Source : LOSS PREVENTION BULLETIN, 142, 10-11.
Location : ,

Injured : 0 **Dead :** 0

Abstract

During a few days prior to this incident, large quantities of cold gas had to be relieved to the flare because of problems in the ethylene plant cold box. At the time the ambient temperature was probably below freezing point. However, before the incident, the plant was running smoothly and the flare was well lit. An operator heard a rumbling noise and saw material being ejected from the flare. Other witnesses saw a stream of water and ice particles issuing from the flare stack. The flame was extinguished, then eventually re-lit about two hours later.
Immediately after the incident, the flare blowdown drum was found to be about one-third full of liquid mainly water. The molecular seal drain line was inspected and had water drained from it, and was presumed to be clear of blockage. A few days later, this line was blown back with steam to the molecular seal and a partial blockage thereby cleared, while a considerable quantity of water was drained from the line. Visual inspection with binoculars confirmed that all of the flare tip external parts were in good condition.
[inspection, explosion / pressure release]

Lessons

[None Reported]

10423Date Unknown

Source : LOSS PREVENTION BULLETIN, 142, 9.
Location : ,

Injured : 0 **Dead :** 0

Abstract

An explosion occurred within a styrene plant flare stack, resulting in the stack splitting in three places totalling approximately two-thirds of its circumference. Whilst the plant was undergoing immediate shutdown, two further explosions took place. The plant was finally shutdown safely without injury to personnel.
Investigation of the incident:
The investigation showed that the bursting discs that protected the relief systems on the associated main condensers had failed, and that two separate condenser relief valves were passing. It was concluded, therefore, that air had been pulled into the flare stack due to the existence of these conditions. The oxygen analyser did start to climb, but steadied and never reached its trip setting. An explosive mixture was established at, and around, the flare tip and an internal explosion followed. This caused the damage to the base section, and air being sucked in through the damaged section led to the two subsequent explosions.
[bursting disc failure, damage to equipment]

Lessons

The following recommendations were made:
A large number of recommendations were made, covering the short-term up to, and including, recommissioning and the longer term. These are summarised because of their general applicability to the safety of operation of flare stack systems.
Shorter term:
The inspection and overhaul of all vacuum duty safety valves, including any associated pneumatics. The integrity of all the bursting discs should be investigated, and include the rating of discs and investigation of the design of disc holders to ensure they are adequate for vacuum duty and the design pressure.
The inspection and overhaul of all controllers and pneumatics associated with the pressure control valves.

11456Date Unknown

Source : PETROLEUM REVIEW, OCTOBER 1986.

Location : ,

Injured : 1 **Dead :** 0

Abstract

A leak of ammonia was discovered in the refrigeration area of an ammonia plant, the vapour cloud being emitted from a vent on the refrigeration compressor. An attempt was made to control and dilute the emission. After about ten minutes a site fireman, wearing a full-face mask, with ammonia absorbent canister, collapsed. He was removed from the scene and taken to recover in fresh air.
On examination of the filters in the ammonia canister, taken from the mask, it was found that they were soaked with water, the fibres had expanded and therefore air had been unable to reach the user. The fireman had been working behind a water fog curtain.
[refrigeration unit, gas / vapour release, asphyxiation]

Lessons

A test identified that a teaspoonful of water was sufficient to clog the filter and prevent airflow.

11855Date Unknown

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

As part of a hydrodesulphur modification, two naphtha rebolier pumps were installed. There were problems with leaking packing glands. On one occasion a maintenance man repacked one pump as requested by an operator and reported he had done so. However he had not closed the pump vent valve. The operator did not check the job, try out the pump or record the repair in his log. Pressure of work during the unit start up was the cause. When the pump was next put in service, hot naphtha spaying from the vent caused a major fire.
[naphtha, maintenance, start-up, modification, pump, vent, fire - consequence, damage to equipment, operator error, safety procedures inadequate, design inadequate, operator error]

Lessons

1. The faulty packed glands were replaced by mechanical seals.
2. Operators were reminded that the procedure for starting up pumps included checking that drains and vents were closed.
3. Procedures were modified so that the operator and maintenance man had to check and sign off work as satisfactory before the maintenance man left.

11769Date Unknown

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

During shutdown of a sulphuric acid alkylation unit some butane were drained along with the acid to the spent acid tank. The butane vapour vented from the tank were ignited by a sulphur plant incinerator. These flames in turn ignited flammable vapours venting from a lean diethanolamine surge tank on an H2S (hydrogen sulphide) removal unit. This tank exploded.
[hydrocarbons, settling, atmospheric tank, vent, fire - consequence, explosion, safety procedures inadequate, design inadequate]

Lessons

1. Shutdown start up and other abnormal operations are frequent causes of incidents. Plant operating procedures need to cover these situations where they are predictable.
2. In this case the spent acid was re-routed to a clash drum vented to flare, before flowing to the spent acid tank.
3. The tanks were fitted with pressure vacuum vent valves.
4. Cone roof tanks containing flammable vapours are a significant hazard as these can be ignited by static, lightning or pyrophoric action as well as flames. Checks should be made on the vapours and where flammable conditions frequently occur then:
· The service of the tank should be modified to minimise these conditions or,
· An internal floating roof should be fitted or,
· The tank vapour space should be inerted.

11771Date Unknown

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

Over a period a crude oil distillation unit had been modified to double its capacity. This required the crude sure drum capacity from 6 to 3 minutes holding time and required turbine driven pumps to operate close to the overspeed trip stetting. Due to a minor upset the pump taking solution from the surge drum tripped out. The surge drum filled and the relief valve received to before the operators realised there was a problem. A fire followed.
[normal operations, modification, level meter/control, vent, control valve, spill, fire - consequence, overflow, design inadequate, safety equipment failure, modification procedures inadequate, crude oil]

Lessons

[None Reported]

11808Date Unknown

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

A 60 meter high flare stack collapsed in a 90 kph wind. This was well below the design wind speed. Investigations showed that one of the guy wires had pulled out of the four cable clamps. It was determined that some of the clamp bolts had been tightened to one third of the design torque.
[strong winds, construction, bolts incorrectly tightened, contractor error, inspection inadequate]

Lessons

1. The number of cable clamps was increased from 4 to 6.
2. The bolts were tightened using a torque wrench.
3. The ladder design was changed to provide better access to the cable clamps at the top of the guy wires for inspection.

9701 Date Unknown

Source : ICHEME
Location : ,

Injured : 1 **Dead :** 0

Abstract

A contractors employee developed skin infection, possibly from gloves used during the cleaning of a bench in the HF alkylation unit workshops. [contamination]

Lessons

[None Reported]

9699 Date Unknown

Source : ICHEME

Location : ,

Injured : 1 **Dead :** 0

Abstract

An employer received a small HF (hydrofluoric acid) burn when his gloves developed a pinhole leak. The gloves were of the thin type for close tolerance work and were unsuitable for the heavier work inhand.
[burns, safety procedures inadequate]

Lessons

[None Reported]

9696 Date Unknown

Source : ICHEME
Location : , NETHERLANDS

Injured : 2 **Dead :** 0

Abstract

Burning liquid ejected from the flare stack during Fluid Catalytic Cracker Unit (FCCU) commissioning, due to excessive LPG processing. Two men in the flare stack area were affected by hydrocarbon liquid drenching, but not burnt.
[overpressurisation, explosion]

Lessons

[None Reported]

9664 Date Unknown

Source : MANUFACTURING CHEMISTS ASSOCIATION 1970 VOL. 3, CASE HISTORY 1192.; LOSS PREVENTION IN THE PROCESS INDUSTRIES, F. LEES.

Location : ,

Injured : 0 **Dead :** 0

Abstract

An operator checked the level in a storage tank and then began pumping in a volatile monomer from a tank wagon. The vent pipe of the storage tank was blocked, however and a large quantity of monomer flowed out of the dip leg.
[storage tanks, chemicals, spill, material transfer, unknown chemicals, unidentified cause]

Lessons

[None Reported]

9661 Date Unknown

Source : LOSS PREVENTION IN THE PROCESS INDUSTRIES, F. LEES.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Pressure relief on a low pressure refrigerated ethylene tank was provided by a relief valve set at about 1.5psig and discharging to a vent stack. When the design had been completed, it was realised that if the wind speed was low, cold gas coming out of the stack would drift down and might then ignite. The stack would drift down and might then ignite. The stack was not strong enough to be extended and was too low to use as a flare stack. It was suggested that steam be put up the stack to disperse the cold vapour and this suggestion was adopted. The result was that condensate running down the stack met cold vapour flowing up, frozen and completely blocked the 8 inch pipe. The tank was overpressured and it burst. Fortunately the rupture was a small one, the ethylene leak did not ignite and was dispersed with steam while the tank was emptied.
[design or procedure error, thermite reaction, overpressurisation, gas / vapour release]

Lessons

[None Reported]

9660 Date Unknown

Source : LOSS PREVENTION IN THE PROCESS INDUSTRIES, F. LEES.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A works had a special network of air lines installed some 30 years ago for use with breathing apparatus only. The supply to this network was taken off the top of the general purpose compressed air main as it entered the works. One day a man wearing a face mask inside a vessel got a face full of water. He was able to signal to the anti-gas man and was rescued. Investigations revealed that the compressed air main had been renewed and that the branch to the breathing apparatus network had been connected to the bottom of the compressed air main. As a result a slug of water in the main would all go into the catchpot and fill it more quickly than it could empty.
[protective safety equipment, operation inadequate, near miss]

Lessons

[None Reported]

9653 Date Unknown

Source : LOSS PREVENTION IN THE PROCESS INDUSTRIES, F. LEES.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A storage tank was cleaned out and filled with a high purity liquid. A polyethylene bag was put over the vent to prevent contamination. It was a hot day and the temperature of the liquid in the tank rose. There was a sudden shower, vapour in the tank condensed and the tank collapsed inwards.
[storage tanks, cleaning, high temperature, unknown chemicals]

Lessons

[None Reported]

9644 Date Unknown

Source : MANUFACTURING CHEMISTS ASSOCIATION 1966 VOL. 2, CASE HISTORY 703.; LOSS PREVENTION IN THE PROCESS INDUSTRIES, F. LEES.

Location : ,

Injured : 0 **Dead :** 0

Abstract

An employee was repairing a blower on the vent stack of a dissolver. When he had finished the work, he switched the machine on, but observed that it was not operating. He reached into the stack to give the fan blades a turn and there was an explosion. The vent stack had contained a flammable mixture, which was probably ignited by static electricity from the man's body.

Lessons

[None Reported]

9642 Date Unknown

Source : MANUFACTURING CHEMISTS ASSOCIATION 1966 VOL. 2, CASE HISTORY 1097.; LOSS PREVENTION IN THE PROCESS INDUSTRIES, F. LEES.

Location : ,

Injured : 0 **Dead :** 0

Abstract

An explosion occurred in the open air in the vicinity of a hydrogen vent stack and caused severe damage. It was normal practice to vent hydrogen for periods of approximately 45 minutes. On this particular occasion there was no wind, the hydrogen failed to disperse an explosion followed.
[damage to equipment, venting]

Lessons

[None Reported]

11810Date Unknown

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

A short circuit in the fireye system of a refinery steam boiler caused the shutdown of the system.
Due to the lack of co-ordination in fuses and circuit breakers this caused the shutdown of the other steam boiler.
The incident affected the amount of (lack of) steam operating the hydrogen gas compressor on the catalytic reformer, releasing gas to the flare.
Temperatures were below 0 degrees C and the drain from the flare molecular seal was plugged.
venting, flare stack, overpressure, near miss, safety equipment failure, electrical equipment failure, safety procedures inadequate]

Lessons

1. This incident is a very good illustration of the need for regular audits on safety related equipment to ensure that it remains in working order for long periods when it is not required to operate.
2. In the present case the following steps were taken:
· The centre steam injection system was shut down in cold weather.
· The molecular seal draw was connected to the fuel gas system so that it could be checked and blown clear on a regular schedule.
· Methane was injected into the flare system in cold weather.
· A pressure recorder was installed on the flare header.

11811Date Unknown

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

An explosion occurred when hydrogen was being vented upward at a rate of 50 to 100 tonnes an hour at high velocity. This ignited spontaneously. The resulting explosion rattled windows 3 km away. However, the damage on the plant was limited to broken glass, doors blown off, some damage to walls and some deformation of structural steel.
[venting, flow rate too high, design inadequate, damage to equipment]

Lessons

1. Rapid venting of hydrocarbon should preferably be through a flare stack remote from the plant.
2. The very high velocities concerned may generate static. This could be the true source of ignition.

11819Date Unknown

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

During commissioning of a hydrocracker, a release of liquid light hydrocarbons to the flare header caused a non return valve to freeze shut. There was a none return valve on the sub header from each of the several units connected to the main flare header. This was to isolate units which were shutdown individually. Also connected to the flare sub header were the outlets from bursting discs on the cooling water return header. These were to protect the water header in case of a tube rupture in water coolers which contained product at up to 100 bar pressure. Because of the frozen check valve, pressure built up in the hydrocracker flare sub header and caused the bursting discs to fail in reverse flow. The severe slugging caused by the hydrocarbon vapour in the water header caused a riser at the cooling tower to rupture and collapse. Water from the header shorted out an adjacent electrical substation. Fortunately the hydrocarbon did not ignite.
[commissioning, cooling water system, non return valve, bursting disc, rupture, damage to equipment, design inadequate, freezing, LPG]

Lessons

Valving in flare headers to be minimised. Any valve installed there is to be designed so that it cannot fail or freeze in a closed position, e.g. gate levels should be installed with the stem horizon or up side down.

2 Date Unknown

Source : WHITE B.J, WATSON B.J, TRUSLOVE T.E, REPORT ON A STUDY OF CHEMICAL TANKER VENTING AND GAS FREEING ARRANGEMENTS; SCOTTISH ENERGY CENTRE; 20 JANUARY 1988

Location : , SINGAPORE

Injured : 0 **Dead :** 0

Abstract

A marine tanker arrived in Singapore and discharged a cargo of oil at a single point mooring buoy. For some months the crew were aware that the valve that would admit inert-gas from the inert-gas system to No. 2 tanks was seized closed. When the cargo was discharged, all tanks were inerted with the exception of the No. 2 tanks. Discharging was complete and the ship was preparing for sea when there was a lightning strike. Within seconds there was an explosion in the No. 2 tanks and the fore end of the ship was blown off. The fore part sank onto the pipeline dragging the loading buoy under. It was concluded that the ignition entered the vent of No. 2 tank as it was established that, to avoid maintenance, the flame arrester had been removed.

Lessons

The investigators were agreed that flame entering the vent stack from an explosion would move so fast that no scorching would be expected. They were also convinced that the most likely place for a lightning strike was a mast or a vent stack and that the vent stack provided the most probable means of entry into the tank. It was observed that while a search of the recovered debris showed many parts of the flame arresters, none of the parts belonged to the element. It was later revealed that to avoid maintenance, the elements of the flame had been removed and they were all in store.

7184 Date Unknown

Source : LOSS PREVENTION BULLETIN, 049, 25.

Location : ,

Injured : 1 **Dead :** 0

Abstract

An operator removed the cover of a 100 gallon reactor after the reaction was complete. He placed a spot ventilator (exhaust fan with flexible duct) at the opening of the reactor just prior to taking a sample. He transferred the material into another vessel and recharged the reactor in preparation of a new batch. During this time, the operator was exposed to phosphorus oxychloride fumes. Some 12 hours later this exposure resulted in a severe irritation of his lungs. [sampling, charging reactor, reactors and reaction equipment]

Lessons

It is essential that exhaust vents are sited so that fumes cannot return to their point of origin or to any work area.

7119 Date Unknown

Source : LOSS PREVENTION BULLETIN, 032, 13-14.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A catastrophic failure of the shell/bottom junction of a cone roof tank occurred at a refinery when the tank was overpressured by compressed air injected for mixing. The failure was caused by mechanical faults in the PV (pressure-vacuum) vent and by weak roof seam construction. Fortunately, this was a small tank in lubricating oil service, and no serious fire risk resulted from the sudden dumping of the oil contents. No personnel were in the immediate area at the time, and no injuries were incurred.

The tank failure resulted from two mechanical construction faults:

1. The internal dimensions of the PV vent were such that, in the closed position, the pressure valve spindle dropped out of its guide and became jammed. As a result, the tank was overpressured by the compressed air injected for mixing purposes. On subsequent checking it was found that two other valves from the same manufacturer had the same design fault.
2. Although the tank was fabricated with a correctly dimensional weak roof-shell weld seam, this safety feature had been made completely ineffective by the addition of internal brackets between the outer end of each roof rafter and the adjacent shell plate. These brackets were not shown on the tank drawings, and were presumably installed by the tank fabricator to facilitate erection.

Without the protection of the PV vent valve or weak roof seam, the tank failed at the shell/bottom junction when subject to overpressure. The sudden dumping of the oil contents created a vacuum within the tank, which caused severe implosion deformation of the shell.

[overpressurisation, tank failure, damage to equipment, storage]

Lessons

Arising from this incident, the following recommendations were implemented for general application:

1. Check all PV valves for potential jamming, as occurred in the case described.

Note: PV vent valves should be listed and scheduled for regular inspection in the same way as safety valves.

2. Check all new construction cone roof tanks before commissioning to ensure that there are no internal brackets which would prevent the proper functioning of the weak roof seam. This incident demonstrated that an external check of the weak roof seam is not sufficient to ensure that this essential safety feature is fully effective.
3. On existing cone-roof tanks, a similar internal inspection of the roof/shell junction should be made when next taken out of service for cleaning.

7121 Date Unknown

Source : LOSS PREVENTION BULLETIN, 035, 9.
Location : ,

Injured : 0 **Dead :** 0

Abstract

An operating procedure prescribed that after discharging a batch containing aluminium chloride melt into water, the reaction vessel must be flooded with water to clean it. During this cleaning procedure the glass vent burst and dense fumes of hydrochloric acid and sublimed aluminium escaped. When the water was being added the reactor contained some 100 kg of aluminium chloride which reacted violently with water. The pressure shock, which resulted from the sudden evolution of hydrochloric acid, ruptured the glass vent.
[high pressure]

Lessons

In the future, the reactor will be checked visually and by dipping before any water is introduced. The glass vent was fitted with a plastic sleeve.

7132 Date Unknown

Source : LOSS PREVENTION BULLETIN, 035, 5.
Location : ,

Injured : 1 **Dead :** 0

Abstract

Two operators were about to charge a filter press cake still moist with petroleum ether from metallic boxes into a paddle drier. When scraping the rest out of the fifth box, a jet of flame broke out of the funnel opening. The fire brigade had to put out the heavily smoking fire. One of operators suffered burns on one arm and on the head.

To scrape the press cake from the metallic press box, the latter was suspended on a mobile rack, running on plastic wheels, and hung freely in the air. When the operator, wearing shoes with conductive soles, toughed the press cake with the metallic shovel, a spark flashed over and triggered the fire. Material damage was caused.

[lack of earthing, fire - consequence, damage to equipment, charging reactor]

Lessons

The following measures were taken: Earthing of the press box and use of a plastic shovel.

7138 Date Unknown

Source : LOSS PREVENTION BULLETIN, 043, 39-40.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A dry rise sprinkler system fitted into an unheated warehouse had the air connection fitted above the water clack or flap valve. It thus maintained the riser and distributor under air, but if a heat sensitive bulb burst and the air pressure was released, the flap valve, working on a differential pressure of 4:1, allowed water to flow through the system and to sprinkle from the burst head.
The plant air system was used to supply the necessary air. Due to a drop in air pressure, the flap valve opened and water rose above the air inlet pipe.
The water was at 10 bar. The air supply was 4 bar. Although the air supply was fitted with a non-return valve, it leaked. Water passed back slowly into the plant air system and rendered the whole plant air system useless.
[air system failure, warehousing]

Lessons

Fire protection system in general, but drier risers in particular, should be supplied from an independent air supply. This will minimise the consequential loss of the almost inevitable failure of any non-return valve.

7150 Date Unknown

Source : LOSS PREVENTION BULLETIN, 031, 25.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A pressure release system set at 28 bar (405 lb f/in2) vented a steam receiver vertically through the roof of a building through a 100 mm (4 inch) diameter pipe. Water droplets from this vent had cascaded on to the platform in front of the entrance doorway so someone fitted a right angle bend to the top of the pipe to direct the spray away from the platform. A supporting angle near the top of the pipe was welded to the building roof purlins which would take the thrust.
In due course when the relief operated, the thrust sheared the light welding which held the support angle in place, and bent the branch on the stream vessel necessitating an expensive repair and steam vessel re-proving.

Lessons

[None Reported]

7152 Date Unknown

Source : LOSS PREVENTION BULLETIN, 042, 14-15.
Location : ,

Injured : 1 **Dead :** 0

Abstract

Failure of a 25 mm (1inch) glass line containing aqueous hydrochloric acid (HC1). A fitter was instructed by the maintenance foreman to re-joint an aftercooler on an HCl (hydrochloric acid) absorber. A necessary clearance certificate was prepared by the process shift foreman and accepted by the fitter.
Whilst the fitter was standing on the ground floor of the HCl recovery unit assessing the job to be done, he felt himself being sprayed with a liquid. He was simultaneously enveloped in a cloud of HCl fumes. He ran to an emergency safety shower, thoroughly showered himself and reported to the Medical Department. He had not sustained acid burns, nor suffered ill effects from inhalation of acid fumes. He was, however, suffering from shock.
Investigation found that a fitting on the HCl absorber drain line had broken from which the aqueous HCl was sprayed.
After investigation it was found that:
1. Two days previously maintenance work had been carried out on the HCl absorber drain line and the plant was operating normally prior to the incident.
2. The fitter concerned had had considerable experience of working on glass/plant.
3. Had the wind been blowing from the opposite direction the only emergency shower would have been clouded in HCl fumes.
4. The normal safety equipment required for working on this unit, helmet, goggles and rubber gloves, was being worn.
[separation, absorption, spill]

Lessons

Recommendations and Actions:
1.The HCl absorber was shut-down, drained and washed out before any work in the vicinity was commenced.
2. A technical (construction) representative from the glass manufacturer (contractors) were invited to discuss the erection of glass equipment with fitters and supervisors.
3. Fitters to attend courses on the construction and maintenance of glass equipment.

7155 Date Unknown

Source : LOSS PREVENTION BULLETIN, 045, 5.

Location : ,

Injured : 0 **Dead :** 0

Abstract

An explosion in a drier. A pressure rise in a drying vessel operated by a chemical company resulted in an explosion which split the vessel and propelled its major part through the roof of the process building. There were no injuries but considerable damage was done to the plant.

The emergency vent system designed to protect the vessel relied on reverse buckling knife edge rupture discs. Following the explosion the rupture disc between the vessel and the vent stack was seen to have partially opened with half its area supported by one of the knife edges. The reason for this mode of failure of the ruptured disc is still being investigated.

[high pressure, bursting disc failure, heating, damage to equipment]

Lessons

[None Reported]

7160 Date Unknown

Source : LOSS PREVENTION BULLETIN, 047, 23-25.
Location : ,

Injured : 0 **Dead :** 0

Abstract

This incident occurred on a distillation column, normally in hydrocarbon service, while welding during a shutdown. A minor explosion occurred which dislodged the trays. There was no subsequent fire and no injuries.
The column had been shutdown, isolated by spading or disconnection and steamed preparatory to installing a new 40 mm (1 and a half inch) connection in the 200 mm (8 inch) liquid line to the reboiler. The line was then high pressure water jetted. The column was tested by a gas detector and by visual inspection before a Fire Risk Permit was issued. The hole for the new nozzle was flame cut and a heavy smoke was noticed coming out of the top column manhole when the cut was near completion. Before the work could be stopped however there was a minor explosion within the column with a jet of flame reported from the bottom column manhole. There was no sign of an internal fire but the column was purged with steam for a period before cooling and inspection.
The following points emerged from the investigation:
1. The line being cut was coated internally with a layer of hard carbon-like material which had not been removed by the high pressure water jetting.
2. A period of about two hours elapsed between issuing the permit and the job being started. During this time the reboiler had been coated with an antifoulant preparatory to start-up. (The liquid inlet to the reboiler remained disconnected and blanked).
Subsequent testing of the antifoulant showed it most unlikely to have provided fuel for the explosion and that the cause of the incident was due to the creation of a heavy smoke containing sufficient carbon to eventually ignite.
[cleaning inadequate]

Lessons

Site procedures have been modified to:
1. Minimise the extent of plant and equipment which could possibly give rise to such an explosion by isolating the smallest item (in this case the shortest length of pipe), that will allow the maintenance job to be undertaken.
2. Minimise any delay between issuing a permit and the job commencing.

7172 Date Unknown

Source : LOSS PREVENTION BULLETIN, 047, 26-27.
Location : ,

Injured : 0 **Dead :** 0

Abstract

For environment reasons, all the vents on a chemical plant were collected in a vent main and passed to a furnace. To balance the vent flow and furnace requirement, the vents passed into the furnace fan and constituted about 30% of the furnace air flow requirement.
The vent main normally ran at 1% to 4% of lower explosive limit.
Following a power cut all the electric motors were tripped. One distillation unit in the chemical plant recovering solvent ran at atmospheric pressure. The condenser cooling water circulation was tripped with the power cut but the steam supply went down slowly.
The result was a heavy build up of un-condensed flammable solvent vapours in the vent manifold (by calculation, above the higher explosive level).
Soon after the furnace was returned on line, the ducting between the fan and the furnace exploded, blowing the ducting apart causing no damage.
It is believed that the explosion was caused by vapour from the vent to the furnace inlet ducting lowering the vapours to within the explosive range, which ignited from the furnace.
[power supply failure]

Lessons

[None Reported]

7183 Date Unknown

Source : LOSS PREVENTION BULLETIN, 049, 11.

Location : ,

Injured : 0 **Dead :** 0

Abstract

Alcohol pumped through disconnected feed line. A pipefitter was assigned the job of disconnecting an overhead alcohol feed line in the tank field. An operator, unaware that the line was disconnected, started the feed pump from the alcohol tank. The pipefitter was completely doused, but managed to stay on the ladder on which he was working. He managed to climb down safely and was immediately put under a safety shower. He suffered no ill effects from the alcohol.
The primary cause was that the pump switch starter button was not locked out. A soft wire had been tied in front of the starter button, but apparently this went unnoticed by the operator. In addition, notification was not given to all operators who might have used this pump, nor was the pump switch, or any of the valves, tagged.
[isolation inadequate, maintenance]

Lessons

This incident demonstrates the importance of communication. No maintenance work of this type should begin until all the operating people have been informed.

7117 Date Unknown

Source : LOSS PREVENTION BULLETIN, 037, 13-14.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A group of four tanks provided rundown storage for liquor produced when several vacuum crystallisers are boiled out. The crystallisers are part of a plant producing a high boiling point acid intermediate to fibres production. All the tanks are stainless steel 4.3 m diameter by 9 m high. Each has a 50 mm vent and a low pressure stream coil in the bottom.
In the incident, a solid layer formed in one of the tanks. When some liquid was pumped out of the tank a space was left underneath the solid. Later more liquid was added on top of the solid. The solid gave way the liquid on top drained so rapidly into the space below that the vent pipe could not let air in sufficiently quickly and the tank collapsed.
According to the level gauge, one of the tanks was empty and had been for 4 days. Fifty tonnes of liquor was run into it, the temperature of the rundown being not more than 50 degrees C at first. Shortly afterwards the sides of the tank started to cave in. Several wrinkles developed which were sufficiently large to prevent it being used without repair.
The vent was seen to be quite clear. But when the manhole, on the tank roof, was removed, the bottom of the tank could not be seen at all. The view was obscured by a raft of solidified acid, stretching right across the tank, and whose top was thought to be about 2m above the tank base. Hot condensate was pumped in and circulated to remove the deposit. Two days later, much of it remained despite the intensive washing.
The collapse of the tank was due to a pressure difference and a number of possibilities were explored, for instance, condensation of vapours when liquor at 30 degrees C was pumped in. The only plausible explanation was that the liquor was pumped in and rested on the raft. It was known that, from time to time, boil out liquor contained lumps of solid acid, so if the raft was not complete at the beginning of the transfer, any lumps in the liquor would fill the holes. Liquor thus built up on the raft until this cracked and collapsed, allowing the liquor to drain through, and suddenly creating a gravity drainage condition, with which the vent was not designed to cope. It was estimated that a vacuum of 15 m bar (6 in wg) would have been generated, more than enough to start collapsing the tank. It was also thought that the raft was quite thick, flat on top, convex under and resting on the tank bottom. Of course, as liquor drained, air under the raft was displaced to the upper part of the tank, so the collapse was only partial.
[solids deposition, design or procedure error]

Lessons

After the incident the storage procedures were amended, the tanks were taken out of service regularly, and washed to avoid thick rafts of solid acid building up. In addition, the upper manholes were left open to provide more venting capacity. This illustrates the possibilities for unexpected incidents when solids can form in a tank.

7185 Date Unknown

Source : LOSS PREVENTION BULLETIN, 049, 25.
Location : ,

Injured : 1 **Dead :** 0

Abstract

An operator was exposed to extremely irritating vapours and hospitalised for two days when a reaction erupted and vented vapour found its way back to the plant.
An investigation revealed that the vapours were escaping from a tank vent located about 600 mm (2 feet) above a broken window pane. This vent in conjunction with a number of others was located below the level of the roof. Negative building pressure and the proximity of the vent to the broken window pane resulted in vapour coming back into the building.
The cause of the eruption was attributed to an operator's failure to charge a solvent to the batch during the prior shift. This failure resulted in insufficient volume in the tank to get proper mixing. The subsequent transfer, filtering, and addition of water wash provided mixing and a reaction resulted. The heat given off in the absence of adequate solvent medium promoted a further uncontrolled reaction and subsequent vapour release.
[gas / vapour release, operator error, unwanted chemical reaction]

Lessons

This incident is an example of poor housekeeping, the failure to replace broken windows, and emphasises the need for vents to be located and extended if necessary above the roof.

7190 Date Unknown

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

Ice was ejected from a flare stack during slight thaws following a very cold spell. Problems of back pressure were experienced due to ice accumulation during prolonged cold weather. The probable cause of the ice was steam condensate, the source of which is the steam supply to the flare tip. It was found that the 1 inch diameter molecular seal was inadequate, the `Top Hat' of the molecular seal had been removed at a maintenance shutdown some years ago after it had been found damaged and dislodged.

Lessons

It is recommended that the steam supply applied internally should not be used in extremely cold climates due to the danger of internal blockage of the stack caused by steam condensing and condensate freezing.

7219 Date Unknown

Source : LOSS PREVENTION BULLETIN, 056, 5-7.
Location : ,

Injured : 0 **Dead :** 0

Abstract

During the initial re-commissioning of an LPG recovery unit after a planned shutdown, leakage occurred in a 50 mm (2 inch) line. Severe corrosion was found on a section of the line which had been insulated solely for personnel protection. The remainder of the line, not insulated but painted, was found to be in good condition. The corroded section of the line was taken out and replaced.
During the subsequent re-commissioning of the unit a second leak occurred in another line, the entire length directly above a 90 degree elbow from a horizontal section. Severe corrosion was found in other places and approximately 60% of the line had to be renewed.
As a result of this experience, a survey of process pipework on all of the units at this site constructed at the same time was undertaken and extensive corrosion was found on many other lines.
[vapour recovery system, spill]

Lessons

The location and features of such corrosion were summarised as follows:
1. The most severe corrosion occurred on equipment and pipelines operating normally at rather low temperatures (below 100 degrees C) or in intermittent use.
2. Lines which were partly insulated, i.e. for personnel protection, were found to be badly corroded.
3. Practically all the corrosion was found to be on unpainted pipework.
4. Corrosion was greatest at places where water could penetrate the weatherproofing, e.g. at flanges, pipe supports, vent and drain points, junctions and bends etc.
5. Aluminium cladding used in these units was seen to be more susceptible to mechanical damage than galvanised sheeting. (Galvanised steel, aluminiumised steel or stainless steel cladding are often to be preferred for fire protection reasons and the possibility of incendive sparking from the thermite reaction should be considered where aluminium is proposed.)
External corrosion was also found on the towers of the LPG recovery unit and on one tower of the catalytic reforming unit. The corrosion varied from general to light wastage with local pitting corrosion on the top dished heads and to local rough wastage of tower shells directly above the insulation support rings. The lagging used on these plants gave a solution with a pH of 4.9 and it was later established that the insulation had been manufactured from blast furnace slag.

7224 Date Unknown

Source : LOSS PREVENTION BULLETIN, 057, 22-23.
Location : ,

Injured : 0 **Dead :** 0

Abstract

An internal floating roof tank containing light naphtha was struck by lightning and set on fire. Subsequent investigations revealed that the initial explosion tore the cone roof completely away from the entire circumference of the shell seam.
Immediately prior to the fire vaporising naphtha had been transferred from back-up storage to the tank. The transfer had been stopped at a level of 10.2 m (34ft) and direct receipt from the treating plant continued. Ten minutes later lightning struck the tank. The conditions which contributed to this fire are probably unique. The light naphtha with a high Reid vapour pressure containing air from a treating plant caused a flammable zone to exist between the internal and external roof.
The fire was extinguished within one and a half hours using a 3% foam solution overhead at a rate of 4,000 gpm, but re-ignition occurred, the cause unknown. The tank then continued to burn in spite of an additional 600 gpm of 3% foam solution injected subsurface into the tank. Efforts were than concentrated on keeping the outside shell of the tank cool with the water sprays and on transferring the material to other storage. Final extinguishment was achieved eighteen hours later.
A survey was conducted on 25 of the 45 internal floating roof tanks. The vapour space between the floating roof and the cone roof was tested for hydrocarbons using a combustible gas detector. Of the 25 tanks tested, only one was in the flammable range. The rest showed minimal levels on the internal roof (maximum 11% of lower explosive limit) with negotiable levels on the vents. The one tank showing levels above the lower explosive limit was on the same duty as the tank that had caught fire. Inspection of the tank indicated that the ladder seal had been improperly trimmed and bubbling liquid was visible.
[fire - consequence]

Lessons

It had been decided to switch light naphtha product to open top floating roof storage. Plans also included periodic monitoring of all internal floating roof tanks for combustibles.
The following comments were made:
Difficulties of extinguishing fires in covered floating roof tanks have been noted. Application of foam, whether over the top or by base injection, is largely dependant on the situation at the time and on prior installed facilities. There are obvious advantages in the use of base injection but the application rate and injection points must be sized for the tank in question.

7255 Date Unknown

Source : LOSS PREVENTION BULLETIN, 074, 15.
Location : ,

Injured : 0 **Dead :** 0

Abstract

The start-up of a superheater worked fairly well, but the temperature indicator in the stack was off scale, high. At the time this was wrongly diagnosed as a faulty instrument. The thermocouple probe was withdrawn and found to be red hot. As the reason for this was a mystery the superheater was immediately shut down. Nothing obvious was found to be wrong, so it was cautiously re-started on low fire, with the cooling air turned off. The superheater worked well, and this time the indicated stack temperature remained low and close to its design value.
The firing rate was increased and following the operating procedure, turned on the cooling air fan. There was an explosion in the furnace. Flames were ejected through all the air inlets and some damage was caused.
The subsequent investigation showed that the settings on the burner had been disturbed and the furnace was running very rich, giving incomplete combustion. Secondary combustion was occurring above the heat shield at the point of cooling air injection. This was the reason for the very high stack temperature.
On low fire there was no secondary combustion, but when the cooling air fan was restarted, a flammable mixture formed in the top of the furnace and the stack, with unfortunate results.
The black smoke which the superheater had produced at low fire was not noticed because of the large amount of dilution occurring in the main stack.
[damage to equipment, fire - consequence]

Lessons

[None Reported]

7405 Date Unknown

Source : LOSS PREVENTION BULLETIN, 088, 1.
Location : ,

Injured : 1 **Dead :** 0

Abstract

A technician was operating a recovery unit. He had been requested to take a 23 litre sample of the solvent evaporator bottoms. He planned to take the sample from the sample line on the discharge of the north bottoms pump. The sample line was plugged and he prepared to put the south pump on with the north pump to increase the pressure, hoping to clear the line. Each pump has a basket strainer on the suction line with the suction blocked valve flanged to the strainer. Prior to starting the pump he opened the suction valve. The strainer cover leaked, spraying 170 degrees C material onto his legs. He immediately entered the nearest safety shower and removed his clothing. He was transported to hospital for emergency treatment.
The south pump had not been used for some time as the basket mesh was too fine. A new basket had been purchased and installed earlier in the week. When it was installed the technician placed the flange cover and retainer bolts on the strainer but failed to tighten the bolts.
[sampling, operator error, spill, operation inadequate, flow restriction]

Lessons

Corrective action:
1. A splash shield has been placed over the strainers. Splash shields will be welded to strainer lids where possible throughout the plant.
2. Operating procedure signs are being placed at all filter or strainer locations.
3. Remote operation of block valve at strainer location is being reviewed.
4. Strainer and filter opening (and closing) procedures will be incorporated in the training programme.
5. All strainers are being reviewed to determine necessity and will be eliminated if not required.

7411 Date Unknown

Source : LOSS PREVENTION BULLETIN, 024, 169-170.
Location : ,

Injured : 0 **Dead :** 0

Abstract

In this process the reaction kettle R was normally used for nitration reactions with nitration acid being fed from the measuring vessel M. This vessel was vented via a glass line E.
When the production programme changed, the measuring vessel M, empty but without being cleaned thoroughly, was used to charge ethylbenzylaniline.
As soon as 2 to 3 litres of ethylbenzylaniline had been pumped into the measuring vessel M, a vigorous reaction with development of gases started which caused the glass vent line E to burst.
[uncontrolled reaction, damage to equipment, cleaning inadequate]

Lessons

1. Hazard analysis must also include the operation of measuring vessels, charge tanks, receivers and associated piping.
2. In the course of hazard analysis, special consideration should be given to possible cross contamination and its effected on the chemicals involved.
3. In case of alterations to production equipment involved measuring vessels and feed lines, the possibility of hazardous interactions between chemicals should be investigated by hazard analysis.
4. Even very small quantities of reactive chemicals may trigger uncontrollable decomposition reactions with devastating consequences.
5. Possible interactions of chemicals should be considered in the course of hazard analysis.
6. Each measuring vessel should be fitted with a separate feed line. If this is not possible, e.g. due to limited space, the piece of common line should be kept as short as possible and no valves should be installed in the common line.
7. Different reactants should not pass through the same charge tank and measuring vessel.
8. When production is changed, measuring vessels and feed lines have to be cleaned following a procedure to be indicated by the plant chemist in charge.
9. When new measuring vessels are installed, especially in multipurpose plant, proper provisions for cleaning must be made.
10. The possibility of measuring vessels being overfilled must be considered. If necessary, level indicators and safeguards against overfilling have to be installed, e.g. standpipes.
11. For each feed line, the need for flow control had to be considered. In critical cases, the maximum flow rate has to be limited.
12. If chemicals have to be fed through dip pipes or into a pressurised vessel, it may be necessary to install safeguards against backflow.

7413 Date Unknown

Source : LOSS PREVENTION BULLETIN, 090, 13-14.
Location : ,

Injured : 1 **Dead :** 0

Abstract

An operator had dispensed 105 kg (23 lbs) of glacial acetic acid into a 18.9 litre (5 gallon) plastic bucket which was approximately half full. He placed a lid on the container and started carrying it from building A to building B.
After carrying the container a short distance, approximately 9 metres (30ft) he noticed that the lid was beginning to fall off. As he set the container down to straighten the lid it bumped a pallet. This caused the container to tip, splashing glacial acetic acid in his face and eyes.
He immediately went to the safety shower, approximately 12 metres (40ft) away and began to wash his face and eyes. The water in this safety shower was so cold it took his breath. After approximately five minutes, he got help from other operators. Since there were no eye baths in the immediate area, he was taken to the bathroom and water was poured into his eyes from the sink.
The employee was transported to hospital after approximately 20-25 minutes. Although he had received acid burns to the face and eyes he returned to work two months later with no permanent damage.
The causes were;
1. The bucket used to transport glacial acetic acid was not big enough.
2. The bucket had a lid, but it could not be secured without going to a lot of trouble. Once secured, it would have to be cut in several spots to be removed. This meant the container could no longer be used.
3. When lifted the bucket loses its shape, causing the lid to slide off.
4. In addition, the area through which the bucket was carried was congested and there was inadequate operator training and lack of enforcement of procedures.
[training inadequate]

Lessons

1. Provided an adequate closed container for handling or transporting corrosive material.
2. Label containers.
3. Train people to handle corrosives.
4. Enforce rules that will prevent the use of inadequate containers.
5. Determine what method will be used to ensure the proper procedures are followed.
6. Supervision must detect and instruct. Employees must follow procedures.
7. Specify what equipment is required. i.e. goggles, face shields, jacket, trousers, gloves, when handling corrosives.
8. Specify how this equipment will be obtained.
9. Colour code acid gear.
10. Involve operators in the selection process of personal protective equipment.

7419 Date Unknown

Source : LOSS PREVENTION BULLETIN, 038, 23-25.
Location : ,

Injured : 1 **Dead :** 0

Abstract

Old pipelines were being demolished. They were cleaned as far as possible and then tested with a combustible gas detector. No flammable gas or vapour was detected and so a burner was given permission to cut them up. While he was doing so, sitting on the pipes 3.6 metre (12ft) above the ground, a tar like substance seeped from one of the pipes and caught fire. The fire spread to the man's clothing and he ended up in hospital with burns to his legs and face. The tar like deposit in the pipe caught fire when it was heated by the burner's torch. The deposit was not flammable when it was cold so it could not be detected by the combustible gas detector.
[demolition, hot work, fire - consequence]

Lessons

During welding on pipelines or other equipment which may contain heavy oils or deposits, everyone should be aware that oils which are safe when cold will burn or explode when heated.
When demolishing pipelines there should be as many open ends as possible so that pressure cannot build up. Good access should be provided so that burner or welder can withdraw from the burning point without difficulty if a fire occurs.
When a burning or welding operation is to be carried out, the equipment should be purged with an inert gas and tested for oxygen. Alternatively, fire fighting foam gasified with an inert gas could be employed.

7420 Date Unknown

Source : LOSS PREVENTION BULLETIN, 038, 25-26.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Welding was to be carried out during a shut-down on a safety relief valve tail pipe. It was disconnected at both ends and four hours later the atmosphere at the end furthest from the relief valve was tested with a combustible gas detector. The head of the detector was pushed as far down the tail pipe as it would go, no gas was detected and a permit to work was issued.
While the relief valve discharge flange was being ground, a flash and a bang occurred at the other end of the tail pipe.
Gas in the tail pipe 20 meters (65ft) long and containing a number of bends had not dispersed and had not been detected by a test at the other end of the pipe.
[testing inadequate]

Lessons

Before allowing welding or similar operations on a pipeline which has or could have contained flammable gas or liquid, the line should be swept with nitrogen or steam from end to end. Tests should then be carried out at the point where welding will be carried out.

7422 Date Unknown

Source : LOSS PREVENTION BULLETIN, 038, 26-27.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A nitrogen line had to be modified. It was isolated and depressurised and the atmosphere inside the pipe tested with a combustible gas detector and found to be safe.
Then five and a half hours later welding started and a small fire occurred at the open end of the pipe.
The cause of contamination was not established.
[fire - consequence, testing inadequate]

Lessons

A test done in the morning does not tell what will be present in the pipeline or in the atmosphere just before work begins.

7439 Date Unknown

Source : LOSS PREVENTION BULLETIN, 113, 14.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A leak developed in the steam coil in a cast-iron still, containing a highly toxic liquid. To empty the still, a dip-pipe was installed with a feed line to another still. The valve before the bursting disc in the first still was closed and compressed air fed in. Shortly afterwards, the still ruptured, spilling its contents and splashing a process worker who was walking nearby.
[separation, toxic chemical]

Lessons

Connecting the compressed air main to the still by a length of hose was unsafe working practice in that no reducing valve, operating at the maximum design pressure of the still, and no relief valve were employed.

6943 Date Unknown

Source : LOSS PREVENTION BULLETIN, 014, 7.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A boiler feed pump was being brought on line. It was equipped with vents and these were open to allow trapped air to escape. When water was ejected from the vents, the reaction force produced caused the pipes to whiplash out of the tundish, rotating through 90 degrees, sprayed steam and hot water over the surrounding area, fortunately missing the operator and a nearby electrician.
The initial reaction was to have the vent pipes anchored properly. More detailed investigation, however, revealed that the original vent pipes had been changed by maintenance effort. These changes had not been authorised, but were presumably the result of an over zealous service, straight through cocks were temporarily unavailable so right angle types were fitted with appropriate pipes.
[incorrect equipment installed, gas / vapour release, spill]

Lessons

[None Reported]

1901 Date Unknown

Source : LOSS PREVENTION BULLETIN, 026, 44-45.
Location : ,

Injured : 1 **Dead :** 0

Abstract

A man was severely injured when a vessel burst, and he was sprayed with a corrosive chemical. A vessel was leaking and it was decided to transfer the material by blowing it with compressed air to another vessel. The leaking vessel was protected by a bursting disc and the operator was told to watch the pressure in the vessel and not let it reach p.s.i.g. He opened the valve too far. A valve below the bursting disc was closed.
[material transfer, operator error, injury]

Lessons

It is not good practice and sometimes illegal to fit a valve between a vessel and its bursting disc or relief valve. This valve had been closed for some time and had been fitted to stop escape of gas into the plant after the disc had blown and whilst the latter was being changed.
The best way is to fit two bursting disks or relief valves, each with its own isolation valve, the latter being interlocked so that one is always open.

2543 Date Unknown

Source : LOSS PREVENTION BULLETIN, 026, 46.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A relatively small (30,000 gall) atmospheric pressure, fixed cone roof, storage tank collapsed early in the night shift, the tank assuming the shape of a diabalo. A vent was found blocked. Inspection, by each shift, of the vents was necessary but the foreman knew, and subsequently admitted, that this was not done. In order to protect his colleagues he judged that if he could get the tank back to something like its original shape, no one would know of this omission. As he applied air pressure via a compressed air hose, the tank walls assumed their original shape, there was a loud bang and the tank roof lifted. He had forgotten that part of the roof-to-tank wall weld is deliberately made weak to protect the tank walls and avoid containment loss.
[storage tanks, human causes]

Lessons

[None Reported]

6816 Date Unknown

Source : LOSS PREVENTION BULLETIN, 004, 4-5.
Location : ,

Injured : 1 **Dead :** 0

Abstract

Steam was condensed in a small (2000 gallon) tank from three heat exchangers before disposal to the main condensate tank.
The tank was vented to atmosphere, the discharge from the vent being close to an access stairway to a distillation column, as a consequence of which visibility on the stairway was impeded.
The plant manager decided to correct this situation and extend the vent to the top of the structure. The extended vent line created additional condensing surface and acted as a wetted wall column. Unfortunately, the vent diameter was not large enough, such that the column was flooded.
Within 24 hours of the modification an operator was badly scalded by condensate emission from the vent.
At the design stage the electrical engineers had requested float control of the condensate pumps such that the in line pump switched on when the level in the tank was high and switched off when the level in the tank was low. This system failed to operate and the tank was continually overflowing to drain.
The plant manager decided that the net positive suction head on the pumps was inadequate so he shut down the plant, had a pit dug and concrete lined below the tank in which the existing pumps were installed. Still the pumps did not work, so he ordered new pumps of extra low NPSH requirement and installed these in the pit. Every time the pumps had to be inspected, it necessitated shuting down of the system.
Investigation revealed that the pressure drop in the condensate disposal line was high and the pressure was 17 psig. Thus when the pump was stopped by low level in the tank, condensate at 140 degrees C took the path of least resistance and flashed back through the pump and tank, the static head in the tank increased and the pump started again, the pump and discharge line were full of flashing condensate and consequently the pump cavitated. Severe erosion of the pump impeller was found.
The system was modified to conventional level control, with a 'kick-back' line so that the pump did not operate against a closed control valve.
[design inadequate]

Lessons

[None Reported]

6835 Date Unknown

Source : LOSS PREVENTION BULLETIN, 003, 3.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Ethylbenzylaniline had to be charged to a stainless steel measuring vessel before beginning the first batch of a production campaign. Immediately after the first 2-3 litres had been pumped in a violent reaction occurred in the measuring vessel. The pressure in the vessel rose, resulting in rupture of the glass vent line. The measuring vessel is normally used for containing nitrating acid. Apparently the vessel was not cleaned before use, so that it still contained residual mixed acid which reacted with the ethylbenzylaniline.
[contamination, cleaning inadequate, charging reactor, reaction vessel]

Lessons

[None Reported]

6838 Date Unknown

Source : LOSS PREVENTION BULLETIN, 003, 2.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Excessive foaming occurred during the nitration of 1,8 dihydroxy 2,7-anthraquinone disulphonic acid. The foaming reaction mixture forced its way via the kettle vent into the main ventilation pipe. This pipeline, constructed of slow burning polypropylene, was damaged in several places, so that nitrogen oxide gases escaped into the building.
Due to lack of a metering system nitrating acid was added too quickly. This resulted in the formation of a compact, finely formed foam, and in a corresponding increase in volume.
It was found that the reaction mixture reacts exothermically with slow-burning polypropylene at 120-160 degrees C resulting in temperatures of 200-260 degrees C. The necessary initial temperature must have been produced by reaction of the nitration mixture dust deposits in the ventilation pipe - naphthylamine-sulphuric acids, dihydroxy-anthyaquinone copper phthalocyanine. Normal polypropylene does not react with the nitration mixture at temperatures up to 160 degrees.C.
[unwanted chemical reaction, gas / vapour release, damage to equipment]

Lessons

[None Reported]

6846 Date Unknown

Source : LOSS PREVENTION BULLETIN, 001, 11.
Location : ,

Injured : 4 **Dead :** 0

Abstract

An enamelled 2000 litre kettle was charged with cyanuric chloride, allyl alcohol and water. On slow addition of liquid caustic soda, triallyl cyanurate should have been formed. However, before beginning the addition of caustic soda the temperature of the batch was 28 degrees C instead of the normal 5 degrees C. The kettle had been left without cooling.
The rapidly rising temperature and pressure caused failure of the bursting disc and the man-hole gasket was displaced. Allyl alcohol vapours escaped and subsequent ignition, probably caused by non-explosion proof fluorescent lights, caused an explosion and flash fire. Four people sustained minor injuries.
[operation inadequate, gas / vapour release, fire - consequence, overheating, high pressure, reaction, injury]

Lessons

[None Reported]

6903 Date Unknown

Source : LOSS PREVENTION BULLETIN, 007, 13.
Location : ,

Injured : 2 **Dead :** 0

Abstract

A vertical vessel was certified safe for entry for cleaning out. Two employees commenced work and were rendered unconscious.
The vessel, after washing with water, was left to ventilate with top manhole open, bottom line disconnected and blanked off, and other lines spaded off. Prior to clean out commencing, an operator on one shift, on his own initiative, opened a nitrogen purge, via a flexible hose, into the vessel. His intention was to remove any last traces of flammable vapour left in the bottom of the vessel. He failed to record or inform anyone of this action. Later, the vessel was checked by a supervisor who, seeing the hose, assumed it was an air purge. The atmosphere of the vessel was tested with a combustible gas detector zero test. The two employees recovered.
[entry into confined space, asphyxiation, reaction vessel]

Lessons

This incident illustrates the hazards of nitrogen.
1. Hoses must be vented before disconnection and a vent valve should be provided so that this can be done.
2. Hoses should always withstand the process material and then it does not matter so much if back flow occurs.

6907 Date Unknown

Source : LOSS PREVENTION BULLETIN, 007, 14.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A fitter had been instructed to carry out some work in a disused process area. He was required to wear a two-piece PVC suit with an external air supply to provide overall protection against contact with and inhalation of dangerous substances. The upper section of the suit had been connected to what was assumed to be an installed breathing air supply point. However, when it was put on, the wearer almost immediately collapsed. He was speedily removed from the suit by men in attendance and fortunately revived. It was subsequently established that the air hose supplying the unit had been connected to a nitrogen supply point which had been fitted with an outlet assembly similar to that normally fitted to breathing air supply points.
Measures to prevent a recurrence included inspection and identification of gas lines which could be mistaken for air lines and the introduction of formal arrangements to provide outlets of unique designs at breathing air supply points. Tests were specified to enable users to verify readily the identification of airlines by reference to pressure. Additional training was introduced for those concerned with the use of protective equipment supplied with air from external sources and the role of men in attendance was re-emphasised.
[air line, breathing apparatus, asphyxiation]

Lessons

This incident illustrates the hazards of nitrogen.
1. Hoses must be vented before disconnection and a vent valve should be provided so that this can be done.
2. Hoses should always withstand the process material and then it does not matter so much if back flow occurs.

6915 Date Unknown

Source : LOSS PREVENTION BULLETIN, 009, 1.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A tanker was to be off loaded into a tank, but the valve on the tanker was opened instead of the valve on the tank. Twenty tonnes of concentrated hydrochloric acid were lost via the vent of the tanker. Fortunately no one was inured, but the acid fumes created very severe working conditions. Investigation revealed that operators had not followed the laid down working procedures and had failed to check valve positions before and after movements. [unloading, spill, operator error]

Lessons

[None Reported]

6920 Date Unknown

Source : LOSS PREVENTION BULLETIN, 010, 4.
Location : ,

Injured : 0 **Dead :** 0

Abstract

The charge gas compressor of a large naphtha cracking plant was suddenly stopped by the action of an interlock system, actuated by a temperature trip (trip point 115 degress C) on the second stage of the compressor where the temperature is normally 90 degrees C. The compressor was stripped down after the incident and no faults were found in the machine or its instrumentation.
It was subsequently recalled that the regular monthly inspection of the gas detectors had been in progress at the time of the accident at the rear of the instrument panel and that a transceiver had been used for that purpose.
Further tests confirmed that the shut down action was caused by radio waves emitted by the transceiver. Generally it was found that the effects were dependent on distance and direction of the transceiver aerial from the control instrumentation.
[electrical equipment failure]

Lessons

[None Reported]

7096 Date Unknown

Source : LOSS PREVENTION BULLETIN, 020, 43.
Location : ,

Injured : 0 **Dead :** 0

Abstract

An absorption column irrigated with nitric acid was being prepared for start-up. Slip plates were removed from the process and vent lines. Whilst this was in progress a leak was observed from a flange on a check valve. It was not possible to remove the flange nuts by hand in order to renew the gasket, so, as time was pressing, a contractor employed on the site was called to cut the nuts with a torch. A fire permit was not provided.
During the cutting operation an explosion occurred in a 25 m3 circulation vessel rupturing the lower half of the vessel. In addition, a circulation pump, piping, a window and a door were damaged. There were no personal injuries.
Three absorption columns are connected to a common vent system, the circulation vessel was however vented by a separate fan. The isolation valves were not tight and it was possible that after removal of slip plates a flammable gas-air mixture was sucked from the ventilation system into the plant. During the cutting operation, molten metal sprayed on to the circulation pump where gland re-packing work was in progress. The accident could have been prevented if a fire permit had been provided. It would have ensured that the plant was inspected before hand and it would have prevented the removal of the slip plates.
[flange leak, hot work, blind/spade/slip plate, management system inadequate, design or procedure error, slip plate insertion/removal, metal - molten]

Lessons

As a result of the accident all operations involving flame will only be permitted on the issue of a fire permit which specifies the necessary safety measures which must be taken.
This plant was also modified. The separate fan on the circulation tank was removed and the vent connected to the main ventilation system. All the vent gases are now removed by a fan and fed to a scrubbing tower. This makes it impossible for the gases to be sucked into the plant.
These incidents occurred mainly as a result of:
1. Absence of laid down procedures.
2. Absence of work permit or fire permit, or unsatisfactory clearance certificate.
3. Absence of adequate operating instructions or failure to follow them.
Management should create the 'climate' for compliance with laid down procedures and should monitor the application of such procedures. Systems of work which are impractical should not be imposed.
Management should ensure that procedures have no loop-holes and that they are fully understood and followed.

6945 Date Unknown

Source : LOSS PREVENTION BULLETIN, 014, 5-6.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Maintenance requested process for a clearance certificate for a job which in the event took well over a month. Work continued uneventfully until finally a vent line had to be removed. This ran from the general area of maintenance work, through a curtain wall and finished outside in an area with other vent pipes. They obtained a mobile crane and were busy working on the vent line when they were stopped.
Because of the danger from 'live' vents, work on the wall is not allowed, unless either the equipment is shut down or the vents isolated. In this incident no such precautions were taken, and it must be classed as a 'near miss'. Had a live vent occurred whilst work was in progress, the men could have been scalded by the vapours ejected or suffered toxic effects. There is also the possibility of ignition of the vapour by the maintenance equipment. The works operates a daily endorsement procedure, which applies to both 'outside' contractors, as well as their own in works maintenance teams. The endorsement is intended to assist process in locating personnel in an emergency and to ensure that should plant conditions change, and so invalidate some or all of the provisions of the clearance certificate, then maintenance are prevented from resuming work.
On the day of the incident the clearance was not endorsed but it is doubtful whether an endorsement would have prevented the incident, the removal of the vent pipe could have taken place at any time during the previous four weeks.
As a result of this incident, the works has stressed the need for both process and maintenance to know the relevant works instruction governing work on the curtain wall.

Lessons

This incident raises the issue of including on one clearance certificate a job that can be split in two, each with different hazards and appropriate precaution, particularly if a long time interval between the two parts is likely and/or the second is only a small part of the overall job. Secondly, the incident illustrates the need for process to check all maintenance operations thoroughly, particularly when the approach for permission to do work originates with the maintenance group. Indeed, if process find it difficult to foresee all the hazards in a long complicated job, then they should not issue a certificate for the whole job but only for those parts that can be fully appraised.

6974 Date Unknown

Source : LOSS PREVENTION BULLETIN, 014, 12.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A series of twenty evaporators (immersed coil, liquid heated type) were part of a central, oil fired heating system. The system was prone to spurious shut-downs and so because shut-downs caused the greatest financial loss in the area of the evaporators, it was decided to install a separate higher reliability, electrically heated system for the evaporators alone (leaving the rest of the plant on the oil-fired system). It was decided to transfer the evaporators from the oil-fired system to the new system whilst on line.
The immersion heating coils carrying liquid heat transfer fluid had been successfully transferred from one ring main system to the other. It was the turn of the vent on the first evaporator to be changed over, and after isolating the immersed heating coils and allowing the evaporator to cool down, clearance was given by line manager 1 who was responsible for the evaporators. All the pipework had been previously prepared and it was reckoned that the live vent system (which would still be connected to 19 operational evaporators and other equipment) would only be open to atmosphere for about ten minutes. In the middle of the changeover, line manger 2 happened to walk past and immediately rushed to warn his operatives not to open the inerts vents on his vapour heat transfer fluid users.
Apparently these inerts vents were opened relatively infrequently, but particularly at start-up, by plant 2 operatives to get better heat transfer. The contractors thought they were taking a calculated risk in changing over the venting systems (i.e. they assumed that it was highly unlikely that a relief valve would lift during the ten minute change over period) but in fact they were lucky not to be scalded by a routine venting on plant 2.
[maintenance]

Lessons

[None Reported]

6987 Date Unknown

Source : LOSS PREVENTION BULLETIN, 016, 12-13.
Location : ,

Injured : 1 **Dead :** 0

Abstract

A man was sprayed with caustic in a workshop. A pulsation damping pot had been blown down by releasing the pressure in the bladder, via the Schrader valve on the cylinder.
Maintenance, believing the pot to be de-pressurised, unscrewed the base nut without the caution that should have been exercised if trapped pressure had been suspected. However, there was trapped gas in the liquid side, held there by a non-return poppet valve but it is likely that even if he had known, he would still have assumed that releasing the pressure from the bladder would have taken pressure off the liquid side. Consequently when the base nut was unscrewed caustic liquid suddenly sprayed out, mostly away from the man dismantling the pot but unfortunately onto another man who was using a nearby wall mounted cigarette lighter. He received caustic burns to his back, arms and face. The workshop was not provided with a safety shower and the amenity room was locked.
[spill, high pressure, caustic soda]

Lessons

Recommendations following the accident included the preparation of improved dismantling instructions, the manufacture and installation of a de-pressurising adapter and the installation of a safety shower, or the unlocking of the amenity shower.
Many different types of process valve can retain considerable amounts of product when in closed position, and this may squirt out when the valve is opened in the maintenance workshop. Where possible, valves should therefore be left in the open position before maintenance removed them from the process line. It is essential that maintenance workshops are equipped with eye wash points and where corrosive materials are handled on the plant, safety showers also.

6999 Date Unknown

Source : LOSS PREVENTION BULLETIN, 015, 6.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A hydrogenation process was involved in several incidents which fortunately did not cause appreciable damage or injuries. An ignition occurred in a 3,000 gal. (13.6 m3) stainless holding tank which blew the 40 lb (18 kg) manhole cover over 20 ft (6m) high building. The ends of the tank were also dished out by the explosion, and the tank had to be removed from service. The accident was caused by a frozen flame arrestor which did not allow the small amounts of entrained hydrogen to escape, plus a pyrophoric catalyst which had passed through the filter and dried on a hot steam coil above the liquid level.

Lessons

[None Reported]

7000 Date Unknown

Source : LOSS PREVENTION BULLETIN, 015, 6.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A hydrogen incident occurred when a 2,250 p.s.i (155 ats) rupture disc on a hydrogenation reactor failed at about 1,000 p.s.i (69 ats). The vent line from the disc had two 90 degrees and one 45 degrees elbows. These hampered the sudden pressure release sufficiently to cause the vent line to whip and damage the explosion vent wall on the high pressure cubicle. Hydrogenations are operated by remote control so no one was injured when the vent line attempted to straighten out its bends.
[overpressure relief, damage to equipment, safety equipment failure, reactors and reaction equipment]

Lessons

Rupture discs often fail from fatigue and should be replaced periodically depending on pressures and the corrosive properties of the materials being processed.
Elbows in vent lines should be kept to a minimum or the vent line sized to compensate for additional elbows. In this instance only one elbow was used when the vent line was replaced.

7001 Date Unknown

Source : LOSS PREVENTION BULLETIN, 015, 6.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A small fire occurred when a rupture disc on a feed line from a hydrogen manifold failed. The line was under 225 psi pressure (15.3 atms) when the 300 psi (20.7 atms) rated rupture disc released. Backing up the disc was a pressure relief valve rated to relieve slightly above 300psi pressure. Between the two safety devices was a small valve connection for a pressure gauge to check the rupture discs periodically. It was a relatively new installation, the pressure gauge had not been provided and further, the gauge connection valve had been left partly open. When the disc failed, the pressure relief valve did not open since there was no excessive pressure but the hydrogen escaped at a fairly high velocity through the partially opened gauge valve.
Ignition was probably due to static or the inverse Joul
Thomas effect, a peculiar characteristic of hydrogen since it heats on expansion, a frequent cause of fire when a hydrogen cylinder valve is 'cracked' to free the outlet of any dirt.
[bursting disc failure, fire - consequence, mechanical equipment failure]

Lessons

[None Reported]

7042 Date Unknown

Source : LOSS PREVENTION BULLETIN,020, 45-46.
Location : ,
Injured : 1 **Dead :** 0

Abstract

Six 220-cubic-foot cylinders, part of a fire extinguisher system, had been moved away from their wall supports to allow painters to complete painting the area. While moving them back into position, it was noticed that one cylinder was leaking. A painter had the cylinder against his shoulder, and was attempting to slide it across the floor. At this moment the valve separated from the cylinder and was projected backward hitting the side of a cabinet.
The man suddenly found himself with a jet propelled 215 pound cylinder. He wrestled it to the floor, but was unable to hold it. The cylinder slid across the floor hitting another cylinder, knocking it over and bending its valve. The cylinder then turned 90 degrees to the right and travelled 20 feet where it struck a painters scaffold, causing a painter to fall 7 feet to the floor. After spinning around several times, it travelled back to its approximate starting point, where it struck the wall.
At this point the cylinder turned 90 degrees to the left and travelled the length of the room, chasing an electrician in front of it. It crashed into the end wall 40 feet away breaking loose four concrete blocks. It turned again 90 degrees to the right and darted through a door opening, but the cylinder continued its journey in a straight line for another 60 feet, where it fell from a dock into a truck well. The balance of the cylinder pressure was released as the cylinder spun harmlessly around in the truck well area. The painter who fell from the scaffolding received multiple fractures to his leg.
It is believed that the cylinder valve had been damaged previously, and it was a matter of chance that it separated from the cylinder at this particular time.
[maintenance]

Lessons

In general, when dealing with gas cylinders the following lessons can be learnt:
1. Gas cylinders should be handled with care, should be stored in areas defined for the purpose, outdoors, away from sources of heat, corrosion and other hazards, and should be properly secured.
2. Flexible hoses, fittings and equipment should be designed for the duty required in their use and kept in good condition by regular maintenance.
3. If a cylinder has to be heated use hot air rather than steam or electricity and check that when isolated with the hot air left on the cylinder cannot exceed safe working pressure.
4. Operators should be competent and trained in safe methods of handling and use of gas cylinders and associated equipment.
5. All users should be aware of the hazards involved in the use of gas cylinders and precautions to be taken.
6. Gas cylinders should not be used if they cannot be clearly identified from the label or colour code.

7059 Date Unknown

Source : LOSS PREVENTION BULLETIN, 019, 17.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Transportation. A pipeline had to be welded 20 ft. (6,) above the ground. Tests with a combustible gas detector near the pipeline and on the ground below were negative and so a fire permit was issued.
A piece of hot welding slag bounced off the pipeline and fell on a sump 20 ft (6m) below and 8 ft (2.4m) away. The cover on the sump was loose and some oil inside in side caught fire.
[fire - consequence]

Lessons

Welding jobs should be boxed in with fire-resistant sheets.
Nevertheless, some sparks may reach the ground so drains and sumps should be completely covered.
Even if the drain or sump is gas free at the start of the job it is possible for a back flow in the drains to bring oil into it.

7063 Date Unknown

Source : LOSS PREVENTION BULLETIN, 021, 79.
Location : ,

Injured : 0 **Dead :** 0

Abstract

The temperature controller on the base of a still went out of order at 5 a.m. and drew a straight line but this was not noticed. Between 5 a.m. and 12 noon the temperature of the 19th tray rose from the normal 145 degrees C but this was not noticed. Five other temperatures also rose, as indicated by charts or by entries on the log sheet. The level in the base of the still fell, the level in the reflux drum rose and the take-off rate also rose. All these readings were put down on the record sheet but their significance was not realised.
Finally at 12 noon liquid came out of the reflux drum vent.
The operator was a trainee but a leading hand was in the control room throughout and two supervisors visited it from time to time.
[temperature meter/control, spill, training inadequate, instrumentation failure]

Lessons

Fundamental training of process operators and supervisor should not be overlooked.
In addition the following:
1. It has been suggested that the control limits should be printed in red at the top of each column on the record sheet. The operator would be expected to report any readings out side these limits.
2. Alternatively, a master copy of the record sheet might be marked up with these limits and displayed in the control room or the limits might be marked on the individual instruments.
3. The key readings might be collected together on a "Key Readings Sheets". Record sheets are often so big that supervisors on their tours do not always look through a small number of readings on a key readings sheet. (Why have the full reading sheets? - the information may be useful to the manager or foreman when he is trying to diagnose the cause of a fault, but on at least one subscriber's plant no readings are taken apart from a handful required for record purposes).

7072 Date Unknown

Source : LOSS PREVENTION BULLETIN, 022, 101-102.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Fumes form a tank vent were coming out near a walkway so somebody put a loose blank over the vent. When the tank was pumped out, the sides were sucked in.
The operators then tried to blow the tank out with compressed air. As the tank was, like most tanks, designed to stand a pressure of only twelve inches (300 mm) water gauge, they were lucky that they did not blow the roof off.
[damage to equipment]

Lessons

The correct way to put the tank right would have been to fit a stand-pipe on the roof and then fill the tank with water after an engineer had examined it and decided it was safe to do so.
It is interesting to consider the contributory factors to this incident:
1. If there had been no fumes near the walkway, there would have been no incident. A hazard and operability study at the design stage of may have identified the nuisance from fumes. In any case, it is a general design principle that vents should discharge "to a safe place".
2. The person who put the blank over the vent did not understand the purpose of the vent. Here, education might have prevented this happening.
3. The operators did not appreciate the power of compressed air. Is it possible for operators to use compressed air in an unauthorised or dangerous manner on your plant?

9051 Date Unknown

Source : ENVIRONMENTAL PROTECTION BULLETIN, 045, 23.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A restaurant located in the centre of a small market town had received complaints of cooking odours entering their houses and causing a nuisance. Previously, three odour abatement systems had been tried and had failed to abate the emissions to a satisfactory level. Under the existing abatement system, odorous air was extracted from above the cooking ranges and passed to a carbon filter. Thereafter it exhausted to atmosphere via a 15 m high capped stack.
Unfortunately the turbulence caused by nearby buildings prevented proper dispersion from occurring and so the gases rapidly grounded. The buildings in the area were subject to a preservation order, which prohibited the stack height from being increased.
It was suggested that sufficient dispersion would occur of the cap was removed from the stack and a high velocity nozzle installed. This was done and the resulting increase in the efflux velocity enabled the emissions to disperse successfully.

Lessons

[None Reported]

7862 Date Unknown

Source : DUST EXPLOSION HAZARDS, ICHEME, TRAINING PACKAGES, 022, 4.51.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A rotary drum drier explosion. Maize was being dried in a rotary drum drier which was not equipped with any automatic regulation of the exhaust air temperature. Its explosion relief vents were too small and in the wrong places. An interruption to the feed resulted in the drum overheating, the maize catching fire, burning particles being carried over to the cyclone and a severe explosion in the cyclone.
The damage included:
1. Cyclone cover torn off.
2. Supporting frame of the cyclone compressed by the recoil.
3. Ducts to and from the cyclone torn open and sheared off.
4. 5m2 of roof area broken through, main fan completely destroyed.
5. Production interrupted for several weeks.
[design inadequate, separation equipment, fire - consequence, heating]

Lessons

[None Reported]

7714 Date Unknown

Source : CONTROLLING ELECTROSTATIC HAZARDS, ICHEME, SAFETY TRAINING PACKAGE, 016, 4.25.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A fluid bed drier was being used to dry powder, damp with propyl alcohol. The drying process was two stage. As the drier was being started up to initiate the second stage , a violent explosion occurred with in the drier. Explosion relief vents limited the extent of the damage but not enough to prevent considerable damage.
The source of ignition was thought to be a static spark occurring between the filter frame, a metal assembly in the form of a round web and the wire rope supporting the frame. The rope terminated in a boss which was clamped into the centre of the support frame. However, it was found that there was a degree of play between the boss and the frame. When the air supply fan was switched on, the filters ballooned and the suggested hypothesis was that this was now separated from the support rope, earthed continuity was lost and the frame became charged by contact by close proximity to the highly charged filter fabric.
[lack of earthing, damage to equipment, heating]

Lessons

[None Reported]

7718 Date Unknown

Source : CONTROLLING ELECTROSTATIC HAZARDS, ICHEME, SAFETY TRAINING PACKAGE, 016, 4.35.

Location : ,

Injured : 2 **Dead :** 0

Abstract

A polymer powder was separated from its solvent, butane, by a flash tank. On the day of the incident, the flash tank had become plugged with powder and various attempts were made to clear it. The system was inerted with nitrogen and the manhole on the sixth floor was opened. Two operators started taking the powder out onto the floor and shovelling it down the chute, which ran down the side of the building.

Gas detectors started registering low level alarms, but after an initial withdrawal of personnel, the work resumed. As the powder was being shovelled down the chute the fire started. Flames rose up the chute and out onto the floor. One of the operators received second degree burns and both were treated for smoke inhalation.

The fire burnt for about one hour. It was supported by two sources of fuel, butane evaporating from the powder in the tank cone and from the gas reaching the tank by back flow through a safety valve. The valve had been tied open during the nitrogen flushing of the tank.

[fire - consequence, separation]

Lessons

The following conclusions were made:

The fire was caused by the electrostatic ignition of the powder as it fell down the chute to ground level. The charge was probably generated by friction with the sides of the metal chute. The insulating rubber sleeve did not result in charge building up on the chute.

7723 Date Unknown

Source : SAFE USE OF CHEMICAL ADDITIVES, ICHEME, SAFETY TRAINING PACKAGE, 018, 3.6.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Styrene was being pumped out of a tank when it was seen that the top was beginning to cave in. The pump was stopped immediately.
On investigation it was found that the flame arrestor in the vent of the tank was partially blocked with styrene polymer. This caused a partial vacuum in the tank and drew in the tank roof.
[flow restriction]

Lessons

A flame arrester is a device for cooling gases that pass through it. Consequently when the styrene tank was being filled, vapour passing through the flame arrester would be cooled and some styrene would condense. This condensed liquid would not contain any inhibitor due to its low vapour pressure and would readily polymerise.
This accounts for the polymerisation on the flame arrester, its partial blocked and the vacuum pulled on the tank. Flame arresters in tanks containing monomers are not recommended.

7766 Date Unknown

Source : BARTON J AND ROGERS R, CHEMICAL REACTION HAZARDS, 2ND EDITION, ICHEME, 1997, APPENDIX 1, 165.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Acetic acid was being made for the first time by allowing acetic anhydride to react with water. It was intended that the mixture should be refluxed but there was no time on the shift to complete this, so the reactor was left with the stirrer running and full cooling. Shortly afterwards an uncontrollable exotherm occurred. The bursting disc blew but the 1.25" vent line was too small to relieve the pressure. A glass line to the condenser ruptured.
The reaction will occur without heating and is very vigorous when heated. The process conditions for the new reaction had not been properly researched.
[unwanted chemical reaction]

Lessons

[None Reported]

7801 Date Unknown

Source : BARTON J AND ROGERS R, CHEMICAL REACTION HAZARDS, 2ND EDITION, ICHEME, 1997, APPENDIX 1, 185.
Location : ,

Injured : 0 **Dead :** 0

Abstract

1.36m3 of phenol-formaldehyde resin reactants went out of control in a 2.27 m3 reaction vessel. The vessel had been fitted with a 355 mm bursting disc, which burst ejecting the contents of the vessel into the atmosphere.
[spill]

Lessons

[None Reported]

7808 Date Unknown

Source : BARTON J AND ROGERS R, CHEMICAL REACTION HAZARDS, 2ND EDITION, ICHEME, 1997, APPENDIX 1, 187.
Location : ,

Injured : 0 **Dead :** 0

Abstract

An explosion within the vapour space of a reactor resulted when a methanol vapour reacted with incoming halogen. The explosion ruptured a 51 mm graphite rupture disc on the reactor. The alcohol vapour resulted from a slurry, which was usually washed three times to remove the excess alcohol prior to transfer to the reactor.
[reactors and reaction equipment, bursting disc, methanol]

Lessons

[None Reported]

7837 Date Unknown

Source : MANAGING FOR SAFETY, ICHEME, TRAINING PACKAGES, 017, 4.9,; LOSS PREVENTION BULLETIN, 098, 1-2.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Flammable vapour escape from condenser vent. An operator working in a process building was filling a reactor with a mixture of an intermediate and acetone at approximately 50 degrees C, while the vessel stock temperature was held at reflux (approx 55 degrees C). As the transfer was proceeding under nitrogen pressure, he smelt acetone. As there were no leaks inside the building, he went outside and found that acetone vapour was issuing from the reflux condenser vent. He also observed a small pool of acetone on the floor under the vent drain.
The operator responded by lowering the set point in the reactor jacket and flushing the acetone spill into the underground chemical sewer leading to the treatment plant.
The operator returned to the control room on the first floor of the process building.
Ten minutes later there was a violent explosion centred in the motor control room beneath the control room. The motor control room and its contents were completely destroyed, the walls and ceiling being blown out. No serious injuries occurred.
[charging reactor, reactors and reaction equipment]

Lessons

[None Reported]

7840 Date Unknown

Source : MANAGING FOR SAFETY, ICHEME, TRAINING PACKAGES, 017, 4.25.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A distillation column had been giving problems for several hours during start-up of a large hydrocarbon cracker. The plant was flaring as usual for a time during the start-up. The isolation of a drum alarm and a high level alarm on a blowdown drum and the disconnection of a level transmitter at the base of the column denied a process team of important information, which could have prevented the incident. Cold hydrocarbon liquid overflowed from a blowdown drum and flooded a dry flare main and flare stack, causing loss of containment as a result of embrittlement cracking. A fire and heavy flaring resulted.
[fire - consequence]

Lessons

The following recommendations were made:
1. Pre-start up checklists should be prepared for use during the start up of ail major plant after extensive maintenance. These should cover a physical check of all main plant items and piping and should detail, item by item, the correct alignment of all critical isolation valves including those in safety critical systems.
2. Improve the systems for recording additional work during a plant shutdown, so that a central record is left in place for monitoring, until the conclusion of the commissioning activities.
3. Key events from previous shutdown reports should be extracted and highlighted for special attention on all future start ups.
4. Established shift teams should remain together as far as possible during periods of intensive operations such as start-up and shutdown.
5. The role of additional management members of shift teams should be clearly defined.
6. Arrange refresher training for operating staff with regard to the design parameters of the dry flare system, particularly with regard to its capability of handling very cold streams.

7852 Date Unknown

Source : MANAGING FOR SAFETY, ICHEME, TRAINING PACKAGES, 017, 4.99.
Location : ,

Injured : 0 **Dead :** 0

Abstract

An explosion occurred in a dust filter, which was positioned after a rotary drier in the drying circuit of a polymer producing plant. It was part of a recirculating system for drying a powdered polymer. It was followed by a fire, which was extinguished after 20 minutes. There were no injuries but damage took place to the bag filter itself, to surrounding insulation and to electrical wiring and equipment.
The plant had been designed to minimise damage in the event of a dust explosion and included the following safety features.
1. There was explosion venting of the dust collectors and other equipment, including the rotary drier were capable of containing a deflagration.
2. A comprehensive system was designed in collaboration with experienced suppliers, primarily to protect the whole drying circuit against a spread of fire or explosion. The extinguishing medium was water.
3. There was automatic fixed fire protection (deluge) for certain key items of equipment.
[fire - consequence, damage to equipment, processing]

Lessons

The following recommendations were made:
1. To prevent repetition, measures were taken to carry out more frequent inspections of some areas where material could possibly accumulate.
2. To improve effectiveness of the safety systems, the frequency of interlock testing was increased. The operation of the explosion suppression system was reviewed but it was decided not to change the operating pressures. The inspection and testing of the deluge system was improved. This included a full inspection and testing with water every year at the time of the annual shutdown.

7857 Date Unknown

Source : DUST EXPLOSION HAZARDS, ICHEME, TRAINING PACKAGES, 022, 4.23.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Within one year, two explosions occurred in a large spray drier handling dairy products. The incidents caused both fire and explosion damage. Explosion relief vents at the top of the drier opened into the building causing fire damage to nearby instrumentation. Burnt material also spread to associated fluidised beds and cyclones.
An investigation was made and it appeared that excessive deposits of process material had collected on the walls and roof of the spray drier and had self-heated until combustion occurred spontaneously. Although flammable dust clouds are normally only found in the lower section of co-current driers, the burning fragments at the top (hotter section) may have caused ignition directly when falling through the cloud or by starting a fire in the hopper section.
The following conclusions was made:
Laboratory data after the event indicated that the product being dried was capable of self-heating to a level at which spontaneous combustion occurred, when exposed to temperatures similar to the drier (hot air) inlet.
[fire - consequence, solids deposition, explosion suppression, heating,]

Lessons

The following recommendations were made:
The disruption to the plant was severe and resulted in closure for a considerable period. When the plant was rebuilt, an explosion suppression system was installed to provide the necessary level of protection and overcome the problem of venting inside the building. A study of the thermal decomposition behaviour of the range of products was also required in order to specify safe drying conditions (in terms of temperature and exposure period).
Test needed:
1. MIE (minimum ignition energy) to evaluate electrostatic risk, e.g. (discharge risk from highly charged powder).
2. MIT (minimum ignition temperature) to determine sensitivity of dust cloud to hot surfaces.
3. Thermal stability to examine behaviour when heated.
4. 20 litter sphere test for explosion relief design.
5. Train firing tests for assessment of flame propagation risks from layers o f material within the system.
6. Test powder for resistivity and charge decay time.

7709 Date Unknown

Source : SAFER PIPING, ICHEME, SAFETY TRAINING PACKAGE, 012, 4.83.
Location : ,

Injured : 0 **Dead :** 0

Abstract

The carbon dioxide vent of an ammonia plant, which was operating smoothly, had to be closed in order to feed carbon dioxide to a distribution system which supplies various other plants. The procedure for carrying out this operation was to open the valve in the feed to the distribution system, then to close the carbon dioxide vent valve. Both valves were electrically activated.
The operator intended to follow this procedure but immediately after pushing the button on the panel board to close the carbon dioxide vent valve, the syngas compressor downstream of the carbon dioxide absorber was shut down. This caused pressure rise in the system and the activation of the safety valves upstream of the carbon dioxide absorber.
A major gas leak occurred between the raw gas separator and the carbon dioxide absorber, the leak ignited and caused a heavy fire.
[absorption, fire - consequence, high pressure, processing]

Lessons

The following conclusions were made:
1. Valves must be sized carefully with respect to capacity.
2. Even if the valve has been sized correctly, great care should be taken to design vent systems to sound engineering standards.
3. Modification of existing vent systems should be designed and installed properly. They should not undermine the integrity of the system.
4. The correct operation of the plant should include a regular check of the position of block valves in the vent system.
5. All control buttons should be clearly labelled to prevent accidental activation of the wrong valve.

7864 Date Unknown

Source : DUST EXPLOSION HAZARDS, ICHEME, TRAINING PACKAGES, 022, 4.52; LOSS PREVENTION BULLETIN, 025, 10.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A coal drier explosion occurred. During start-up of a directly-fired, self-inerted, pneumatic conveying coal drier an explosion occurred which resulted in structural damage to the ducts, the internals of the primary cyclone and the main induction fan.
It is believed that the explosion was caused by the following combination of circumstances:
1. A pressure surge causing displacement of the explosion relief ventsat the cyclone.
2. Following the above, a temporary movement of the null pressure point from the drying duct into the cyclone, causing air to be sucked in through the displaced vent and momentary existence of an explosible mixture.
3. A lag in the response of the temperature control equipment.
[separation equipment]

Lessons

The following remedial actions have now been taken:
1. Provision of additional and more sophisticated furnace controls which eliminate the lag.
2. Provision of proximity switches which give warning of any displacement of relief vents and frustrate startup of the plant in the event of displacement.

7870 Date Unknown

Source : LOSS PREVENTION BULLETIN, 107, 23-24.
Location : ,

Injured : 0 **Dead :** 1

Abstract

An explosion in a flare stack during maintenance. At a site, four flares, each with their own knock out vessel and seal vessel, were connected to a flare header. The procedure for decommissioning an individual system was to close the hydrogen sulphide valve, to close the butterfly valve and to open the nitrogen valves. Once the flame on the flare was extinguished, the nitrogen purge was changed to a steam purge, via a valve. Before starting to turn the spectacle blind, the vessels were pumped out and drained. It had been recognised that some hydrocarbon sludge deposits would remain in the knock out vessel. Since the steam purge gave problems to the fitters changing the spectacle blind, it was replaced by a nitrogen purge about an hour before the work started.
Work proceeded to the point at which the spectacle blind had been removed and there was a space of approximately 50 mm between the flanges of the 900 mm line into the knock out vessel. At this stage there was a rumble in the pipe system followed by an emission of gas and soot from the open joint. Nothing further was heard and it was decided to insert the isolating blank and bolt up as quickly as possible. While this was being done a second rumble occurred followed by a loud explosion with a violent expansion of gases through the joint, which was in the process of being bolted up. The force of the explosion blew one of the men, who was directly in line with the flange, over the platform guard-rails to the ground 8 metres below. He subsequently died from his injuries.
The reasons for the explosion were concluded to be:
1. Steam at 13 tonnes/day had been entering the system for about 16 hours. It had been replaced by nitrogen, approximately two hours before the incident. Calculations showed that nitrogen at a rate of 40 tonnes/day would have been required to replace this quantity of condensing steam. However, only 10 tonnes/day was available, so in order to re-establish equilibrium, air would have been sucked in via the flare stack.
2. This air mixed with hydrocarbons accumulated in the seal vessel during steaming.
3. The flammable mixture then moved up to the top of the flare and was ignited by the pilot at the top of the stack, which was still alight.
4. The flame propagated down the flare stack and there was a pressure surge back to where the men were working.
[cleaning inadequate, fatality]

Lessons

The procedure now specifies that only nitrogen purging is to be used and that both seal vessel and knock out vessel are to be filled with water. Any hydrocarbons present are to be floated off before the line is broken, to change the spectacle blind.

7871 Date Unknown

Source : LOSS PREVENTION BULLETIN, 107, 24-26.
Location : ,
Injured : 2 **Dead :** 0

Abstract

Explosions in flare stacks during maintenance. At the time of the incident the second site, two flare stacks and a ground flare were connected to a single knock-out vessel. Each flare had its own seal vessel. The flares could be isolated by slip plates in the lines, between the knock-out vessel and the seal vessels.

The procedure for decommissioning a flare stack and its associated seal vessel was to decrease the flare pressure to a minimum, by reducing seal levels and then to insert the damper plate between the knock-out vessel and the appropriate seal vessel. Breathing apparatus was used, with the site fire brigade standing by. Since work had to be carried out on the seal vessel, and the damper plate could not be relied upon as a gas seal, a spade was installed in the 900 mm line into the seal vessel. The seal vessel was emptied and all lines into the vessel, to the flare stack and to the pilots, were spaded. At this time the PIC A control valve was removed for servicing. About five minutes after the valve had been removed there was a rumble followed by an explosion. Thirty seconds later a second explosion occurred, not as loud as the first, but this time flames came out of the opening where the control valve had been removed. Two men in the vicinity suffered from shock.

As soon as the opening was created into the empty seal vessel, air was pulled in by chimney effect of the flare stack. The system had not been purged and the flammable mixture that had formed, was ignited either by the flame or the pilots on the adjacent flare stack.

The danger of sucking air into the systems, due to the chimney effect, was not mentioned in the operating procedures for the flare. Nitrogen purging was not specified for work on the knock-out pot, only for work on the flare. At that time there was no piped nitrogen in the area, so a transportable supply would have been required.

A connection to the flare area has since been provided from the site nitrogen system. The procedure now specifies:

1. Make the system free by nitrogen purging both seal vessel and stack. The nitrogen flow must be high enough to cause turbulent flow in the 900 mm line and thus ensure thorough dilution of the flare gas. The purging period must have provided 25 volume changes, sufficient to reduce the hydrocarbon concentration to less than 10% of the lower flammable limit.
2. Fill the seal pot with water to make sure that flare gas is completely displaced from the vessel internals.
3. Confirm the gas freeing by a laboratory test.

[slip plate insertion/removal]

Lessons

If steam is used for purging flare systems, the flow rate must be high enough to ensure uncondensed steam is blown to atmosphere and the purging time must be long enough to ensure that volatile hydrocarbons are removed. This can be difficult to calculate. When assessing purge rates and times for nitrogen purging, care is to be taken to ensure that vessels will be thoroughly purged. If possible the gas flow should be turbulent. A long inlet pipe on a seal pot will assist purging. A problem exists with a knock-out vessel, where the purge gas may travel directly from the inlet to outlet. By filling the vessel with water the space to be purged will be much reduced and adequate purging will be achieved provided that gas velocities are high enough.

In practice the purging sequence should be:

1. If the knock-out vessel is in the system which has to be isolated, hydrocarbons should be drained from it. The vessel should then be part-filled with water to reduce the volume to be purged.
2. Remove hydrocarbons off the surface of the water in the seal vessel, via skimmer.
3. Nitrogen purge the system, using turbulent flow and aiming at 10 % LEL
4. Test the hydrocarbon content of the gas in the system. Also test for the presence of toxic gases e.g. hydrogen sulphide, when there is a reason to believe that these might be present.
5. Keep a slight overpressure on the system until the isolating spade has been installed (water in seal vessel).

Even with these precautions it should be remembered that butterfly valves in flare systems will not give tight shut-off after they have been in service for a few years. During spade isolation breathing apparatus and fire-resistant clothing should be worn.

In general jobs on flares and associated equipment should always be:

1. Covered by the proper Work Permit procedure.
2. Well co-ordinated so that all sections concerned in the location are aware of it.
3. Continuously supervised.
4. Done by experienced people trained in the use of breathing apparatus backed up by stand-by (wearing self-contained breathing apparatus).
5. Provided with fire fighting equipment at the ready in case of emergency.

Also iron sulphide is a potential source of ignition in flare systems. Steaming out the equipment will stop the FeS oxidising while it is wet. This may be necessary before air is allowed to enter the system to be maintained.

7880 Date Unknown

Source : LOSS PREVENTION BULLETIN, 095, 19-24.
Location : ,
Injured : 2 **Dead :** 0

Abstract

On the day of the incident, an interruption had occurred in the reactor, plugging the bottom outlet of the flash tank.
When the outlet is plugged, the only way to empty the flash tank is to open the manholes, shovel the powder onto the floor and along to the chute where it falls to ground level. The flash tank is six floors.
The work on the flash tank was started at 8.45 a.m. Nitrogen was hooked up to a nozzle on the tank's bottom outlet. This flushed out the solvent, butane, to the flare thus inerting the tank. At 10.30 a.m. the nitrogen was hooked up to the top of the tank and the nitrogen flushing continued until 12 noon, when the shift supervisor gave permission to open the manhole cover on the seventh floor. Unusually, the powder level was above the manhole cover so, when it was removed, some of the powder fell out onto the floor. There was still a small amount of butane gas in the tank.
The operators tried, unsuccessfully, to open the tank by pushing a nitrogen lance down into the cone. At 12.30 p.m. they tried emptying the tank by opening the bottom manhole on the sixth floor. The powder was taken out onto the floor, but as it was packed tight, dust started to accumulate in the area. At 1.20 p.m. there was still no obvious smell of gas but the gas detectors registered low level alarm. A minute later the high level alarm was activated.
The gas probably came from butane left in the powder.
The opening and emptying of the flash tank was carried out in accordance with previous practice and current procedures, based on the design recommendation.
When the fire started, the shift supervisor was at ground level, 10-15 m from the powder chute. The operator shovelling the powder was standing about 1-2 m from the upper opening of the chute. They both heard a booming sound and the shift supervisor saw a flame rising up from the bottom of the chute. The operator also saw this flame coming up and out of the chute and onto the floor.
The shift supervisor immediately reported the fire to the control room from where the alarm was sounded. The fire crew reported to the incident point and the contingency plan was put into action.
The two operators working on the sixth floor managed to get to safety. One received second degree burns, and both were treated for smoke inhalation.
The fire burnt for about one hour. It was supported by two areas: butane being evaporated from the powder in the tank tone and from the gas reaching the tank by backflow through a safety valve. The valve had been tied open during the nitrogen flushing of the tank.
1. Inerting of the flash tank.
The inerting was carried out by using low pressure nitrogen on the nozzle at the outlet cone, for approximately three hours prior to the opening of the tank. At 10.30 a.m. nitrogen at 6 bar was hooked up to the top of the tank. The powder turned out to be tightly packed and there was abnormally larger quantities in the tank. Channelling probably occurred in the powder during the flushing, thus reducing the rate of butane removal.
2. Stationary gas detectors.
There was a low gas concentration above the powder in the tank when the manhole was opened. This increased the likelihood of channelling.
3. Location of the holebin.
The holebin was placed on a pallet which was carried on a forklift truck. The normal position is on the ground.
The location of the holebin possibly increased the possibility of a build up of electrostatic charge and then discharge. The holebin was also equipped with a polyethylene liner.
4. The Chute.
The chute was used to transport the powder from the sixth floor down to ground level. It ran down the outside of the building and the structure. The bottom was fitted with a rubber sleeve, extending about 10 cm below the end. The chute was earthed.
5. Ignition Sources was identified as electrostatic discharge, and there are several aspects which point to an ignition by electrostatic discharge,
· The friction between a non-conductive powder and chute.
· Very high resistance to ground in the bottom part of the chute (more than 25 meg-ohm).
· Insulating rubber sleeve around the bottom of the chute.
· Non-conductive powder in the container.
· Low relative humidity of the air (40%)
6. Ignition Energy.
Butane gas, when combined with the powder, will change the ignition energy relative to the pure powder.
The gas has an ignition energy of approximately 1-10% of the powder.
Therefore the electrostatically charged powder can act as an ignition source - igniting the gas.
[fire - consequence, reactors and reaction equipment, processing]

Lessons

[None Reported]

7886 Date Unknown

Source : LOSS PREVENTION BULLETIN, 066, 3-4.

Location : ,

Injured : 0 **Dead :** 0

Abstract

An explosion occurred on a plant handling phosphoric acid for fertilisers. The hydrogen produced by corrosion throughout the plant was carried into a particular tank. The tank vent discharged downwards near a walkway so the hydrogen could not escape easily.
The hydrogen could escape as soon as it entered the tank, it could not build up to an explosive level and there was no need for nitrogen blanketing.
A welding spark ignited the escaping hydrogen and blew the roof off the tank.
The tank was modified so that the vent was in the centre of the roof and the hydrogen could escape easily.

Lessons

The hydrogen produced by corrosion is formed as atomic hydrogen which can diffuse through iron and came out on the other side. This can cause hydrogen to turn up in some unexpected places.

7892 Date Unknown

Source : LOSS PREVENTION BULLETIN, 090, 9.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A graphite bursting disc in a pilot plant polymerisation reactor failed to burst and vent over pressure. Subsequent inspection revealed that several feet of water had accumulated in the vertical discharge pipe which vented directly to atmosphere with no bend to avoid rain water ingress.
[design inadequate]

Lessons

Any proposals to modify plant should be formalised and documented and the work should be approved by relevant management and carried out under appropriate work permits. Pilot plants tend to have many joints per length of piping and are shutdown, modified and cleaned relatively frequently. Furthermore, the typically small flowrates generally limit the amount of leakage which can be allowed without seriously affecting the accuracy of the data obtained.
However, within the limited area of the pilot plant, the maximum leakage rate of any flammable or toxic material must also be restricted so as not to result in potentially unsafe working conditions. Efficient and reliable leak testing is therefore essential.
Maintenance work should be carefully supervised to avoid hazards being introduced inadvertently.

7917 Date Unknown

Source : ICHEME
Location : , NORTH SEA

Injured : 0 **Dead :** 0

Abstract

A defective coolant hose sprayed ethylene glycol/water mixture onto the hot exhaust of a diesel generator on a oil platform. Prompt use of hand held fire extinguishers quickly brought the situation under control, it was noticed however, that reignition took place at least once during this incident.
Because this particular coolant hose was enclosed by lagging, regular examination was not undertaken, the hose was changed normally during overhaul. The probable cause of the leak was deterioration of the hose through heat from the exhaust manifold.
[offshore, hose failure, inspection inadequate, spill, fire - consequence, hot surface]

Lessons

Examine diesel engine water/glycol coolant hoses that are located near to exhaust systems or are subject to excessive heat, and take appropriate action as necessary.

7939 Date Unknown

Source : ICHEME
Location : ,

Injured : 1 **Dead :** 0

Abstract

A contractor was employed to increase the size of the vent on an overhead tank from 25mm to 65mm diameter. The tank had previously contained kerosene and prior to the work commencing the sub-contractor, to whom the job was given, had attempted to steam-clean the tank for about an hour using a small portable steam generator.
When the man commenced work on the tank using an oxy/acetylene cutter there was an explosion which blew both ends out of the tank and caused it to be dislodged from its stand. The fitter was thrown off and suffered a suspected fractured skull, two broken arms and a broken leg.
Subsequent to the incident it was found that the sub-contractor had not removed all the fittings from the tank while attempting to steam it out and also he had not brought a flammable vapour detector to the site.
A permit to work system was not in force and although there had been some discussion about working methods, a misunderstanding appears to have arisen about exactly how the cleaning was to be carried out. In fact the steaming equipment was totally inadequate to clean the tank properly and the fact that there was no manhole through which the tank could have been visually inspected compounded the problem. In this situation a flammable vapour detector would have been of very limited use anyway.
A safer way would have been to fill the tank with water, if this were possible, although disposal of the contaminated water may have been difficult.
[hot work, cleaning inadequate]

Lessons

This incident highlights the need for careful selection of contractors, proper control of sub-contracted work and the further need for a permit to work system whereby experienced and knowledgeable personnel can decide on an appropriate and safe method of work.

7956 Date Unknown

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

As the morning shift was taking up its duties a leak of ammonia was reported in the refrigeration area of the ammonia plant. The Fire/Safety department responded and found an ammonia vapour cloud was issuing from a vent on the refrigeration compressor. The fire department made an initial attempt to control and dilute the vapour cloud using the well tried method of water fog. After approximately 10 minutes one of the fireman who was wearing a full face mask with ammonia absorbent canister collapsed. He was removed instantly and recovered within minutes of being taken to fresh air.
After the incident had been controlled an investigation was started as to why the man had collapsed.
The immediate opinion of the operation staff was that the man had either not put on his mask properly or had not removed the seal on the canister thus indicating poor training of this man.
The latter reason was disposed of as the man had already been in the vapour cloud for 10 minutes with no ill effect. Therefore he must have removed the canister seal prior to donning the mask.
The first cause of lack of training was taken quite hard by the safety department who felt that the man, who had been with them for 2 years, was quite adequately trained. They then re-enacted the incident with the man who was involved to ascertain the cause of the collapse. No apparent cause was found until they decided to cut open the canister to check the level of ammonia contamination of the filters.
The examination showed that where the man had been working behind a water fog curtain the filters in the canister had become sodden with water, the fibres had expanded and oxygen was prevented from reaching the user. Tests showed that only a small amount of water (1 teaspoon) was sufficient to clog the filter and prevent air flow.
The plant safety department has since issued a directive that air supplied Breathing Apparatus must be used at all times when tackling toxic gas releases and not filtration type of canisters which could become clogged with water.
[refrigeration unit, gas / vapour release]

Lessons

[None Reported]

8014 Date Unknown

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A butadiene vapour cloud (less than 1 tonne) was released from a 2 inch, 60 feet high blowdown vent located in a tank farm adjacent to a sphere.
The gas release occurred as a cargo of butadiene raffinate commenced unloading from a ship at a nearby jetty.
It resulted from the drain valves on the jetty manifold being inadvertently left open after the blind/spade had been swung on the previous shift. The oncoming shift believed the ship was already lined up to commence unloading and that it was only necessary to wait for the laboratory's clearance on the analysis of the cargo before opening the main jetty isolation valve.
Product segregation at the jetty manifold is achieved by the use of blinds. Before the blinds are swung to the open position, prior to lining up the correct pipework system, any residual pressure that may be present in the manifold is released to the appropriate drain drum which is vented in the tank farm.
Discharge commenced without checking the status of the drain valves. Fortunately liquid was immediately seen coming out of the vent by a tank farm operator who immediately instructed the jetty operator to stop the unloading operation.
A cloud of butadiene vapour, approximately 35 feet in diameter and 10 feet high drifted across the docks and shipping operation at the other jetties were stopped. Precautionary measures were taken by the other ships e.g. all accommodation openings were closed, and the cloud eventually dispersed safely away.
[gas / vapour release, operation omitted]

Lessons

[None Reported]

7465 Date Unknown

Source : LOSS PREVENTION BULLETIN, 088, 22.
Location : ,

Injured : 1 **Dead :** 0

Abstract

A fire occurred in an ethanol esterification batch reactor whilst an operator was emptying the last contents of a bag of oxalic acid into the reactor. The reactor had been filled to about two-thirds full with recovered ethanol containing about 10% of cyclohexane and was at a temperature of 15-20 degrees C. The stirrer and dust extraction equipment were in operation. Crystalline oxalic acid was being added through a hood into the manhole from 50 kg plastic bags. About 40 bags had been added when an ignition occurred at the manhole opening just as the operator was shaking out an emptied bag. The operator sustained burns to the exposed parts of the body.

The investigation showed:

1. The resistance to earth of an operator wearing the shoes worn during the incident was 2+ 1 x 10^7 ohms. This is within the range 104-10^9 ohms specified for anti-static footwear.
2. The resistance to earth of an operator wearing a new pair of standard issue shoes was 3+ l x 10^9 ohms.
3. Tests carried out on an operator wearing PVC gloves, earthed footwear and vigorously shaking a woven polypropylene sack with an inner polyethylene liner (the type used) showed the bag was electrostatically charged. Discharges with a maximum charge transfer of -60 x 10^9 Coulombs were detected between the inner polyethylene liner and the spherical probe.
4. The oxalic acid used was noted to be of two types. One form of the acid comprised moist agglomerates of crystalline material, and other a much drier, free flowing crystalline material. At the time of the incident, a bag of the second type was being added.
5. Emptying a full bag of moist acid into an insulated drum produced lower charge levels than emptying a full bag of dry acid. Discharges with maximum charge transfer of +40 x 10^9 Coulombs and -10 x 10^9 Coulombs could be measured from the bag and wet acid powder respectively when using a probe and electrometer. When emptying a full bag of dry powder into an insulated drum charge transfers of +200 x l0^9 Coulombs and -120 x 10^9 Coulombs were measured respectively.
6. With the extraction system in operation the lower flammable limit boundary was 300 mm below the manhole lid. With the extraction system off, the boundary was 300 mm above the manhole lid. The extraction system was impaired by a partial collapse of the ducting. The flash point of ethanol is 12 degrees C and of cyclohexane -17 degrees C.

It was concluded that the most likely source of ignition was static discharge from the plastic bag. Modifications were put in hand to provide an earthed screw conveyor for the oxalic acid and alterations to the extractor systems.

[charging reactor, fire - consequence, reactors and reaction equipment]

Lessons

[None Reported]

7547 Date Unknown

Source : LOSS PREVENTION BULLETIN, 091, 11.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Operators using brazing rods developed hoarseness and dry, sore throats as a result of exposure to cadmium fumes. After investigation it was found that exhaust ventilation provided at the bench and at the bath was inadequate as it failed to capture the fumes and prevent them entering the workroom. There was a failure to provide and maintain adequate ventilation.
[safety procedures inadequate]

Lessons

[None Reported]

7466 Date Unknown

Source : LOSS PREVENTION BULLETIN, 088, 23.
Location : ,

Injured : 2 **Dead :** 0

Abstract

To purify a faulty batch of a dry, powdery active drug ingredient, the latter had to be dissolved in ethanol in a 1000 litre stirred vessel. The product was sealed in 30 kg PVC sacks which were placed in suitably-sized plastic containers. At the time of the accident, two workers were carrying out the loading operation. To do this, they had cut open the PVC sack and placed it on the edge of the vessel opening. 25 kg of material from an open sack had already been poured into the 25 degrees C, hot vessel in which two solution mixtures of the same type had previously been carried out. During loading, one worker suddenly saw a flame at the bottom of the vessel, some 1.20 m below, followed immediately by an explosion. The workers were hit by the jets of flame which shot out. They suffered burns to face and hands. The building suffered a considerable amount of damage as the outer wall of the extraction building, was forced out by the pressure wave. The wall comprised glass panels and broke at ground level. The incident was caused by static electricity being generated by the flow of the powder across the plastic.
[charging reactor, reaction vessel, plastic bags, damage to equipment, fire - consequence, lack of earthing, shoes, screw conveyor]

Lessons

The following should be considered:
Avoid flammable atmospheres:
1. Ensure the temperature of the flammable liquid is below the flash point. A margin of 15 degrees C below the flash point is usually required to obtain a sufficiently lean mixture.
2. Use an inert gas blanket in the top of the vessel.
3. Charge through a rotary lock screw conveyor or similar. The atmosphere in the vessel outside the flammable region by being too rich, inert blanketed, or too lean by using ventilation.
Avoid static electricity as a source of ignition:
A charge transfer in excess of 75 nanocoulomb x 10-9 Coulombs should be considered hazardous.
1. Use a damp powder and add via an earthed tundish or better still, an earthed screw feed.
2. The operator should wear anti-static shoes and gloves when handling powders to avoid being a collector of any static electricity. The powder should also be purchased in conducting bags to avoid the bags being a collector of static electricity.
3. All metal equipment should be earthed.

7467 Date Unknown

Source : LOSS PREVENTION BULLETIN, 088, 23.
Location : ,

Injured : 2 **Dead :** 0

Abstract

A crystalline product was being shovelled out of a plastic bag through a manhole into a 1000 litre steel reaction vessel containing methanol. A fire occurred when the remaining crystals were shaken from the bag. Ignition was caused by discharge of static electricity from the bag.
Two operators were severely burned.
[fire - consequence, charging reactor, plastic bags, reactors and reaction equipment, screw conveyor, lack of earthing, screw conveyor, shoes, burns]

Lessons

The following should be considered:
Avoid flammable atmospheres:
1. Ensure the temperature of the flammable liquid is below the flash point. A margin of 15 degrees C below the flash point is usually required to obtain a sufficiently lean mixture.
2. Use an inert gas blanket in the top of the vessel.
3. Charge through a rotary lock screw conveyor or similar. The atmosphere in the vessel outside the flammable region by being too rich, inert blanketed, or too lean by using ventilation.
Avoid static electricity as a source of ignition:
A charge transfer in excess of 75 x 10-9 Coulombs should be considered hazardous.
1. Use a damp powder and add via an earthed tundish or better still, an earthed screw feed.
2. The operator should wear anti-static shoes and gloves when handling powders to avoid being a collector of any static electricity. The powder should also be purchased in conducting bags to avoid the bags being a collector of static electricity.
3. All metal equipment should be earthed.

7469 Date Unknown

Source : LOSS PREVENTION BULLETIN, 088, 23.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Explosion in vessel after a distillation operation. Methanol and acetone were distilled off from mother-liquors in a vessel. Without cooling or using nitrogen, the vessel was opened and an organic powder charged by hand from a plastic bag. After about ten shovels of the powder had been added, an explosion occurred inside the vessel causing a small fire which broke a glass coil condenser. The incident was caused by static electricity being generated by the flow of the powder across the plastic.
[charging reactor, plastic bags, fire - consequence, screw conveyor, shoes]

Lessons

The following should be considered:
Avoid flammable atmospheres:
1. Ensure the temperature of the flammable liquid is below the flash point. A margin of 15 degrees C below the flash point is usually required to obtain a sufficiently lean mixture.
2. Use an inert gas blanket in the top of the vessel.
3. Charge through a rotary lock screw conveyor or similar. The atmosphere in the vessel outside the flammable region by being too rich, inert blanketed, or too lean by using ventilation.

Avoid static electricity as a source of ignition:
A charge transfer in excess of 75 x 10-9 Coulombs should be considered hazardous.
1. Use a damp powder and add via an earthed tundish or better still, an earthed screw feed.
2. The operator should wear anti-static shoes and gloves when handling powders to avoid being a collector of any static electricity. The powder should also be purchased in conducting bags to avoid the bags being a collector of static electricity.
3. All metal equipment should be earthed.

7470 Date Unknown

Source : LOSS PREVENTION BULLETIN, 088, 23.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Static electrical discharges were seen when an organic powder was tipped into a vessel from plastic bags. No fire occurred as the vessel contained non-flammable material but flammable solvents were handled nearby.
Measurement of static showed voltages of up to 12 kV.
[charging reactor, near miss, screw conveyor, shoes]

Lessons

The following should be considered:
Avoid flammable atmospheres:
1. Ensure the temperature of the flammable liquid is below the flash point. A margin of 15 degrees C below the flash point is usually required to obtain a sufficiently lean mixture.
2. Use an inert gas blanket in the top of the vessel.
3. Charge through a rotary lock screw conveyor or similar. The atmosphere in the vessel outside the flammable region by being too rich, inert blanketed, or too lean by using ventilation.
Avoid static electricity as a source of ignition:
A charge transfer in excess of 75 x 10-9 Coulombs should be considered hazardous.
1. Use a damp powder and add via an earthed tundish or better still, an earthed screw feed.
2. The operator should wear anti-static shoes and gloves when handling powders to avoid being a collector of any static electricity. The powder should also be purchased in conducting bags to avoid the bags being a collector of static electricity.
3. All metal equipment should be earthed.

7475 Date Unknown

Source : LOSS PREVENTION BULLETIN, 087, 27-29.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A still was being used to strip ortho-nitrobenzaldehyde from a 600 kg mixture of other isomers and impurities. The feedstock which had been in stock for some months had been identified as unstable. The instability was thought to be due to the presence of benzoic acid and after laboratory trials, a treatment method was devised consisting of dissolving the nitrobenzaldehyde in toluene and washing with dilute sodium bicarbonate which appeared to improve the stability. After washing and separation from the aqueous phase, the nitrobenzaldehyde in toluene was charged to the still and the toluene distilled off. The nitrobenzaldehyde mixture was tested for stability and once cleared, the still was reduced to 751 mm Hg vacuum and the temperature slowly raised to 132 degrees C. The steam was turned off but the temperature continued to rise and the vacuum was deteriorating owing to evolution of oxides of nitrogen from decomposition. This deterioration accelerated and so the operators evacuated realising that the process could not be controlled. The last observed readings were temperature152 degrees C, and pressure 0.345 bar (5lb/inch2) positive. Within seconds the bursting discs blew followed immediately by explosion of the still.

[sodium carbonate, evacuation, o-nitrobenzaldehyde]

Lessons

[None Reported]

7477 Date Unknown

Source : LOSS PREVENTION BULLETIN, 091, LOSS PREVENTION BULLETIN, 091, 22.

Location : ,

Injured : 0 **Dead :** 0

Abstract

An operator opened a full drum of sodium hydrosulphite (sodium dithionite) and removed a small quantity for a batch charge. When he returned to the area where the drum was stored he found that the contents of the drum were ablaze. The fire was tackled with dry chemical fire extinguishers and the drum was transported to a safety shower where the contents were deluged with water. After the fire was extinguished, the remaining material was dissolved and dropped to the sewer.

Examination of the drum and review of the incident with the operator did not reveal an explanation of the incident. Further discussion with another site revealed that the material is very sensitive to moisture. (Drops of sweat are sufficient to start a reaction resulting in a fire.)

After investigation these conclusions were made of the causes:

1. Fit of lid on opened drum.
2. Moisture in storage area (humidity).
3. Scoop laid on surrounding surface allowing a contaminated/wet scoop.
4. Dilution tank being cleaned nearby allowing water to splash in the area.
5. Drum lid placed on surrounding surface.
6. Drum stored in unobserved area.
7. Not fully recognising moisture hazard/sensitivity.

[charging reactor, fire - consequence, spontaneous combustion]

Lessons

The lesson to be re-learned here is the moisture sensitivity of the material.

Small amounts of water or contact with a highly humid atmosphere in the presence of air may cause a fire or ignite nearby combustible materials.

7484 Date Unknown

Source : LOSS PREVENTION BULLETIN, 093, 35.
Location : ,

Injured : 0 **Dead :** 0

Abstract

An electrical contractor was carrying out preparatory work for running a cable to a new fan. The work was being done under the supervision of a Support Group Electrician with a permit to work (PTW) covering the relevant aspects of the job. Whilst working on a portable staging on the ground floor, he was sprayed by hot condensate from a vent pipe on a blow down header.
The precautions stated on the PTW were satisfactory for the work that was being carried out, and there was no reason to suspect that there was risk from the vent pipe close by.
The pipe, approximately three metres above ground level, is from a blow-down header which in turn carries a number of aqueous process streams, including an automatic blow-down from steam drums, discharging directly to drain.
It was not possible to carry out a modification to this venting arrangement safely without serious process disruption, so the area was fenced off until the vent could be made safe.
[spill, maintenance]

Lessons

The following recommendations were made:
Some of the actions to prevent a recurrence include:
1. A more detailed job specification to be prepared.
2. Block the jacking stud holes off with small bolts.
3. Look at alternative ways of lowering the sparger.

7495 Date Unknown

Source : LOSS PREVENTION BULLETIN, 092, 9-10.
Location : ,

Injured : 1 **Dead :** 0

Abstract

A foreman suffered scalding when he was sprayed with hot water between 80-90 degrees C, whilst attempting to clear a blockage in the blowdown pipe below a boiler.
He found the blockage to be upstream of the blowdown valve. When the water was turned on the blockage cleared immediately with the resultant water flow blowing the hose out of the blowdown valve and showering the foreman with hot water. He attempted to close the blowdown valve, but was prevented by the flow of hot water. He took a cold shower and reported to the surgery where he was treated and then taken to hospital.
[maintenance, safety shower, injury]

Lessons

The following recommendations were made:
1. The boiler water temperature should be checked and must be less than 60 degrees C, before the blowdown valve is rodded or removed.
2. Protective clothing including goggles and waterproofs should be worn when working on the blowdown valve with the boiler containing water.
3. If work must be carried out when the water temperature in the boiler exceeds 60 degrees C, suitable protective clothing must be worn to prevent injury to personnel.
4. An alternative means of safely clearing blockages should be investigated.
5. Operating procedures should be prepared. Such procedures must draw attention to the hazards which may be encountered and the precautions to be taken.
6. The water treatment procedures should be reviewed to reduce the likelihood of scale formation and thereby lessen the possibility of a blowdown blockage.
7. Consideration should be given to raising a clearance certificate or check list to cover jobs which are not being handed over to another section but which nevertheless contain a small potential hazard.
8. Emergency instructions to cover the first aid procedures to be adopted in the case of injury from hot water or steam etc. be prepared for exhibition in boiler houses, calorifier rooms, etc.

7504 Date Unknown

Source : LOSS PREVENTION BULLETIN, 120, 9-10.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A combustion in the vapour space of a 1300 litre chlorination kettle resulted in the rupture of a bursting disc and the release of black smoke outside the production building. Another combustion occurred about 15 minutes later just after the feeds to the reactor had been shut off. There were no injuries or equipment damage and no material release other than the smoke. The combustion resulted from a mixture of chlorine gas and ethyl acetate vapour in the head space of the kettle.
After investigation a follow up literature review showed that chlorine/organic systems can have very low autoignition temperatures. With pure oxygen, organic vapour explosions are extremely violent, and may detonate. Air/vapour explosions are usually more vigorous than chlorine/vapour ones, but not grossly so. In this example the explosion seems to have been mild.
The procedures for check-out of equipment prior to start-up were also reviewed.
1. A fundamental review of the process determined that the ethyl acetate flush procedure could be eliminated altogether. The line was blanked.
2. A reactant weight-loss cross check and lack-of-reaction checks, based on colour change and exotherm rate were added to the operating instructions.

Lessons

Two major recommendations for the chlorination process were:
1. A better inerting procedure (although oxygen did not appear to be involved).
2. Feed control and interlocks based on reactant feed which were considered inherently safer than those based on chlorine feed.

7529 Date Unknown

Source : LOSS PREVENTION BULLETIN, 124, 11-12.
Location : ,

Injured : 0 **Dead :** 0

Abstract

White fumes were seen coming from an air extract stack. At first it was thought to be a fire, but was subsequently identified as a release of HF (hydrogen fluoride) from a leaking vent line. The site emergency services were notified immediately and the plant and extract fans were shut down promptly. Nobody was injured, nor was it necessary to declare a site emergency.
The following conclusions were made:
1. The HF release via the air extract stack was caused by a hole in the offgas vent from a kiln. During kiln operation this hole allowed HF, steam or water vapour, hydrogen and nitrogen to escape to the local atmosphere of the filter room.
2. Prior to the incident it is probable that two leakage paths co-existed. One was a hole with a leakage flow limited by the surrounding but insecure lagging, the other from a poor joint at the flange just above the hole. This flange leakage point was correctly identified and repair was instigated, but only the flange joint received attention. Removal and replacement of the flange probably dislodged or disturbed the lagging and thereby exposed the hole that subsequently allowed the HF release.
3. The `remaining' hole would have been revealed, prior to the incident, had a procedure of pressure/leak testing the equipment and its associated pipework been undertaken after the integrity of the system had been breached. This procedure is implemented at cold start-up conditions, but is not mandated following the repair of leaking joints. Had this leak test been carried out after the identification of the failed filter, the point of leakage may have been easier to find and this may have revealed the hole.
4. The hole was caused by HF attack and corrosion; the result of a combination of localised poor lagging and inadequate trace heating. This induced dew point effect condensed HF and thereby created a specific corrosion point.
5. The blanked end of these 'T' pieces are no longer used and can therefore be eliminated.
6. The HF leaks caused the initial failure of the air extract filters.
[testing inadequate, design or procedure error, gas / vapour release]

Lessons

The following recommendations were made:
1. On all equipment, the offgas vent line 'T' piece should be examined, internally and externally for an indication of corrosion of pipework or welds, or inadequate joints. They should then be trace heated and lagged.
2. The 'T' pieces for all equipment should be systematically replaced with, for example, swept bends of appropriate material, complete with trace heating and lagging. This should be done immediately for those showing evidence of corrosion and all should be completed within twelve months.
3. A procedure should be prepared for inclusion in the Plant Operating Instructions which details verification of the integrity of the equipment or associated pipework, after intrusive work on the system has been carried out. This procedure should include pressure, leak and/or HF in air tests, as appropriate.
4. Periodic HF in air tests should be instigated, during normal equipment operation, to monitor the integrity of the system.

7682 Date Unknown

Source : FURNACE FIRES AND EXPLOSIONS, ICHEME, TRAINING PACKAGE, 005, 9.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Before lighting a furnace the atmosphere inside was tested with a combustible gas detector. The instrument indicated that gas was present.
This was no way connected with the furnace. It came from the base of the cooling tower nearby which cools the water from direct contact jet condensers on three vacuum stills. The fan on the cooling tower had been switched off to save electricity as it was not necessary for cooling. When it was switched on, the vapours dispersed.
Near miss.
[testing]

Lessons

The following recommendations were made:
1. Changes made for good reasons may introduce new hazards could arise.
2. Keep the fan running.
3. Install an alarm which will sound on fan failure or fit a combustible gas detector between the tower and the furnace.
4. On a new plant, area classification should draw attention to the hazard. The area round the cooling tower should be e.g. Division 2 and the furnace should be placed outside the Division 2 area.

7556 Date Unknown

Source : LOSS PREVENTION BULLETIN, 091, 12.

Location : ,

Injured : 1 **Dead :** 0

Abstract

An operator was cyanosed whilst removing monochloro aniline from the base of a still. He was wearing protective clothing but one of the gloves had a hole in it.

[cleaning, personal protective equipment]

Lessons

[None Reported]

7561 Date Unknown

Source : LOSS PREVENTION BULLETIN, 091, 13.

Location : ,

Injured : 1 **Dead :** 0

Abstract

A workman sustained burns to his face whilst he was lagging a pipe adjoining a caustic soda filter containment area in which transfer pumps were leaking. He stood in liquid, which he assumed was rainwater, wearing canvas shoes instead of the protective footwear provided.
[personal protective equipment, maintenance]

Lessons

[None Reported]

7568 Date Unknown

Source : LOSS PREVENTION BULLETIN, 100, 27.
Location : ,

Injured : 1 **Dead :** 0

Abstract

A mechanical failure of a yolk nut assembly of a 50 mm globe vent valve unit occurred.
This failure allowed the valve to self open and depressurise the operating 65 bar g pressure hydrogen system into a 50 mm diameter high elevation vent stack normally used only for nitrogen purging of the system.
This vent stack system included a 4 m unsupported length of piping above its top clamp and a 90 degree bend at the top. The unusually high reactive forces caused it to distort violently around the compressor house enclosed beams which support it.
A full flow jet of hydrogen gas was directed down into the enclosure where the operator was working, ignition took place at some undetermined point causing the operator's injuries and extensive damage to plant and equipment.
The technician was able to leave the area and put himself under the nearest emergency safety shower, he was then given further attention by plant personnel before being taken to hospital by ambulance.
His flame retardant overalls (standard plant issue in flammable gas areas) although scorched on the back saved him from major injury.
[valve failure, fire - consequence, damage to equipment, injury]

Lessons

[None Reported]

7623 Date Unknown

Source : LOSS PREVENTION BULLETIN, 130, 8-10.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A bursting disc on a naphtha cracking furnace failed due to increased back pressure caused by the tripping out of service of the downstream cracked gas compressor. The disc released cracked gas and quench oil to atmosphere, the quench oil igniting at ground level, and the subsequent fire spread up the furnace structure, igniting the escaping from the bursting disc vent. The fires were extinguished and resultant damage was found to be minor, enabling the plant to be recommissioned within twenty four hours.

The cracked gas compressor had tripped due to a high level in one of the interstage drums. The machine tripping increased the pressure at the first stage suction drum which relieved to flare via the pressure indicating control valve which was set at 1.1 barg (16 psig). Shortly after the machine tripped the bursting disc failed. It was some minutes before it was realised that the bursting disc had blown and only then was the naphtha, fuel gas and quench oil feed to the furnace shut off from the control room. This delay, along with the fact that the quench oil shut off valve was subsequently found to be passing, resulted in a considerable quantity of hydrocarbons, especially quench oil, escaping to atmosphere. The quench oil accumulated at ground level and was subsequently ignited by a furnace that had just pressurised.

An investigation revealed that both the primary and secondary bursting disc had failed. The primary disc was found to have been fitted in the reverse direction

[bursting disc failure, fire - consequence, equipment, installation inadequate]

Lessons

The following recommendations were made:

1. A high temperature alarm should be provided on the bursting disc vent, downstream of the discs to give indication of disc failure in the control room.
2. The quench oil control valves should be modified so that tight shut off can be achieved from the control room.
3. The possibility of remote operation of the cracked gas and quench oil block valves from the control room should be explored.
4. The bursting disc flanges and disc carrier assemblies should be modified to ensure location of the bursting discs in the correct fitting position and to give better protection to the disc membrane.
5. An established procedure for change of primary and inspection of secondary discs at each major furnace shut down should be written up and should be enforced.
6. The 0.64 cm (¼") weep hole on the vent is a source of hazard and should be valved off and a suitable means found to prevent build up of rainwater.
7. A pressure gauge should be installed between the primary and secondary discs to give indication of primary disc failure.
8. An operating procedure should be written for handling the failure of bursting discs on a furnace.

Other points raised for consideration were:

1. A reassessment of bursting disc pressures should be made and consideration given to the advantages of re-siting the secondary disc sufficient distance away from the primary so as not to be damaged on failure of the primary.
2. Raising the height of discharge vent.
3. Whether alternative methods of furnace protection could be provided instead of discs.

7631 Date Unknown

Source : LOSS PREVENTION BULLETIN, 131, 17-18.
Location : ,
Injured : 0 **Dead :** 0

Abstract

An explosion and fire took place several months after start up of a solvent recovery plant. The explosion centred on a solvent storage tank causing substantial damage to the tank and connecting pipework. There were no injuries. Investigation revealed that a number of small errors combined to cause the explosion. After investigation it was found that the most likely cause of the incident to be the overheating of a seal pot heater, causing ignition of flammable vapours from the tank once the seal pot had blown.
The events leading to the ignition were:
1. Due to a pressure surge associated with start-up of a still, the seal pot 'blew', ejecting water from the pot.
2. The weather was cold and the electrical heater was switching in.
3. Since the heater element was no longer immersed, it overheated and ignited flammable vapours flowing through the unsealed vent.
4. There was a flammable mixture of vapours in the tank head space either because the solvent was at a temperature below design, and/or due to air displaced from other parts of the system during the start-up of the still.
5. The flame travelled back through the vent into the tank to cause the explosion.
6. Fortunately the flame did not propagate through the vent header to cause an escalation of the incident.
[fire - consequence]

Lessons

The following recommendations were made:
During the design phase, the plant had been subject to a Hazop and much thought had been given to the safety of the electrical heater and its control system by a competent team.
The heater was specified so that the maximum surface temperature was well below the autoignition temperature of the solvent vapours.
However, the vital point was missed that this was only guaranteed whilst the element was immersed. Tests after the incident confirmed that, when dry, the surface temperatures rose well above the autoignition temperature.
Hazop as a technique is not infallible and does not necessarily identify several simultaneous deviations - as happened here. Additionally it is important to ensure that the understanding gained during the Hazop is effectively communicated to those responsible for implementing the design.
With the benefit of hindsight it can be seen that the minor problems that arose during commissioning led to an erosion of the margins of safety. It is vital that those involved in the commissioning can assess any discrepancies between the actual hardware and operating conditions and the design intent.
The basis of safety must be clearly and explicitly stated to the commissioning team. For example, in this case, was the basis of safety the maintenance of vapour concentrations above the flammable limits, or the elimination of ignition sources, or both?
Clearly having the right team present during commissioning is vital. There must be an appropriate blend of disciplines, including drawing from the design and Hazop team members.

7656 Date Unknown

Source : HAZARDS OF OVER AND UNDER PRESSURING OF VESSELS, ICHEME, SAFTEY TRAINING PACKAGE, 001, 9.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A tank containing liquid ethylene split through overpressuring. Fortunately the leak was not serious and was dispersed with steam and did not catch fire. The tank was refrigerated at minus 100 degrees C, and at atmospheric pressure. The vapour evolved is refrigerated and put back to the tank. When the tank is with maintenance, vapour is released via a relief valve into a stack. The cause of this incident was due to the stack being a vent stack not a flare stack, steam being used to ensure a good flow up the stack and to disperse the vapour. When the split occurred the refrigeration unit had been shut down for some time. The cold ethylene vapour froze the steam and blocked the stack. A high pressure had been showing on the tank before the incident and had been logged by the operators but they did not appreciate the significance.
[overpressurisation, gas / vapour release]

Lessons

The following recommendations were made:
1. As a short term measure, the steam was supplied to a ring round the top of the stack and not up the stack itself.
2. The stack was replaced by a flare stack.
3. Danger levels should be marked on a record sheet.

7657 Date Unknown

Source : HAZARDS OF OVER AND UNDER PRESSURING OF VESSELS, ICHEME, SAFTEY TRAINING PACKAGE, 001, 10.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A storage tank was sucked in when it was being pumped out.
The main causes were:
There were three pipes on the tank, each fitted with a flame arrestor. One vent pipe alone would have been sufficient for the pump out rate, but the flame traps had not been cleaned for over two years, though the maintenance schedule showed that they should be cleaned every year. When the tank, which had been left standing for some time, was pumped out, a vacuum developed and the tank collapsed.
[maintenance inadequate, storage tanks]

Lessons

The following recommendations were made:
1. Flame arrestors must be cleaned regularly. If maintenance effort cannot be made available, then flame arrestors should be designed so that they can be changed by process.
2. It is not sufficient to install safety equipment, we must make sure that we maintain it regularly.
3. Sometimes, if we neglect safety precautions we take a chance and it comes off. In this case collapse of the tank in the end was inevitable if the flame arrestor was not cleaned, though it was impossible to forecast how long would elapse before this occurred.

7660 Date Unknown

Source : HAZARDS OF OVER AND UNDER PRESSURING OF VESSELS, ICHEME, TRAINING PACKAGE, 001, 15.
Location : ,

Injured : 1 **Dead :** 0

Abstract

The end of a 20 m3 storage tank blew off and injured a person working nearby.
The tank was used for storing, in a liquid form, a product that melts at 97 degrees C. It is therefore heated by a 7 bar (100 lbf/in2) steam coil. At the time of the incident the tank was almost empty and was being prepared to receive some product. The inlet line was being blown with compressed air to prove that it was clear, the normal procedure. The air was not getting through and the operator suspected a choke in the pipeline.
The vent on the tank was choked and this was difficult to see. The air pressure 5 bar (75 lbf/in2 gauge) was sufficient to burst the tank (pressure 0.3 bar [5 lbf/in2 gauge]). Originally the tank had a 150 mm diameter vent but at some time this was blanked off and a 75 mm diameter 25 mm deep dip branch was used as the vent. The vent was not heated. The lack of heating on the vent had been reported several times but nothing had been done. Nobody knew that with the vent choked the air pressure could burst the tank.
Although the material in the tank was about 150 degrees C, (the temperature of 7 bar [100 lbf/in2], above its flash point (120 degrees C), there is no evidence that a deflagration occurred.
[inspection inadequate, rupture, injury]

Lessons

The following recommendations were made:
1. Vent holes, whether or not fitted with flametraps, on vessels containing liquids, which solidify at ambient temperatures, must be heated by steam or electric tracing or some other means.
2. Vent holes, whether or not fitted with flame flaps must be inspected regularly. Although we have inspected systems for relief valve, a hole is usually not inspected regularly. This is wrong.
If the tank contains material which is solid at ambient temperature, then the vent must be inspected frequently, say every day or before every movement of material into the tank. A full time tank inspector may have to be appointed. A design of flametrap is available which can be removed for inspection by the operator, without the need for fitters.
3. Vent sizes must not be reduced without checking that the new size is adequate. Vent sizes should be registered like relief valve details.
4. Tanks containing flammable materials above their flash points should have flametraps fitted on their vents and should be blown with nitrogen, not air.
5. Operators should be taught that storage tanks are fragile.
6. The mode of failure of a vessel should be considered. Where failure is possible, vertical cylinders are less hazardous than horizontal cylinders, provided they rupture at the roof-to-wall seam and not the base-to-wall seam.

7669 Date Unknown

Source : FIRES AND EXPLOSIONS, ICHEME, TRAINING PACKAGE, 003, 3-4.
Location : ,

Injured : 0 **Dead :** 0

Abstract

An explosion occurred in the base of a flare stack. Fuel and air together with the pilot flame on top of the flare stack was the source of ignition.
The fuel came from the process. The air entered through a leak in a large bolted joint.
[joint leak]

Lessons

The following recommendations were made:
1. Weld stacks, do not make bolted joints between large unmachined surfaces.
2. Analysis stacks regularly for oxygen, large stacks should be fitted with fixed analysers, small stacks should be analysed with a portable analyser.
3. Keep a continuous flow of gas, if possible inert gas, up the stack to prevent air diffusing down. It will also help to sweep away any small leaks of air that occur.

7679 Date Unknown

Source : FURNACE FIRES AND EXPLOSIONS, ICHEME, TRAINING PACKAGE, 005, 1.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A supervisor tested the atmosphere inside a furnace with a combustible gas detector. No gas was detected so the slip-plate was removed and the poker lit and inserted into the furnace. An explosion occurred. It took only five minutes to remove the slip-plate and only another two minutes elapsed before the poker was inserted.
[testing]

Lessons

The following recommendations were made:
1. Test the atmosphere.
2. If negative, light the poker and insert it, or switch on the electric lighter.
3. Remover the slip-plate or other positive isolation, i.e. close the bleed, drain the lute etc.
4. Open the main valve. The solenoid valve should open when the poker is inserted.