1248525 April 2000

Source : CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD, 25 APRIL, 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 : Hyde Park, USA

Injured : 2 **Dead :** 0

Abstract

An explosion occurred at a foundry spraying two workers with 2,500-degree molten iron.
The incident occurred whilst the workers were making a giant roll in a centrifugal spinner, welding a ladle that held 8,000 pounds of molten iron that they began to pour into a spin caster.
Partway through the process, the caster began to vibrate and then explode.
[burns, centrifuge, injury]

Lessons

[None Reported]

1248120 April 2000

Source : CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD, 22 APRIL, 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 : Holcomb, USA

Injured : 2 **Dead :** 1

Abstract

An explosion occurred at a beef-processing plant killing one worker and injuring two others.
The incident occurred when a tallow separator exploded in the rendering area of the plant. One of the workers injured suffered chest and facial burns.
An investigation into the incident is being carried out, although it is thought that the cause of the explosion was due to mechanical failure.
[mechanical equipment failure, fatality, injury]

Lessons

[None Reported]

12497May 1999

Source : EVENING CHRONICLE, 21 MAY, 1999, (http://www.evening-chronicle.co.uk)
Location : Tynside, UK

Injured : 2 **Dead :** 1

Abstract

An explosion occurred at a factory killing a worker and injuring two others. At the time of the incident repair work was being carried out on a press heat exchanger when a filter blocked. It is thought that due to the filer being blocked a pipe fracture occurred resulting in a massive release of high-pressure steam. An investigation is underway into the cause of the explosion.
[burns, fatality, flow restriction, injury]

Lessons

[None Reported]

1198523 October 1997

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

Abstract

A carry over of phosphorous oxychloride to a vent scrubber reacted with water causing overpressurisation damage. A polypropylene drain line was damaged and production loss occurred.
[unwanted chemical reaction, damage to equipment]

Lessons

[None Reported]

1273409 October 1997

Source : CHEMICAL HAZARDS IN INDUSTRY NO: 1, JANUARY 1998.
Location : Frankfurt, GERMANY

Injured : 0 **Dead :** 0

Abstract

A fire occurred at a coatings facility. The fire occurred in a filter unit releasing a vapour cloud that drifted over a residential area. No one was injured in the incident.
It is not know how the fire started.
[fire - consequence, gas / vapour release, carbon monoxide]

Lessons

[None Reported]

1198304 October 1997

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

Abstract

A filter press failed releasing approximately 3 tonnes of diacetate dope, containing acetone. The spilt dope was sprayed with water and collected in drums for re-use.
[mechanical equipment failure, spill]

Lessons

[None Reported]

1134709 April 1997

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

Injured : 0 **Dead :** 0

Abstract

One hundred and fifty tonnes of chloroform leaked from a ruptured filter on a pipeline supplying a fluorochemicals plant. The leak continued for four hours before it was detected and halted. Most of the chemical soaked into the ground but a small amount was recovered from an interception trench and by dredging of the nearby canal.
[operational activities]

Lessons

[None Reported]

1174404 February 1997

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

Abstract

A company technician and an instrument/electrical contractor were preparing to install a local capillary sealed differential pressure indicator to a catalyst filter. The men had been issued with a permit to work which requires full personal protection equipment and self contained breathing apparatus to be worn. On arriving at the location a nitrogen hose, connected to the catalyst system, was restricting access to the workplace.
To improve access, the hose, previously used to purge the filter from the system and valve isolated at either extremity, was disconnected. This operation released a small quantity of the filter which created a cloud of 10 to 12 inch length to which both men were exposed. At the time of this activity neither of the men had their breathing mask fitted since they were not aware that the disconnection constituted a break of containment for which breathing apparatus had to be worn.
Immediately after this event the contractor, who had been closer to the release than the technician, went to the control room for treatment (water wash and application of catalyst anti-dote gel), after which he received further treatment at the Medical Centre.
The technician was not aware that he had been affected until about an hour later, after this delay he too washed and applied anti-dote in the control room and went for treatment at the Medical Centre.
Both men were taken to hospital where they were kept overnight for observation. They were released in the morning and returned to work that day.
[maintenance, burns, safety procedures inadequate, gas / vapour release, injury]

Lessons

Recommendations following the accident included the following:
Reinforce to Production Teams that connecting and disconnecting of hoses is breaking containment with associated personal protection equipment /control of work requirements.
Operating Instructions to be updated in detail. Infrequent operations require a greater level of detail.
All personnel should be made aware that all injuries, no matter hoe apparently trivial, should be reported to the Medical Centre for immediate treatment to avoid a more serious condition developing.

7653 1997

Source : LOSS PREVENTION BULLETIN, 134, 25.
Location : ,

Injured : 0 **Dead :** 1

Abstract

A maintenance assistant was working with a filter in silo used to store wood chips. The chips, produced by a chipping machine from broken pallets and waste wood, were loaded into the top of the silo by a charging conveyor, suspended vertically, moved up and down within the silo equalising the level of the contents.
To gain access to the upper end of the charging conveyor, the employee rode the equalising conveyor to the top of the silo. As it was lowered back down, it started automatically, and he became trapped between the conveyer's slats and a drive shaft. Rescue was carried out by the emergency services, but the employee died later from internal injuries. Fatality.
[silo/hopper, storage]

Lessons

[None Reported]

111461997

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

When attempting to reinstate a utilities area HVAC system after a full power outage, it was found that the fans could not be started because of initiation of smoke detectors within the duct. Upon investigation, it was found that the heater bank had been energized, the fans were not running, and heat build-up was substantial and had melted/ignited nearby gas detectors and filters.

The control logic should have prevented power being supplied to the heaters unless the fans were running. High temperature protection devices should also have tripped the heater. All control/enable circuits were checked and found to be operating correctly. However, on checking the thyristors, 2 out of 3 were found to have failed in the "made" (closed) position. This allowed voltage to the heaters, effectively bypassing the control circuits. The trip logic was checked and it was found that smoke detection within the duct or vent fan failure did not trip the feeder to the heater. Trip action relied on the thyristor controller, rather than opening the supply contactor.

[operational activities, filter, process control & instrumentation, control failure, fire - consequence]

Lessons

The following recommendations were made:

HVAC systems should not use a component that cannot be relied upon to fail "safe" (e.g., thyristor) as a primary means of isolation.

The power supply to the heater should be isolated directly in the event of a duct fire/over temperature.

Control or electrical supervisors should check their HVAC systems to satisfy themselves that existing trip action is adequate and would have prevented this incident. They should also check that existing thyristors in their HVAC control systems have not failed in the closed position, as this may not be apparent when the system is operating. Control or electrical engineers involved in new projects should ensure that there is an independent shut down mechanism for HVAC equipment, especially for packaged units.

9022 1997

Source : CHEMICAL HAZARDS IN INDUSTRY, 1997, AUG.
Location : , USA

Injured : 0 **Dead :** 0

Abstract

An explosion occurred at a coating factory. The explosion occurred in the duct system of a scrubber which destroys volatile organic compounds (VOCs). No injuries were reported and no hazardous substances were released to the environment.
[near miss]

Lessons

[None Reported]

1196819 November 1996

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A release of hydrogen chloride occurred when a scrubber was not able to cope with the release of fumes during tanker unloading operations. Two contractors were affected by the release.
[gas / vapour release, mechanical equipment failure]

Lessons

[None Reported]

8557 11 February 1995

Source : HSE NEWS RELEASE.
Location : Sutherland, UK

Injured : 0 **Dead :** 0

Abstract

During operations at a residue recovery plant the radiation monitors went into alarm. The plant was shut down and the area evacuated. A detailed survey of the area was made where no significant contamination was found and the plant restarted. The pressure in the main glovebox was then found to be increasing gradually and air activity monitors went into alarm and the plant was shut down and evacuated for the second time. It was subsequently confirmed that the pressurisation of the glovebox had been caused by a leak in the compressed air hoses of a centrifuge drive combined with a blockage in the glovebox filter. [radioactive, evacuation, plant shutdown, processing]

Lessons

[None Reported]

8395 02 January 1995

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

Abstract

Separator explosion at a refinery. During bar screen raking (the first treatment step) to clean out any large debris which might have been filtered, an explosion occurred within the
enclosed bar screen vapour space. There was injury and damage to equipment. It was found that modifications made had created an explosive hazard, and a new inherent process hazard was not completely understood or managed.
[cleaning, fire - consequence, refining, modification procedures inadequate, injury]

Lessons

Process hazard analysis teams should be reminded to consider all modes of operation during a review. The rake operating procedure should have been considered when discussing the potential for oxygen entering the bar screen vapour space.
Some of the technical information supplied by the carbon canister vendor was found to have been misleading, and following the recommended procedures did not necessarily eliminate the inherent hazards. This affected the quality of the hazard analysis.

6760 10 November 1994

Source : SEDGWICK LOSS CONTROL NEWSLETTER, 4TH QUARTER, 1994.
Location : Corpus Christi; Texas, USA

Injured : 2 **Dead :** 0

Abstract

Brief fire at an oil water separator extinguished in 35 minutes.
[fire - consequence, separation]

Lessons

[None Reported]

6575 31 May 1994

Source : SEDGWICK LOSS CONTROL NEWSLETTER, 2ND QUARTER, 1994.
Location : Kokkola, FINLAND

Injured : 1 **Dead :** 0

Abstract

Explosion in an organic intermediates plant. Substance involved 3,4 methylenedioxy-N-ethylaniline. Equipment, vacuum distillation column.

Lessons

[None Reported]

6517 20 April 1994

Source : SEDGWICK LOSS CONTROL NEWSLETTER, 2ND QUARTER, 1994.
Location : Come By Chance, Newfoundland, CANADA

Injured : 0 **Dead :** 0

Abstract

Fire in a vacuum distillation column at refinery.
[refining, fire - consequence]

Lessons

[None Reported]

6403 01 February 1994

Source : LLOYDS LIST, 1994, 2 FEB.; CIVIL PROTECTION, 1994, SUMMER; ENDS REPORT, 1994, FEB.

Location : Immingham, UK

Injured : 0 **Dead :** 0

Abstract

A marine transportation incident. Valve in oily water separator on oil marine tanker left open at terminal and oil sheen seen.
[pollution]

Lessons

[None Reported]

1160422 December 1993

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A new bag filter was being installed on the feed to a polyethylene powder bin, at a chemical facility, when a powder transfer was accidentally routed to the bin. The filter was required to replace an existing cyclone, which was to be destructed. Installation of the filter was nearing completion when the incident occurred.
Approximately two tonnes of powder entered the filter. This was discharged into, and over, the bin, some spilling onto the ground. Although electrical work was being undertaken at the time, no personnel were in the vicinity of the release.
Approximately fifty minutes after the release, a small internal explosion, which blew out the lens, occurred within a floodlight located at the base of the powder bin. A small fire then started within the floodlight's casing. This was immediately extinguished. The cabling to the light was disconnected.
An enquiry team investigated the events surrounding the spillage and subsequent fire.
[maintenance, material transfer, fire - consequence]

Lessons

1. The blanking diagram for the bin was unsatisfactory in that it did not ensure adequate isolations were made, and maintained, during the work being undertaken. As an example, no distinction was made between the cyclone and the bin itself. As a result, installation of the filter was progressed and no blank was fitted between the filter and the bin.
2. Operator error resulted in the accidental transfer of the powder to the bin. The wrong bin was lined up.
3. The floodlight was certified correctly for the area in which it was located. However it was identified that powder could possibly get into the light fitting during a lamp change operation. From the information available, it was concluded that this was the most probable way in which powder had entered the lamp.
4. At the time of the incident, the lamp was not operating, but was powered up. In such a condition the ignitor continued to pulse until the circuit was de-energised or the lamp replaced. It was concluded that the source of ignition could have been an electrostatic discharge, caused by the ignitor, which was coincident with a flammable dust cloud generated within the floodlight. This powder could have been disturbed by vibration, due to the clean up operation, which followed the spillage.
5. The 'lack of clarity in the Permit to Work' and that 'no mechanism exists to ensure withdrawal of a Man Entry Certificate if isolation is compromised', were highlighted by the team.

6221 06 September 1993

Source : EUROPEAN CHEMICAL NEWS, 1993, 13 SEP.
Location : Ludwigshafen, GERMANY

Injured : 0 **Dead :** 0

Abstract

Fire broke out during welding in a gas scrubbing plant.
[scrubber, fire - consequence]

Lessons

[None Reported]

6175 02 August 1993

Source : EUROPEAN CHEMICAL NEWS, 1993, 16 AUG.; CHEMICAL ENGINEERING, 1993, SEP.
Location : Dottikon, SWITZERLAND

Injured : 0 **Dead :** 2

Abstract

An explosion occurred when a methanol/toluene mixture was being routinely filtered using a pressure filter to make an undisclosed intermediate. Fatality. [separation equipment, filtration, methanol, fire - consequence]

Lessons

[None Reported]

6170 August 1993

Source : OCCUPATIONAL SAFETY OBSERVER, 1994, MAR.
Location : Shelbyville; Kentucky, USA

Injured : 3 **Dead :** 1

Abstract

Four workers at a packaging plant were performing maintenance on a parts cleaning system when an explosion and fire ripped through the room. The room contained a number of highly flammable and toxic substances including methyl ethyl ketone, ethyl acetate, acetone and toluene used as solvents. The operation consisted in the removal of a pump from the cabinet system and repairing the filter system. The pump had been removed and a welder was preparing to repair the basket cover when the explosion occurred. Some attempt had been made to clear flammable material but 2 soak tanks were not removed and their lids were unsealed. Fatality.
[packaging equipment, welding, permit to work system inadequate]

Lessons

[None Reported]

5843 03 November 1992

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

A dust explosion occurred in a bag filter of a polymer plant and vented through explosion panels. A fire subsequently occurred in the bag filter dust collector. It was determined that the polymer accumulation inside the filter bag had degraded and autoignited due to long time at elevated temperature.
[autoignition, fire - consequence, processing]

Lessons

In future plant to have increased inspection and cleaning of bags. Improved bag design being considered.

5788 21 September 1992

Source : THE CHEMICAL ENGINEER, 1992, 15 OCT., & 10 DEC., & 1994, 30 JUN.; CHEMICAL TECHNOLOGY EUROPE, 1994, JUL/AUG, 30-31.; A REPORT OF THE INVESTIGATION BY THE HEALTH AND SAFETY EXECUTIVE INTO THE FATAL FIRE AT HICKSON & WELCH LTD., HMSO, 1994, ISBN, 07176 0702 X.

Location : Castleford; West Yorkshire, UK

Injured : 14 **Dead :** 5

Abstract

Incident during cleaning of a nitrotoluene distillation still vessel. The mintenance procedure involved using a steam coil in the base of the still to indirectly heat solid residues to soften them prior to removal. Hot spots develeoped in the waste and a decomposition began leading to an exothermic reaction and eventually a fireball. A temperature of 80 degrees C was to be used for the softening process, however it is believed that much higher temperature was reached. This may have occurred if the thermometer in the still did not register the true temperature as it was not submersed in the residue. The 2-3 tonnes of residue was heat sensitive and produced a fierce jet of flame which shot out of the manhole opening and consumed the wooden built control room. Fatality.
[fire - consequence]

Lessons

1. Where the batch distillation of highly energetic materials (such as mononitrotoluenes or other organic nitro compounds) is carried out still residues should be analysed, monitored and removed at regular intervals to prevent possible build up of unstable impurities.
2. The use of chemical plant for a different process or purpose should be treated as a plant change procedure requiring rigorous assessment. Consequently, before plant is used to carry out non-routine operation authorisation should be obtained from an appropriate level of management who should ensure that plant hazards have been identified, risks assessed and the precautions determined.
3. Safe systems of work covering all aspects of operation and maintenance of all process plant should be established and defined in comprehensive instructions including those operations undertaken at frequent intervals. These systems should be monitored by management and reviewed at appropriate intervals.
4. The nature, operation and limitations of control systems on process plant should be determined, and their implications for health and safety taken into account, before non-routine operations requiring their use are authorised.
5. Companies should assess and monitor the workload and other implications of restructuring levels of management and supervision to ensure that key personnel have adequate resources, including time and cover, to discharge their responsibilities.
6. Persons authorised to issue permits to work should be sufficiently knowledgeable about the hazards associated with relevant plant. If authorised personnel are relocated to former workstations refresher training should be given and recorded before re-authorisation.
7. The design and location of control and other buildings near chemical plant which processes significant quantities of flammable and/or toxic substances should be based on the assessment of the potential for fire, explosion and/or toxic releases at these plants. Companies should assess the suitability of existing control buildings and, if they are found to be vulnerable, reasonably practicable mitigating action should be taken.
8. Companies should regularly monitor and audit their own compliance with performance standards defined in their fire certificates. Particular attention should be paid to the effects of material alterations, e.g. installation of pipework and cable ducts and other works in areas concealed by false ceilings, to ensure that fire-resisting integrity of protected routes is maintained and fire training records should be regularly updated.
9. When exercising their own on-site emergency plans companies should ensure that roll call information on missing persons is passed immediately, accurately and directly to the senior fire officer in charge. Roll call procedures should be practised routinely to ensure that they are effective when carried out at all periods of the working day.

5668 25 May 1992

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

Injured : 0 **Dead :** 0

Abstract

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

Lessons

[None Reported]

7610 08 May 1992

Source : LOSS PREVENTION BULLETIN, 129, 10-11,; LLOYDS LIST, 1992, 29 MAY.

Location : Tarragona, SPAIN

Injured : 0 **Dead :** 0

Abstract

During normal operation of this ethylene plant, a leak was detected in the cooling/heating water jacket for the upper zone reactor tubes. The ethylene plant was immediately shut down and the pressure in the reactor was gradually reduced to 25 bar. Water was drained from the jacket and ethylene detectors were inserted to identify the location of the gas leak. Ethylene gas was reintroduced into the system and the pressure was gradually increased to 980 bar. When the source of the leak was detected the operators started to reduce the pressure in the reactor and separators.

As the pressure in the reactor and separators started to decrease, a loud noise was heard in the control room. Operators believed the noise to be a large ethylene leak and actuated the emergency dump system which closed the ethylene and oxygen inlet valves of the reactor, released gas through the reactor vents, and closed the outlet valve of the high pressure separator. Almost immediately after the emergency dump system was actuated, an explosion occurred which was followed by fire.

The explosion caused substantial damage to equipment and buildings within a one-half mile radius of the plant and severely damaged the concrete containment bunker for the reactor and high pressure separator. The walls of the bunker remained standing, secured by the steel reinforcing, but had been bowed outwards. The damage patterns suggest that there were two simultaneous vapour cloud explosions, one within the bunker and one centred above the top of the bunker. The fire following the explosions was extinguished within 10 minutes as the flow of gas was shut off. Fire damage was observed on the top of the high pressure separator and at the bottom valves of the low pressure separator.

The initial release of ethylene gas during testing came from the high pressure separator lid, which was secured to the body by a series of studs and was sealed with a steel ring. The leakage was said to have been caused by differential thermal contraction of the seal and the lid/body assembly following the introduction of cold ethylene gas into the reactor and separators for test purposes. There was no evidence of fracture or mechanical failure on either the seal ring, lid or body of the high pressure separator. Additional ethylene gas was released from the reactor and separators when the emergency dump system was actuated. The source of ignition for the ethylene gas was failure of insulation on electrical wiring for a remote operated dump valve. This valve would have been operated with electrical sparking during the emergency dump system actuation.

[fire - consequence, reactors and reaction equipment]

Lessons

[None Reported]

5552 21 January 1992

Source : SEDGWICK LOSS CONTROL NEWSLETTER, 1ST QUARTER, 1992.
Location : Moscow, RUSSIA

Injured : 0 **Dead :** 0

Abstract

A fire occurred on the 25 metre vacuum distillation column of refinery.
[fire - consequence, refining]

Lessons

[None Reported]

5548 13 January 1992

Source : ICHEME

Location : ,

Injured : 2 **Dead :** 0

Abstract

Centrifuge feed tank exploded during a cleaning operation. The rupture was caused by steam pressure due to heat from the chemical reaction of an alkaline catalysed polymerisation of hydrogen cyanide. The hydrogen cyanide came from a decomposition of a product.

Lessons

[None Reported]

7872 January 1992

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

Location : ,

Injured : 0 **Dead :** 0

Abstract

A centrifuge feed tank, of 30 m3 capacity, manufactured of rubber lined carbon steel and containing an aqueous slurry of iminobaisacetonitrile (IBA), ruptured due to overpressurisation caused by decomposition reactions during a cleaning operation. Although personnel injuries were minor, there was extensive damage to plant facilities. The cost of plant rebuilding and the business interruption loss amounted to the equivalent of well over £10 million (1992).

On the day of the incident a large build-up of solids was noticed on the internal coil and in the tank headspace, and level instrumentation problems were experienced. Further investigation revealed that the tank vent was blocked and causing the level transmission errors by allowing a vacuum in the tank. Realising that tank clean out was necessary, operational staff stopped transfers into the tank and continued feeding forward to the centrifuge via a side outlet. When the level dropped to this outlet, an attempt to empty the heel of slurry to the centrifuge through the tank bottom was made, but the connection was blocked. The blockage was cleared but the heel was not emptied.

The tank was then filled with process water until the level reached the upper tangent line of the top head, as observed through a sightglass. At 1615 hours circulation was started and steam was turned on to the coil, with the objective of heating the contents to 70 degrees C and then allowing circulation of the hot water for a further 30 minutes. Soon after the steam flow was started the level indicator reading returned to normal, suggesting that the tank vent was at least partially open.

At 1640 hours the tank contents reached 40 degrees C, the upper limit of the installed temperature indicator. Subsequently, temperature measurements were made using a portable surface-reading pyrometer on the circulation pump suction piping. At 1740 the temperature was 55 degrees C and at 1835 it had reached 74 degrees C. Steam was then shut-off from the coil, the circulation was stopped, and an operator tried to empty the tank contents via a gravity drain line.

Draining was unsuccessful due to a blockage in the pipe, a flexible hose to a drain valve on the discharge of the pump. At 1910 hours draining was started via the hose to a floor drain. The operator looked through the tank sightglass to confirm that the level had started to decrease before returning to the control room. At about 1920 hours two field operators responded to what sounded like a high pressure steam leak in the feed tank area of the plant. Almost immediately they came within view of the tank, at a distance of about 12 metres, it violently ruptured. They were blown backwards and sprayed with a black residue, but returned to the control room unaided and sustained only minor injuries.

The tank overpressurisation was caused by the steam pressure that was generated by the heat of chemical reactions. Initially the IBA started to decompose due to overheating during the cleaning operation. The hydrogen cyanide (HCN) formed then polymerised, significantly augmenting the heat evolution, and provided the heat essential for vessel rupture.

The chemical reactions were initiated by the use of a tank cleaning operation which was unsuitable for the process material, particularly in respect of heating medium, water quality and procedure.

[vent blocked, solids deposition]

Lessons

As a result of the investigation a series of preventative recommendations were made:

1. Reduction in IBA build-up.

Consider the impact of upstream equipment performance and operations on solids build-up in the feed tank.

Consider the installation of nozzle inserts in the feed tank entry and re-circulation piping to minimise splashing and run-down on the head.

Consider operating the feed tank through the bottom outlet only and decide on the need for a side outlet.

2. Reduction in IBA quantity at clean out.

Establish clear guidance on the planning and minimum frequency of feed tank clean outs.

Enssure that cleaning is carried out before the build-up is too large, and only after the feed tank is fully drained.

3. Reduction in temperature to safe level below IBA decomposition.

Enssure that steam is not used for cleaning the feed tank and for unblocking/decontaminating associated piping. Remove steam connections to the coil.

Develop a safe temperature controlled method for cleaning the feed tank and associated piping, provide the necessary facilities to support the method, and establish formal instructions for clean out.

Enssure that steam is not used for cleaning all other vessels where IBA is present and for unblocking/decontaminating associated piping. Provide for temperature controlled cleaning as above. Where steam heating is employed as part of normal operation, evaluate the use of tempered water or gain formal approval of continued use of steam.

4. Reduction in IBA exposure time to heat.

Provide for specified time limits as part of new cleaning procedures.

5. Prevention of contact with alkaline solutions.

Connect only non-basic pH controlled water to the feed tank.

Connect only non-basic pH controlled water to other vessels containing IBA and/or HCN .

6. Improvement in process instrumentation.

Provide an improved temperature measuring system on the feed tank to reliably monitor both normal and clean out temperature ranges.

Provide a high temperature alarm, high temperature interlock, and high rate of temperature rise interlock on the feedtank. Either interlock should discontinue cleaning operations and initiate corrective actions.

Provide a high temperature alarm, high temperature interlock, and high rate of temperature rise interlock on other vessels containing IBA and/or HCN. Either interlock to be discontinue normal operations and cleaning operations, and initiate corrective actions.

Provide an improved level measuring system on the feed tank to operate reliably independently of vessel pressure.

7. Improvement facilities in emergency.

Consider the provision of quench systems to terminate a reaction if started in the feed tank and other vessels containing IBA. Ensure that the feed tank and other vessels containing IBA are provided with vent systems of adequate size which can be monitored and maintained operational.

8. Improvement in process knowledge and documentation.

Enssure that all process documentation is updated to effectively emphasise the reactivity and thermal stability characteristics of IBA. Establish a procedure to review, incorporate and communicate changes or new information impacting process safety at least annually. Educate all personnel on the hazards of IBA reactivity, particularly in respect to the revised operating and cleaning procedures introduced.

9. Additional hazard assessment.

Conduct HAZOP studies on designated IBA/HCN containing vessels throughout the manufacturing process.

928 1992

Source : ICHEME

Location : ,

Injured : 12 **Dead :** 5

Abstract

Explosion in nitrotoluene still. A steam coil in the base of the still was being used to soften residue inside, during maintenance. The result was an exothermic runaway.

After investigation it was found that the thermometer at the base of the still was not in contact with the residue and gave a false reading of residue temperature. Fatality.

[unwanted chemical reaction]

Lessons

Heating of residues may produce "lighter" flammable materials and hot spots that can cause ignition and explosions.

5501 06 December 1991

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

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

Lessons

[None Reported]

5382 15 July 1991

Source : LLOYDS LIST, 1991, 19 JUL.
Location : Jurong, SINGAPORE

Injured : 1 **Dead :** 1

Abstract

Flash fire occurred in a vacuum distillation column and a visebreaker. Fatality.
[fire - consequence, cracking equipment]

Lessons

[None Reported]

5372 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, 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.

Causes of this accident were:

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.

[fire - consequence, separation]

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]

1023116 September 1990

Source : ICHEME
Location : , UK

Injured : 1 **Dead :** 0

Abstract

An off-gas cyclone separator, on a phthallic anhydride plant, suddenly fell through the floor without prior warning, during preparation of the plant for scheduled maintenance. One operator suffered a broken foot.
The cyclone had been overloaded with wash water, due to a blockage in the inlet line to an associated wash water tank. The prolonged use of a pump, as part of the exhaust gas stack wash procedure, would, in the presence of this blockage, lead to a steady build-up of liquid in the cyclone. It was estimated that approximately 35 tonnes of liquid and almost 4,25 tonnes solids had accumulated in the cyclone vessel prior to the incident. This, together with the weight of the cyclone itself, was sufficient to shear the supporting bolts.
This was the root cause of the incident.
[design or procedure error, plant / property / equipment]

Lessons

The report stated the following recommendations:
1. Install overload detection/alarm system
2. Implement procedures for response to "batch" operation to control the water inventory.
3. Modify the stack/cyclone drain lines so that they are independent of each other.
4. Several recommendations to address the basic reason for accumulation of blockages, and the prevailing "culture" in respect of response to responding to signs of blockage.

5045 11 July 1990

Source : PORT ARTHUR NEWS, 1990, 12 JUL.
Location : Beaumont; Texas, USA

Injured : 0 **Dead :** 0

Abstract

Lightning struck oil and water separator plant causing fire.
[separation, fire - consequence]

Lessons

[None Reported]

9908 30 January 1990

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

Over a weekend here were problems with an olefins waste water stripper. Oil was present on the surface of the API separator. This gave rise to hydrocarbon odours both on the plant site and in the neighbouring environment. Even when the plant was returning to normal operations the smell persisted. Complaints were received from local residents directly, and also on television interviews.
[gas / vapour release]

Lessons

The need for efficient contact with local organisations.

9991 09 January 1990

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

Abstract

During normal operations ENB (ethylidene norbornene) was inadvertently pumped from an API separator into a sewer system, causing a small (not severe) environmental odour incident.
[operation inadequate]

Lessons

Better controls are needed to prevent inadequate operation of interceptors.

4724 25 September 1989

Source : HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1989, NOV.; LLOYDS LIST, 1989, 28 SEP.
Location : Chemery, FRANCE

Injured : 0 **Dead :** 0

Abstract

An underground storage cavern holding natural gas sprang a leak releasing 5.2 million cubic feet per hour. Plugged 2 days later. Leak began during maintenance involving removal of filter 3600 ft underground.
[gas / vapour release]

Lessons

[None Reported]

8762 1989

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

Location : ,

Injured : 0 **Dead :** 0

Abstract

During the replacing of a water pumping filter in the gas injection part of an underground natural gas storage area, the control over a bar used for mounting the bottom packing of it was lost. The pressure of the gas forced the bar to be lifted by 25 m and, consequently, natural gas escaped from the central zone of the bar, initially at a flowrate of 100,000 150.000 m3/h at 100-120 bar, afterwards the internal and external emergency plans were activated (mainly police intervention to keep curious people away at a safe distance of 300 m was necessary). The release was stopped with the assistance of a specialised contractor called in by the manufacturer, who covered the escape source with sludge and brought the bar to its original position increasing the load on it. [maintenance, leak, spill, liquid liquid separation, distillation, gas / vapour release]

Lessons

[None Reported]

4388 19 December 1988

Source : HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1989, FEB.
Location : Krefeld, WEST GERMANY

Injured : 0 **Dead :** 0

Abstract

400 kg of chlorobenzene and dichloromethane leaked into a river through damaged filters.
[spill]

Lessons

[None Reported]

9985 November 1988

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

Abstract

A gas / vapour release occurred during the normal operation of a caustic soda scrubber on the cracked gas from an ethylene plant. The release occurred at a joint failure in the weld between a flange and pipework. This was attributed to stress caused by excessive vibration as a result of inadequate pipe support.

Lessons

[None Reported]

8069 01 September 1988

Source : ICHEME

Location : ,

Injured : 16 **Dead :** 0

Abstract

More than 16 people were affected by a release of about 250 litres of hydrofluoric acid/butane mixture from a passing drain valve.
The incident occurred during the start-up of an acid regenerator after a maintenance shutdown for minor repairs to the regenerator and depropaniser.
As soon as acid and isobutane were fed to the acid regenerator there was a leakage via a passing drain valve on the bottom of the relief gas scrubber into the open drain.
Shortly afterwards there was a high level alarm on the scrubber (two manual valving errors had resulted in the acid/isobutane feed to the regenerator being misdirected to the scrubber) and the startup was suspended.
The operators then decided to drain the scrubber (normal practice) and at this point discovered the passing drain valve. When the drain valve was cracked open the quantity of butane/acid released was greater than expected. The operator then had difficulty closing the valve fully using the valve spanner, after consulting his supervisor he used a 0.9 metre cheater bar for increased leverage/easier access and at this point the valve yolk sleeve failed allowing the valve to open resulting in a large uncontrolled release via the open drain.
Fortunately the operator had put a water hose in the drain while investigating the original source of the leak which probably washed most of the HF (hydrofluoric acid) down the drain and the release was further controlled by fire monitors, nevertheless, the HF concentration 500m downwind was estimated to be 5mg/m (UK recommended short term 10 minute exposure limit). The vapour cloud was estimated to be 10m high and 20m wide as it passed the bitumen blowing unit hot oil furnace (about 100m from the source) but did not ignite.
The causes of the incident can be listed as follows:
1. The drain line from the scrubber was discharged into an open drain.
2. The scrubber contained large amounts of HF/butane due to incorrect valving during startup.
3. The failure of the drain valve arose because of the valve design defect but also the use of a cheater bar to overcome difficulties in closing the valve (cause of valve operating difficulty not known).
[valve failure, gas / vapour release]

Lessons

1. Revise the acid regenerator startup and shutdown procedures differentiate between shutdown to depressure the regenerator and shutdowns to merely take the regenerator off line.
2. Revise the depropaniser startup and shutdown procedures to clarify what level of shutdown is intended for the acid regenerator.
3. Produce loose-leaf startup and shutdown procedures for the acid regenerator with provision for signing off each step.
4. The acid gas scrubber should be modified to provide an operable closed drainage system to the neutralising pit.
5. Alkylation Unit personnel should be advised of the need for correct clothing at all times.
6. Emergency procedures should be reviewed to ensure that sources of ignition are extinguished in the event of a gas leak.

4265 26 August 1988

Source : HEMPSEED J W, ORMSBY R W, EXPLOSION WITHIN A HELIUM PURIFIER, PLANT OPERATIONS PROGRESS, 1991, 10, (3), JUL., 184-187.
Location : , BELGIUM

Injured : 0 **Dead :** 0

Abstract

A cryogenic charcoal adsorber used to purify helium for cylinder filling suffered an explosion. The feed gas contained only 1.4 percent, calculations confirm that a liquid phase containing approximately 85 percent oxygen could have formed at the inlet to the bed and soaked into the charcoal. This explosive mixture was probably ignited by the flow surge when the bed depressurized to allow change over from a full to an empty bank of cylinders.
Parts of the vessel were recovered up to 250 metres from the installation and windows were cracked by the shock wave at approximately 60 metres.
[unwanted chemical reaction, purification, cryogenic purifier, adsorption, separation]

Lessons

Other adsorbents, such as silica gel, can be substituted for carbon which can make the system more inherently safe.
Incorporation of a condenser/separator prior to the adsorber unit to ensure that condensed air is separated and removed prior to adsorption.
An in-line filter and sump arrangement to collect frozen liquid oil droplets and allow blowdown prior to entering the condenser/separator.
More rigorous hardware and procedural requirements for inlet gas stream impurity analysis.
Less pressure differential between bed operating pressures and settings of the back pressure valves to reduce any effects of bed depressurization.
Increased preventive maintenance procedures for the oil removal systems to minimize any potential of oil carryover into the bed.
Use of hot nitrogen purge through the adsorbent bed during the reactivation cycle.

1072420 August 1988

Source : ICHEME
Location : , UK

Injured : 2 **Dead :** 0

Abstract

Two employees were splashed by hot dimethyl isophthalate after a vessel sight glass in the plant treatment area cracked and were treated for burns. Both men wore safety glasses which prevented more serious injury. All three emergency services were quickly in attendance and the plant temporarily shutdown.
Possible causes include:
1. Inherent susceptibility of a gauge glass in this location - a glass fractured in a sightglass in this position in 1985 which was caused by stressing due to overtightening.
2. Earlier in the month, the sightglass was found to be leaking and the inner gaskets were replaced. The glass and/or sightglass may have been damaged at this time.
3. The sightglass was rated for 150 psig. It seems unlikely that non-shock pressure in excess of the rated pressure could have occurred. However, the possibility of 'hammer' occurring when the valve on the line to the filter inlet was opened was investigated.
[processing, plant shutdown, damage to equipment, injury]

Lessons

The following recommendations were made:
1. Removal of the damaged sightglass and blanking off the resulting open ends, a test to determine the rise in pressure caused by thermal expansion should be carried out, material should be blown from pipework and the filter into the vessel, material should be transferred to s stainless steel stoolpiece used to replace the sightglass.
2. The following items should be inspected: the pressure regulator, relief valve and non-return valve on the air supply to the line below the sightglass, the pump non-return valve and the vessel should be inspected for signs of debris.
3. The need for sightglasses in this system should be re-examined. The possible causes of failure should be further investigated and discussions held with suppliers and company specialists. Recommendations should then be made as to whether and under what conditions sightglasses may be used. Prior to this being done, the system should only be put back into service if both sightglasses (i.e. below the vessel and on the filter outlet line) are replaced with stainless steel spoolpieces.

9905 20 August 1988

Source : ICHEME

Location : ,

Injured : 2 **Dead :** 0

Abstract

A sightglass failed in a line between a reactor and a filter, spraying two operatives with dimethyl isophthalate (DMIP) at 120-140 degrees C. DMIP is a plasticiser which melts at 65 degrees C, and was being manufactured. It had been transferred to the reactor, for neutralising with alkali and vacuum drying, before being pumped to the filter to remove salts. The procedure was that after pumping, the line was blown clear with air at 3.5 barg. For this the valve at the base of the reactor was closed, the pump was stopped, and the compressed air introduced immediately after the sightglass which was below the reactor. The sightglass did not clear, indicating line blockage. The Plant Superintendent then moved away to operate valves in order to bypass the filter, which allowed the line to clear. He was in process of operating the valves again, to return them to their original settings, when he heard a bang. the sightglass had failed, spraying two operatives with hot (120 degrees C) DMIP.

Subsequent investigations showed that the sightglass, of toughened sodaglass, had probably failed at its centre. The diameter of the sightglass was 12.5 cm and its thickness was 10 mm. It was operating at less than its design pressure and temperature, and within the permitted limits of thermal shock. No clear mechanism for the failure was determined.

[safety equipment failure, reactors and reaction equipment, material transfer]

Lessons

The use of sightglasses was reviewed and they were eliminated wherever possible. The particular sightglass was not reinstated; as its function was to monitor liquid flow it was replaced with a flowmeter. Previous experience had shown that sightglasses were prone to premature failure, leading to total shattering of the glass and to, large and uncontrolled releases.

Where elimination is not possible improved methods should be considered. These include:

1. Protective screen in front of the sightglass.
2. Overdesign by rating to higher pressure and smaller ports.
3. Use of double sightglasses.
4. Use of integral glass/metal windows.
5. Replacement glasses to be stored in individual containers.
6. Details to be recorded in the plant register.

1019721 July 1988

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

On the morning of 21st July, a fitter assembled a filter stack and was applying compression to the stack when a loud crack occurred and compression was lost. The stack was dismantled and the weld attaching the top stub shaft to the filter shaft was found to have failed.
The stack consists of 3 support spiders and 28 filter plates with spacer rings fitted between plates. These were mounted on a 3 part shaft which was of welded construction and consisted of a bottom drive stub shaft, a hollow central filter shaft and a top stub shaft which had a lifting attachment hole. O-rings were fitted to give a seal between the filter elements, which after assembly on the shaft require to be compressed down. The two end stub shafts took the compression load through a collar welded to the bottom stub shaft and a compression ring, which was screw-fitted to the top stub shaft.
The weld fracture was visually inspected and two important factors were noted.
1. The machined weld prep. was 4.4mm deep and not the 8mm design depth.
2. The weld was not penetrated to the root of the weld prep.
The failure occurred because the weld in its original as supplied condition was not prepared as shown in the original specification and as a consequence bridged rather than penetrated to the root of the prep.
[maintenance, damage to equipment, filter, material of construction failure]

Lessons

1. All company users of this type of equipment were informed.
2. All shaft welds of this type were inspected using N.D.T. techniques to confirm their integrity.
3. This incident was given extensive publicity in the company. 4. There may have been many instances in which equipment was lifted and where loads were transmitted by welds which had not been inspected to an adequate standard and for which records were not available.

4163 12 May 1988

Source : HAZARDOUS CARGO BULLETIN INCIDENT LOG, 1988, JUL,; LLOYDS LIST, 1988, 8 JUNE.
Location : Cleveland; Ohio, USA

Injured : 9 **Dead :** 1

Abstract

An explosion and fire occurred on a metal-processing plant due to a rooftop dust collection system which exploded, sending shards of flaming metal throughout the storage and grinding area below.
The plant processes highly toxic and explosive metal powders into metal briquettes for use by the steel industry.
[dust explosion, filter, fire - consequence, fatality]

Lessons

[None Reported]

4147 18 April 1988

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

An explosion of ammonia/hydrogen separator due to metallurgical problem.
[reaction vessel, material of construction failure]

Lessons

[None Reported]

8772 1988

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

Location : ,

Injured : 0 **Dead :** 0

Abstract

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

Lessons

[None Reported]

8741 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

Due to a defective connection on the suction line of a pump, several tonnes of gaseous hydrocarbons escaped. The cloud ignited at a distance of about 50 m from the leakage source. An attempt to isolate the system failed. The pipeline between the pump and the gas column separator was isolated to avoid fire propagation to other installations, but the jet fire was not extinguished in order to avoid explosive cloud formation. After this accident, the following measures have been established to prevent similar accidents to occur in the future periodic leak test of critical flanges, training of maintenance personnel in assembling these flanges.
[explosion, fire - consequence, training inadequate, operator error, refining]

Lessons

[None Reported]

7526 1988

Source : LOSS PREVENTION BULLETIN, 124, 4-5.
Location : ,

Injured : 0 **Dead :** 1

Abstract

A gas scrubber on an onshore plant was being recommissioned after being out of service for the fitting of a new 'O' ring seal, and was being repressurised in stages. It had been taken up to 20 N/mm2, being held at 5 N/mm2 and 10 N/mm2 while being checked for leaks, and had been at this pressure for a few minutes when the closure door was expelled resulting in the rapid depressurisation of the vessel from 20 N/mm2, this resulted in fatal injuries to an operator. The closure door was torn from its hinges and this, together with other debris, was projected across the site, the door coming to rest approximately 70 metres from the scrubber. Other debris was scattered over an area up to a maximum distance of 160 metres.
Extensive damage was caused to a water bath heater, and secondary filter vessel on either side of the scrubber, and shock damage occurred on the primary filter base supports and connecting pipework. Severe impact damage was caused to instruments, impulse pipework and electrical fittings. Fatality.
[commissioning, damage to equipment]

Lessons

The following recommendations were made:
1. All 'tube turn' closure nut pockets should be inspected for weld cracking.
2. Where nut pockets are considered poorly constructed or if nuts are a slack fit, the pockets should be replaced by carefully designed (preferably forged) pockets.
3. All `tube turn' closures should be checked to ensure that the head and hub flange radii do not contact the yoke radii. This can be checked by opening the closures, cleaning thoroughly, applying engineers blue, making up the closures and finally opening for inspection. If there is contact between the yoke radii and the head and/or hub flange radii, then the yokes should be removed and the radii machined back.

4065 1988

Source : CANADIAN OCCUPATIONAL HEALTH AND SAFETY NEWS, 1988, 4 APR.
Location : Calgary, CANADA

Injured : 0 **Dead :** 2

Abstract

Release of sour gas while taking routine water sample from inlet separator. The separator collects the corrosion inhibitors used to protect the pipeline walls. The operators were not wearing the required breathing apparatus. Fatality.
[asphyxiation]

Lessons

[None Reported]

8746 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 a period in which the plant was out of operation upon a request of the authority, a certain quantity of an aqueous ammonia solution flowed in the water drain network of the establishment and through it to a nearby river. The overflow came from a tank collecting ammonia from an amination plant. The overflow was caused by the malfunction of a valve feeding the scrubber, which treats releases from the safety valves of the amination autoclaves with water. The high level in the tank caused an alarm to ring. The valve was closed two hours later. Ammonia levels of 25 mg/l. (maximum 70 mg/l) were measured in the effluent of the plant (maximum allowable value 15 mg/l).
[valve failure, spill, processing]

Lessons

Following this accident, it has been established that overflow from this tank will be routed to the biological waste water treatment unit.

4060 1988

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

Abstract

A fire occurred involving an aluminium smelting furnace and a rectifier. Source of ignition was electrical.

Lessons

[None Reported]

1018601 November 1987

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

A fire occurred in and around the hot loop separator of the acrylates distillation unit. Prior to the fire, the unit had been processing a liquid monomer, HEMA (hydroxy ethyl methacrylate). Being a monomer, this liquid has the propensity to polymerise and in doing so form a solid. The formation of this solid in the separator is the most frequent cause of process failure. The day before, the process failed due to a bulk polymerisation in the separator. The unit was left drained and vented overnight.

The separator lid was removed the day after and it was commented that the separator was remarkably fume free. The inside of the vessel was inspected and some large lumps of polymer were removed from the top and placed on the open grid flooring adjacent. The fumes were quite bad by this time. An air hose was introduced to disperse the fumes. To effectively clear such a polymer build-up, a process operator returned to the acrylates structure to start water washing 20 minutes later. Fires on the lower floors were spotted (caused by falling burning debris or polymer igniting the cable trays and other material) and extinguished and the fire alarm was raised. The operator reached the top floor and flames were rising to a height of 2-3 feet from the separator.

[distillation, separator, fire - consequence, spontaneous combustion, polymerisation]

Lessons

Since a fitter is required in order to remove any item of plant, water flushing can only be carried out when maintenance personnel are available. The polymer may then be left in the separator at elevated temperatures for a prolonged period before the separator lid is removed. HEMA polymer now removed from the separator is then still hot and may still be reactive.

Putting large lumps of hot polymer onto the open grating must be regarded as placing the material in a 'forced draught' since the structure is largely open with only the top floor enclosed. The introduction of an air hose must also be considered 'forced draught'. Both locations experienced similar conditions - hot hydrocarbon exposed to excessive fresh oxygen supply which must be regarded as hazardous.

It is the opinion of the incident investigation team that the hot HEMA polymer exposed to a forced draught had spontaneously ignited. The following was recommended:

1. A detailed operating procedure for removal of polymer must be devised and adhered to i.e. copious water dousing, breaking down large growths into small lumps, polymer removal in sealed containers, complete isolation from ventilated environments.
2. Other divisions should be made aware of the incident
3. Further laboratory investigation should be undertaken to gather appropriate data and to assist in understanding the mechanisms of the incident.
4. Mechanical inspection of the separator should be undertaken following six months of operation
5. Re-iteration of the emergency procedures should be undertaken with the site fire teams in the light of experience gained from this incident.
6. The importance of good housekeeping must be made plain to the production and project departments with respect to contract labour.

3931 19 June 1987

Source : ICHEME

Location : Jubail, SAUDI ARABIA

Injured : 0 **Dead :** 0

Abstract

A fire occurred on a separator at a petrochemical ethylene plant.
[fire - consequence]

Lessons

[None Reported]

1243601 May 1987

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

Abstract

Contaminated water spilled into a batch of vacuum filters after an operator hosed down a grated floor.
The operator was stopped and the filters were covered with plastic sheets. The batch was washed and then scrapped for safety reasons.
[contamination, operator error, cleaning]

Lessons

[None Reported]

3874 18 March 1987

Source : LLOYDS LIST, 1987, 19 MAR.
Location : Lucas Heights; Sydney, AUSTRALIA

Injured : 0 **Dead :** 0

Abstract

A fire occurred in a nuclear research laboratory in an area used to process medical isotopes. The fire started in a charcoal filter and resulted in the release of a small amount of radioactive material into the atmosphere.
[fire - consequence, radioactive release, pollution, laboratory work, radioactive isotopes]

Lessons

[None Reported]

3873 15 March 1987

Source : LLOYDS LIST, 1987, 15 MAR,; DUST EXPLOSIONS IN THE PROCESS INDUSTRIES. ECKHOFF.
Location : Harbinin, CHINA

Injured : 183 **Dead :** 58

Abstract

An explosion of flax dust occurred in a linen textile plant.
13,000 square metres of factory buildings were destroyed.
The incident occurred when a chain of explosions touched off in the system of dust collectors. The system included 1000 m tube in all and 17 dust collectors with cloth filters which had a volume flow of 448,000 cubic metres per hour, the dust volume in the system reached 1300 - 1900 kg a day. A great quantity of fluffy flax fibre in the carding process also ignited and then propagated like a relay race in the explosion.
Because the scene of the accident was destroyed by the explosion, substantial evidence of the initial source cannot be obtained.
Although, among the possible ignitions, electrostatic seemed most likely, friction and sparks were also possible.
[fire - consequence, damage to equipment, solids processing equipment, fatality, dust explosion]

Lessons

This serious disaster exposes the difficulties of searching for the cause as it was affected by the emergency response and the loss of witnesses. However the explosion demonstrates the consequences of poor housekeeping in industrial plants where fine dust can cause serious loss of life.

7263 17 February 1987

Source : LOSS PREVENTION BULLETIN, 080, 21.

Location : ,

Injured : 0 **Dead :** 0

Abstract

Two contractors were working inside the skirt of a butadiene plant distillation column. They were installing a clamp on a leaking process line flange. An entry permit had been issued and the men were wearing breathing apparatus supplied by a works trolley set.

The men came out of the confined space claiming that they were receiving an inadequate air supply. A replacement set was supplied and on this occasion the reduction in air supply occurred suddenly, such that the air masks had to be removed and evacuation took place immediately. The job was completed satisfactorily using a further trolley set.

After investigation the findings were as follows:

1. The sintered metal air filters in the air pressure regulators were blocked with debris, consisting of metal filings from the component fittings and slivers of teflon tape used on the component threads.

2. The filters were clearly old and appeared to be partially blocked with fine dust. There was no procedure for regular, periodic changing of the filters. Similarly there was no procedure for checking the air flow using a rotameter on each occasion prior to issue.

As a result of this incident, procedures have been revised to ensure that the filters are changed annually and that proper records are maintained. Also to insure that a rotameter test is carried out on each occasion prior to issue of the equipment and the result recorded in as issue book.

[entry into confined space, maintenance, flange leak, testing inadequate]

Lessons

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

8008 08 January 1987

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

Abstract

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

Lessons

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

13126January 1987

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

Large quantities of hydrochloric acid vapors are generated when a batch of copper phthalocyanine and chlorosulphonic acid is heated up in a 6300 1itre reaction kettle. This gas is piped into a scrubber which is located close to the kettle. Suddenly, large quantities of the hydrochloric acid gas were released into the production building through a crack in the glass pipe near the inlet of the scrubber.
Cause:
The crack in the laminated glass pipe may have been caused by repair and maintenance work or by vibrations.
[gas / vapour release, processing]

Lessons

The following recommendations were made:

1. Installation of the glass pipe with vibration dampers.
2. Programmed inspection of glass pipes (safety maintenance and control programs).
3. In case of a gas release, if possible, disposal of the gas and vapors via the ventilation and scrubbing system of the building (windows to be kept closed).

1889 1987

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

Location : ,

Injured : 0 **Dead :** 0

Abstract

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

Lessons

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

9718 04 September 1986

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

An explosion occurred within an electrical motor associated with an ethanol plant main gas scrubber. There were no injuries to personnel, but the force of the explosion detached one of the cooling exchangers and projected it a distance of 10-12 feet. The cause was inadequate lubrication of the NDE (non drive) end bearing of the motor in a probable sequence as follows:
1. Due to an over right in lubrication schedules, the motor oil level deteriorated to the extent that the NDE bearing assembly itself deteriorated (due to under lubrication).
2. This led to damage to the motor shaft sleeve (cracked welds).
3. Lubricating oil flowed through these cracks to the hot sleeve, oil possibly exceeded its flash point.
4. The oil was dispersed as a mist by the fan.
5. Metal NDE assembly parts reached a temperature high enough to ignite the hot oil mist.
6. The motor contained to run until the NDE bearing seized and tripped the pump on electrical overload.
[maintenance inadequate, damage to equipment]

Lessons

The main recommendation was to review lubrication schedules for electrical equipment and procedures for their implementation, right across the factory.
In addition, further safeguards against the possibility of lubrication failure, extending to installation of an alternative design of motor, if necessary, were recommended for consideration.

3644 16 June 1986

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

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

Lessons

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

3643 15 June 1986

Source : LOSS PREVENTION BULLETIN, 099, 14; EVENING SUN BALTIMORE. 1986, 16 JUN.
Location : Pascagoula; Mississippi, USA

Injured : 0 **Dead :** 0

Abstract

A batch still used to separate aniline product from its reaction by-products was shut-down on a Saturday due to a leak on the bonnet of a valve on the discharge side of a steam-heater reboiler. The reboiler served the still and its feed drum. Since repairs were not to be made until Monday, the circulating feed pump was shut down and valves were closed to isolate the reboiler, the steam supply to the reboiler, and the leaking valve. Cooling water to the condenser and operation of the reflux pump continued for several hours to lower the temperatures on the tower to a satisfactory level.
About eight and a half hours later, operators observed a high level in the reflux drum and high temperature at the bottom of the idle still. During the next hour, operators attempted to reduce these levels and temperatures but for unknown reasons, pressures increased. A relief valve at the top of the tower lifted, a vent at the reflux accumulator released liquids, and the tower bottom temperature went to 550 degrees F. Shortly after the area was evacuated, several explosions were heard. The explosions, the cause of which have not yet been determined, damaged structures and broke piping in an adjoining nitration unit. Flying fragments punctured two 2,000 barrel atmospheric tanks and a 15,000 gallon pressure tank which contributed fuel to a large ground fire. The still and its feed drum were destroyed, making the investigation into the cause of this accident most difficult.
[separation, high temperature, damage to equipment]

Lessons

[None Reported]

1145708 March 1986

Source : THE SCOTSMAN, 10 MAR, 1986.
Location : Edinburgh, SCOTLAND

Injured : 2 **Dead :** 0

Abstract

Two men were injured when a solvent still exploded at a chemical works. A wall and roof were damaged, as was a pipe, at the formaldehyde plant.
Police cordoned off the area and firemen, wearing chemical suits, tackled the fire. Local residents were evacuated from their homes, half a mile away. It was reported that noxious fumes were released after the explosion.
[gas / vapour release, damage to equipment, evacuation, processing, distillation, injury]

Lessons

[None Reported]

3510 14 January 1986

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

Abstract

A fire occurred involving a precipitator at a refineryFluid Catalytic Cracker Unit (FCCU) plant.
[fire - consequence, refining, fluid cracker]

Lessons

[None Reported]

126811986

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

Injured : - **Dead :** 0

Abstract

Oleum fumes were released during loading of a tank. The incident occurred when the operator left his post allowing the material to overflow into a fume scrubber. The scrubber circulation tank eventually overflowed into a bund, causing dense fuming. Several members of the public were affected.
[operator error, gas / vapour release]

Lessons

[None Reported]

126821986

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

Injured : - **Dead :** 0

Abstract

Several people were affected by hydrochloric acid that leaked from a chemical plant. The leak occurred when an air-lock blocked the flow of water to a scrubber, despite instrument readings.
[flow restriction, gas / vapour release]

Lessons

Improved instrumentation, automatic back-up water supply and reactor shut-down controls have since been installed.

123151986

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

Abstract

A fire occurred during cleaning of a suction filter. The incident occurred when the suction filter was opened and was found that the inlet valve to the filter was blocked with material. Attempts were then made to unblock the valve during which the blockage came loose causing hydrocarbons to be released, as the inlet valve was not fully closed.
The consequent gas cloud ignited, the fire flashed back and the area was engulfed in flames. One worker was killed and several others seriously injured.
[fire - consequence, flow restriction, gas / vapour release, leak, fatality, injury]

Lessons

[None Reported]

3425 17 October 1985

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

A fire occurred on a centrifuge on a production plant.
[fire - consequence]

Lessons

[None Reported]

3365 August 1985

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

A fire occurred on a precipitator at a fertiliser plant.
[fire - consequence]

Lessons

[None Reported]

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.

3205 16 January 1985

Source : COMMUNITY DOCUMENTATION CENTRE ON INDUSTRIAL RISK, REVIEW OF ENVIRONMENTAL ACCIDENTS AND INCIDENTS, INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS & THE COMMISSION OF THE EUROPEAN COMMUNITIES JOINT RESEACH CENTRE, 1992, ISBN 92 826 3535 X.

Location : Portland; Oregon, USA

Injured : 0 **Dead :** 0

Abstract

Malfunction of a separator pond led to release of waste oil to lake and wetlands.
[pollution]

Lessons

[None Reported]

8735 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 the regeneration of an active coal filter by means of air, a chlorine-iron fire occurred when chlorine was reloaded. Emergency plant shutdown followed. [fire - consequence, gas / vapour release, plant shutdown, processing]

Lessons

[None Reported]

3162 13 December 1984

Source : LOSS PREVENTION BULLETIN, 099, 5.
Location : Amuay, VENEZUELA

Injured : 0 **Dead :** 0

Abstract

A straight run of 8 inch line carrying hot oil from the high pressure separator to the low pressure stripper in a refinery hydrodesulphuriser fractured circumferentially in the parent metal in the heat zone about 1.5 inches from a weld. Hot oil at 700 psi and 650 F sprayed across the roadway into the hydrogen unit where ignition occurred. Intense fire around the pipeway in the hydrogen plant caused a 16 inch gas line to rupture adding a second blow torch to the fire. More pipes ruptured.
[fire - consequence, refining, oil - hot]

Lessons

[None Reported]

4310 09 February 1983

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

Abstract

A fire occurred in the area of the suction filters of the visbreaker quench and bottoms pumps. There was no injury to personnel and damage to plant was restricted mainly to cabling.
Whilst attempting to drain visbroken residue from an isolated quench circulation pump filter, a plugged drain line suddenly released and the oil ignited. The ensuing flames prevented access to an elevated platform to close the drain valve. Consequently, it was necessary to shutdown the visbreaker and the nearby VDU and Fluid Catalytic Cracker Unit (FCCU).
[fire - consequence, processing]

Lessons

[None Reported]

1004101 January 1983

Source : ICHEME,; SAFETY AND HEALTH IN MARKETING, JAN-MARCH, 1983.
Location : , GREECE

Injured : 0 **Dead :** 1

Abstract

A centrifugal separator, which formed part of the factory's central grease lubrication system, had broken down and the maintenance personnel were looking for a suspected leak. A pipe section, approximately 1 metre long, which ran through the closed separator vessel, could not be inspected unless a hole was cut in the pipe wall, 5 mm thick.
A welder was instructed to cut out a plate using an oxy-acetylene torch. After working for a few minutes a violent explosion occurred and the welder was crushed between the plate he was in the process of cutting and the separator wall.
Several pounds of grease were found to have accumulated in the pipe. The heat of the torch vaporised the heavy oil in the grease which built up to a flammable concentration and then exploded, fatally injuring the welder.
[welding, grease, explosion, fatality, cleaning procedure incorrect, inadequate procedure, centrifuge, separator]

Lessons

The of heating even small amounts of heavy hydrocarbons can give off large amounts of vapour which on mixing with air can become explosive. Under these circumstances heavy products can be even more hazardous than light products such as motor spirit because heavy oils do not reveal their presence under explosimeter tests and this can result in a false sense of security. If surfaces which are to be heated cannot be cleaned thoroughly then the heating should be carried out under a continuous purge.

9194 January 1983

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

Abstract

An autoclave had a its screwdown block valves replaced with five ball valves to improve reliability and ease of use. The ball valve needed to sustain 5000 psi. Of the five valves attached to the autoclave four were in the red and green lines and subject to system pressure. They did not fail. The fifth was in larger pipework (1.1/16 inch OD) of the quick release line and down stream of the normal quick release valve. It was left open at the time of the failure and quick release of the autoclave was initiated with the normal valve. Thus, apart from the considerable pressure drop in the pipe itself, the ball valve was not subjected to pressure at the time.
The break did not occur in the main valve body, but in a gland which provided for assembly and pre-loading of the seal. The gland contained the connecting pipe and seal with its internal 0.5 inch BSP female thread and screwed into the valve body with its larger male thread. Sealing with the main body was effected by O ring under the shoulder of the gland hexagon. A fracture was present in a conical shape, between the inner and outer threads of the gland.
Research revealed that the gland was made of weak, free-cutting mild steel and weakened further by bad machining of the threads.
[centrifuging, centrifuge, valve failure, damage to equipment, material of construction failure]

Lessons

[None Reported]

1001016 November 1982

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

Start-up was underway following a 3 week turnaround. Water batching was in progress and the initial water charge had been processed through an autoclave, through the crystalliser, and was in the filter tank. The next step was to transfer the water batch under pressure from the filter tank to the ammonia still. The operator began heating the water batch and when the temperature reached 150 degrees C, he lined up the correct valves to the ammonia still and steamed the line. He then applied the customary 110 psig steam pad to the filter tank and began transfer. All conditions were apparently normal. Approximately ten minutes into the transfer, the ammonia still ruptured, spraying hot water and steam from a vertical crack in the sidewall of the vessel. The crack extended from the bottom dish to the top head and was approximately 6 inch wide at the middle of the tank. It was found later that the pressure was 20 psig and the temperature was 118 degrees C, and that the rupture disc was found to be intact.
The cause of the rupture, which was at well below normal operating pressure, was due to corrosion of the steel tank sidewalls. This had occurred when the brick lining had become cracked and the corrosive liquid was able to seep through to the metal.
[ammonia, corrosion, inspection inadequate, rupture, still, material transfer, low pressure]

Lessons

The following recommendations included:
1. The method for evaluating the condition of brick lined vessels in pressure service should be improved and include an accurate assessment of the substrate steel thickness and strength.
2. Consideration should be given to replacing these vessels with alloy metals.

9308 10 August 1982

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A fire occurred in a styrene plant, in the immediate vicinity of the dehydrogenation mixture product pump, adjacent to the separator.
No injuries occurred as a result of the fire. It is estimated that a loss of containment of three and a half tones of hydrocarbon occurred, with fire damage mainly to electrical and instrument installations, costing in the order of £10,000 (1982). Prior to the incident the styrene plant was operating normally, except that the "A" train as under maintenance. The plant conditions were normal right up to the point of the incident occurring.
The cause of the fire was due to a major failure of the dehydrated mixture pump and most likely initiated of the pump failure bearing failure. The fire damage to the pump did not allow a definitive conclusion, however, it is thought that the source of ignition was either sparks arising from the seal housing retaining bolts striking the bearing housing retainer studs, or from fractional heat created by excessive wear between the pump shaft and pump stationary parts.
A flashback occurred in the adjacent process drain system, which did not cause damage.
[fire - consequence, damage to equipment, pump failure]

Lessons

The following recommendations were made:
1. Where a pump design includes bearing pedestal supports to be fitted.
2. On removal of rotating elements, pump alignment to be checked and recorded when the element is reinstated.
3. Routine vibration checking of all pumps to be carried out.
4. The practices of operators routinely checking pump bearing houses by feel for temperature and vibration to be encouraged.

9306 02 April 1982

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

Abstract

Sufficient acidic aqueous effluent was discharged from the styrene plant to turn the factory chemical effluent acidic. This resulted in the generation of hydrogen sulphide at the chemical effluent sump, in concentration up to 140 ppm. The effluent contains sodium sulphide from the oilefins plant caustic scrubbers.
[spill]

Lessons

[None Reported]

110191982

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

Sodium sulphide waste was being fed to the effluent in an alkaline solution and from there to an API separator. At the time of the incident, acidic aluminium chloride solution was also being fed to effluent during a shutdown of the styrene plant. The pH of the effluent fell from its normal level of 11-12 to 3-3.5, resulting in the release of hydrogen sulphide.
[gas / vapour release, process causes]

Lessons

The operating procedure to be amended to control more closely the addition of acidic waste to effluent.

122901982

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

An incident occurred due to temporary plant modification. The incident occurred when a temporary start-up filter was put in a compressor suction line. As it was unfortunately placed between the compressor inlet and the low suction pressure trip, this modification set up the possibility of an incident.
This initiated a decomposition reaction further on in the process. The resulting high pressure caused pipe joints to spring, the escaping gas ignited and the ensuing fire caused over £100,000 (1982) damage.
[modification procedures inadequate, leak, fire - consequence, maintenance]

Lessons

[None Reported]

9410 13 May 1981

Source : ICHEME
Location : , UK

Injured : 1 **Dead :** 0

Abstract

A contractor was assisted from a sand filter he had been inside emptying using a vacuum hose. He was taken to the medical centre arriving there in a state nearing collapse. He recovered in the centre and was taken home by one of his colleagues.
[entry into confined space, near miss]

Lessons

[None Reported]

9130 April 1981

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

Injured : 0 **Dead :** 0

Abstract

45 tonnes of highly radioactive waste was released which was caused by an open valve of a filter sludge tank.
[spill]

Lessons

[None Reported]

120151981

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

Abstract

An extensive fire occurred on the LPG recovery installation of a large refinery. It was caused by the ignition of a vapour cloud which had resulted from the escape of liquid butane during the draining of a caustic solution from a salt filter after a hydrogen sulphide scrubber vessel. A number of lines in the fire zone subsequently ruptured providing additional fuel. The successful application of fire fighting techniques prevented the fire from spreading and damage was limited to an area of 20 m by 20 m. the fire was brought under control within 50 minutes and final extinguishment 1 hour later. The cost of repair was $1.5 million (1981). The butane salt filter drum was 8.1 m3 in volume and contained liquid butane at 17 bar and ambient temperature. The drainage system from the base of the salt filter consisted of a 2 inch drain line containing two valves, a quick shut-off plug valve nearer to the drum and a throttling gate valve. The operator decided to drain the system by opening first the plug valve by turning it in an anti-clockwise direction and then the gate valve with a pipewrench as it was very stiff. No liquid came out and he assumed that it was blocked. He decided to isolate the system by first closing the plug valve. When he did this the drain line started to spray first caustic and then butane liquid. He jumped back and lost his pipewrench but tried to isolate the release by shutting the gate valve by hand without success. An intense fire developed about 50 metres high and the unit was shutdown.The fire also caused the rupture by expansion of the flare line 72 metres from the fire and a fuel gas producer line, both did not ignite but hydrogen sulphide was detected in the area. It was estimated that 25 tonnes of propane and 18 tonnes of butane had burnt.The investigation found that the plug valve on the drain line of the caustic butane salt filter drum had been incorrectly assembled. The plug valve had its gland stop knocks, which limit the turning of the plug from fully open to fully shut, had been reassembled in such a way that turning the plug in a clockwise direction would open the valve instead of closing it and vice versa. Thus the operator actually closed the plug valve then opened the gate valve and therefore got no flow. He then intended to close the plug valve and actually opened thus getting a flow of caustic and butane. [butane, propane, normal operations, filter, fire - consequence, valve failure, maintenance inadequate]

Lessons

1. The plug valve was incorrectly re-assembled.
2. The system was modified.
3. Plug valves were provided with the same standardised method of open/closed indication.

1020417 November 1980

Source : ICHEME
Location : Wales, UK

Injured : 0 **Dead :** 0

Abstract

An explosion occurred in a water skim tank associated with an ethyl benzene dehydrogenation reactor system. The reaction mixture from the reactors containing styrene, ethylbengene, bengene, tolunene, hydrogen, C02 and steam. Following separation in a "separator", the water layer containing entrained hydrocarbons and styrene polymers, passes to the skin tank where future separation of the two phases taken place. An emergency plant shutdown, due to partial electric power failure, was carried out and the explosion occurred about one hour later.
[reactors and reaction equipment, leak]

Lessons

It was concluded that air was drawn into the skim tank during the shut down. This formed a flammable mixture with the hydrocarbons and this was probably ignited frictional over heating of the neck bush on the tank's submerged pump shaft. The skim tank water level fell, creating a vaccum, and air was drawn in via an atmospheric vent. This could in fact, have happened at any time, since the tank is not nitrogen purged. The main recommendations were to prevent this reaming. These were:
1. Blanketing with insert gas
2. Preventing air ingress
3. Replacing of the submerged pump by an external pump
4. Installation of a panel mounted low skim tank level alarm
5. Automatic closure of the tank level control valve on air failure

1171817 May 1980

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A condenser on a chlorine still failed resulting in chlorine passing into the cooling water and a subsequent serious emission from the cooling water towers. The release lasted approx 1 hour and it is estimated that 2-3 tonnes of chlorine were released.
The plant was started up 14 days later and three days after that a second condenser also failed giving rise to another smaller chlorine emission via the cooling water towers.
Examination of both condensers showed that there had been a tube failure due to corrosion on the exterior of the tubes (water side). Corrosion was particularly noticeable in those areas corresponding to the bottom tube plate in contact with the water and the baffles. The corrosion is considered to be due to a build-up of sediment which absorbed the corrosion inhibitor in the water in contact with the tubes. The build up of sediment is attributed to the low velocity of the water in the condensers. The designed flow velocity for the condensers were well below those recommended in EPI CHE 115.
[gas / vapour release,

Lessons

1. Engineering procedures for the testing of shell and tube condensers on critical duty should be examined.
2. The cooling water flow through the duty condenser should be increased.
3. Cleaning procedures should be examined for vessels on critical duty prior to storage and at shut downs to prevent silt up.
4. Consideration should be given to installing chlorine analysers on chlorine absorption systems and cooling water towers as early warning of chlorine break-through

7127 May 1980

Source : LOSS PREVENTION BULLETIN, 037, 24-25.

Location : ,

Injured : 0 **Dead :** 0

Abstract

On the evening of the incident, large quantities of white powder were observed in the area of two lime silos. It was apparent that the chute along the bottom of the one of the silos had become detached due to the bolts along one side being sheared. The sloping side walls at the bottom of the silo had then bulged outwards and allowed some 30 tonnes of lime to spill to the ground.

The following conclusions were drawn after investigation of the incident:

1. The failure of the silo was most probably caused by the blockage of the filter bags which resulted in the build up of an internal pressure from the fluidising air. The failure may have been initiated by failure of the cross brace welds.
2. The silos were under-designed by present day standards and were not classed as pressure vessels at the time of the incident.
3. The silos were loaded above their design capacity of 30 tonnes and the method of assessing lime level was inaccurate.
4. The filter bags were difficult to clean and would block unless cleaned frequently.

[silo/hopper, high pressure]

Lessons

The following recommendations were made:

1. The silos to be re-designed to current standards and assessed as pressure vessels.
2. An improved filter system to be provided which includes equipment to monitor the efficiency of the filters.
3. A high level alarm to be fitted to prevent overloading.
4. Action to be taken to prevent unauthorised resetting of relief and reducing valves.

1976 01 February 1980

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

Abstract

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

Lessons

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

1132124 January 1980

Source : ICHEME
Location : , BELGIUM

Injured : 0 **Dead :** 0

Abstract

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

Lessons

[None Reported]

9978 28 September 1979

Source : ICHEME
Location : , BELGIUM

Injured : 1 **Dead :** 0

Abstract

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

Lessons

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

1201825 September 1979

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

Abstract

A caustic soda scrubbing vessel on an ethylene plant experienced foaming problems which caused the liquid level gauge to give false readings. To overcome the problem an experimental ultra sonic level detector was installed on the top of the balance column serving the normal liquid level gauge. To accommodate the 150 mm flange of the ultra sonic level detector a 150/100 mm adapter was attached to the top of the balance columl's 100 mm flange. To prevent contact between the product and the detector a full Teflon sheet was inserted between the 150 mm flange. Problems were encountered obtaining the "right tightness" resulting in a modified assembly comprising a smaller, recessed Teflon sheet attached to the sensor assembly with araldite. A further modification was then necessary which involved filling the whole cavity between the ultra sonic detector, it's enclosure and the Teflon sheet with resin. The latest modified assembly had been in service for just over one hour before the measurement head enclosure failed allowing product to leak. Failure was attributed to the action of caustic soda on the assembly.
[hydrocarbons, sodium hydroxide, scrubber, level detector, process control & instrumentation, design or procedure error, operation inadequate, spill]

Lessons

Compatibility studies should have been carried out beforehand to determine whether the material of the ultra sonic detector was fully compatible with caustic soda and hydrocarbons.

1054412 July 1979

Source : ICHEME
Location : , BELGIUM

Injured : 0 **Dead :** 0

Abstract

About two weeks after maintenance on a filter, a significant ethylene gas release occurred, which was not ignited. Although the filter unit had been brought back up to pressure after the maintenance, it had not been brought onto line in the process. The leak occurred when the filter during start-up, and was caused by a misaligned flange of a high pressure gas filter, combined with the partial degradation of the filter gasket. The gas cloud was dispersed within about one minute of the initial gas detector alarm, as a result of a total plant shut-down and the application of the plant sprinkler system in the effected area.
[start-up, filter, plant shutdown, flange failure, gasket failure, gas / vapour release]

Lessons

Following a detailed investigation the following lessons were relevant to the cause of the incident:
1. A procedure and check list for renewing the O-ring gasket and closing the filters has been written.
2. Equipment for ensuring that the gaskets do not exceed a hardness rating were provided
3. The manufacturers of the filters reconsidered their recommended material specification for the O-ring gaskets for this particular process condition.

1076719 June 1979

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

A number of incidents of caustic stress corrosion cracking of 321 type stainless steel, on a pilot plant preheater. The upstream scrubber used 5% caustic soda solution to remove hydrogen sulphide from a hydrogen recycle stream. A large leak of hydrogen and oil vapour occurred into the laboratory, which fortunately did not ignite.
[scrubber, sodium hydroxide, gas / vapour release]

Lessons

For stress corrosion cracking to occur with 300 series stainless steels, all three conditions below must be present:
1. Temperature above 300 degree C.
2. NaOH concentration above 4g/l.
3. Total surface stress above 100 N/mm2.

1833 05 March 1979

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

Abstract

A fire occurred in a refinery xylene plant involving a centrifuge and lube oil. Cause: mechanical equipment failure. Source of ignition was hot surface.
[fire - consequence, refining]

Lessons

[None Reported]

9380 06 December 1978

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

Abstract

An incident occurred on an ethanol plant. Acid sweeping from a reactor bed was so corroded, the product line from the flash separator drum that the line failed.
[reactors and reaction equipment, corrosion]

Lessons

[None Reported]

9476 10 August 1978

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

Abstract

A fire occurred in the bag filter of a phenolic resin plant. There was extensive damage to the filter and auxiliary equipment, fortunately there were no injuries.
The plant was down for eight days during which a fire suppressant system was installed.
The probable cause of the fire was self ignition of product.
[fire - consequence, processing, plant shutdown, solids processing equipment, exothermic reaction]

Lessons

1. The temperatures recorded in the bag filter were above the level at which an exotherm could occur in the dust.
2. Fire suppressant systems are required in these conditions.

1203312 December 1977

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

Abstract

The Dewaxing Unit involved in this incident used dichloroethane - methylene chloride (Deem) for dewaxing, with three rotary drum filters for wax recovery. The filter area for each filter is 60m 2, with pressure tight filters hoods, which are maintained at a low constant pressure by a balance line connected to the gas holder.
The unit was shut down from the 9th to the 12th December 1977 principally for work on the electric motor of the propane compressor, but at the same time partially blocked spray nozzles in filter 'Y' were replaced.
At 06.30hr on the 12th December the start-up of the unit commenced, using only two of the three filters, namely 'X' and 'Z'. At about 07.00hr two of the available four filter gas compressors were commissioned to provide a vacuum in the main filtrate and wash filtrate accumulators, and also compressed filter gas for cake-removal in the filters.
Shortly after starting the filter gas compressors, the hood of the filter not in commission, 'Y', collapsed suffering extensive damage.
An immediate check on the prevailing process conditions revealed that the 6 inch valve in the main filtrate line to 'Y' was open whereas all other main valves to 'Y' were closed. Therefore the filter 'Y' was not completely isolated as was assumed on commissioning filters 'X' and 'Z'. This valve was probably overlooked on preparing the filter for handover to the maintenance department at the shutdown. With the open filtrate valve, and the filter cloth in filter 'Y' free of cake and offering no resistance, a vacuum of 0.4 bar abs. resulted in the filter hood causing it to implode. If the 6 inch valve in the balance line to the gas holder had been opened before the filtrate valve, as is the correct normal procedure, then the vacuum condition would not have arisen.
The filter hoods are each equipped with an atmospheric liquid seal (U-tube containing a low viscosity dewaxed oil) to safeguard against overpressure. The seal offers by virtue of its construction, no protection against the high vacuum condition. Should a vacuum arise in the filter hood, the hinged lid on the atmospheric leg remains closed preventing ingress of air.
The design pressure conditions for the hood are, normal operation 50 mm WG, maximum 150 mm WG, test pressure with air equivalent to 200 mm WG. The seal as well as offering no protection against vacuum condition is in all probability undersized for pressure conditions in that the seal diameter is only 80 mm compared with the 150 mm of the balance line. It was found that the filters on the No.1 Dewaxing Unit were of the same type. The cost of fabricating a new hood utilising existing end walls and base frame, resheeting the filter, and installing the hood amounted to about 100,000 DM, and in addition throughput was limited to 80% for a period of 10 days.
[separation, filter, seal, overpressurisation, operation inadequate, implosion, damage to equipment]

Lessons

Measures taken to prevent repetition:
1. The hinged lids on the atmospheric legs of the filter U-seals in both dewaxing units have been removed.
2. The operating instructions for starting up and shutting down filters have been supplemented with an instruction giving particular reference to the inherent danger of implosion and stressing the proper sequence of valve operation.
3. Provisionally the U-seals have been modified to limit the amount of seal liquid that can be introduced and thereby protecting the filter hoods at pressure/vacuum in excess of about 300 mm WG.
4. The refinery is seeking an optimum technical solution to give the filters adequate protection against the occurrence of unduly high pressure/vacuum. Ideally the overpressure device should relieve to a closed system to avoid polluting the atmosphere in the filter building with solvent vapours. This could well mean that separate devices will be used to cater for pressure and vacuum conditions.
Most refineries with dewaxing plants, will have seals on their filters of a type which give protection both against pressure and vacuum. The various points raised by this incident should be carefully considered by each refinery.
The use of a plastic sight glass for these dewaxing units using a flammable solvent for dewaxing, e.g. MEK/Toluene is not appropriate, although this is acceptable on the Di-Me type unit.

1411 July 1977

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

Abstract

Thirty tonnes of HDPE, high density polyethylene, were being transferred from a double cone mixer to a 100 cum (cubic metres), 50 tonnes storage bin or silo. 10 minutes later there was an explosion which destroyed 2 silos and a vent bag filter. Parts of the silos were blown several hundred yards and into an adjacent factory. Ignition thought to be in bag filter and possibly caused by static. Dust explosion.
[silo/hopper, material transfer, damage to equipment]

Lessons

[None Reported]

1005724 February 1977

Source : ICHEME

Location : ,

Injured : 1 **Dead :** 0

Abstract

An operator had completed mechanical cleaning of a soiled filter in the charging dome of a paddle drier and was flushing it with cold water which ran down into the drier. When he loosened the cover of the dome, the cover was lifted approximately 60 cm by internal pressure and the operator sustained first degree burns in his face by escaping steam.

Prior to the cleaning operation, the steam heating of the drier had been switched off, but its contents were still at a temperature of approximately 140 degrees C. Thus the incoming flushing water was vaporised immediately.

[high pressure]

Lessons

For changing filters, the same safety precautions have to be applied as for discharging the apparatus, i.e. it must be cooled for at least half an hour before it may be opened. If for any reason flushing water is applied, the temperature must be below 100 degrees C.

9900 1977

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

The dry gas from the product stabiliser on a pentane isomerisation unit contained HCl (hydrochloric acid), which was used to activate the catalyst. To prevent corrosion downstream the gas was passed through a caustic scrubber. However, the mixing was not instantaneous or completely effective. This led to serious corrosion in the bottom of the scrubber and its trays.
[mixer, near miss, design inadequate, corrosion]

Lessons

1. When neutralising an acid all the equipment in contact with it has to be corrosion resistant up to the point that neutralisation is complete.
2. To reduce the amount of expensive corrosion resistant alloy used, rapid mixing is desirable. In this case a static mixer with the caustic and gas flowing directly to the inlet was installed. 3. The mixing zone was only 30cms long.

9883 1977

Source : ICHEME
Location : , UK

Injured : 1 **Dead :** 1

Abstract

A gas recovery plant had been shutdown. It was being steamed out and drained prior to opening up the equipment. However, no valves had been closed to isolate the debutaniser from the butane rundown storage which allowed a reverse flow into the column. In addition the debutaniser vent to flare was only partly open. As a result the column was under some pressure. When the operator opened the drain valve it was partially plugged so he opened it further. A gush of condensate and butane was released and the operator had to escape the butane cloud do could not re-close the valve. The cloud was ignited by maintenance equipment. The operator had omitted several routine checks which would have shown him that the column was in an unsafe condition for draining. However, the written procedures were not clear on all points.
[butane, shutdown, draining, still, drain, product loss, fire - consequence, fatality, operator error, faulty instructions, design inadequate]

Lessons

The discharge point of all drains from pressure vessels was relocated sufficiently far from the drain valve that the operator would always be able to re-close the valve if there was a sudden release of hydrocarbon.
Procedures were written and training of operators improved to minimise the risk of hem making multiple errors.

9367 23 October 1976

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

Abstract

A fire occurred on a green oil separator. Owing to process problems a lagging fire occurred when a line was maintained at 450 degrees F for an extended period of time. The lagging was cork with a grease based filler which started to decompose.

Lessons

[None Reported]

1169302 October 1976

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

A fire occurred on a sulphur recovery plant.

The fire occurred in the tail gas wash drum of this sulphur recovery plant, there were no injuries but damage to the drum was estimated at about £25,000 (1976) (Note - not all sulphur recovery plants have a tail gas wash drum, on others the vessel is named differently eg. sulphur scrubber).

Both reactors had been submitted to the normal "burn-through" period and the temperature of the tail gas at the outlet of the wash drum had reached a constant level. During the subsequent air cooling stage a sudden rise of temperature was observed followed by smoke from the stack. The fire in the washdrum burned a small hole in the shell of the drum and sulphur fumes were released into the atmosphere. Air was sucked into the drum through the hole and the internal fire increased in intensity.

There was no means of valve isolation for the drum and therefore a blank was inserted at the incinerator by operators and firemen wearing breathing apparatus. Water was introduced into the wash drum via its overhead line, and when the drum was filled the fire was brought under control. An area of the drum shell of approximately 1.5m 2 was burned away.

The operating procedure used had been in use at the this refinery for some 15 years without any prior incident. It is assumed that localised pockets of sulphur in the internal packing of the wash drum, possibly in the area of the tail gas inlet, which were not removed during the "burn-through" period, ignited and burned rapidly during the increased air flow of the cooling stage.

The use of nitrogen to control the air flow during the cooling stage has been considered by the refinery, but is probably prohibitive on cost and quantity required.

[separation, operational activities, scrubber, additional chemical present, fire - consequence, sulphur]

Lessons

Similar incidents have happened at other refineries over the years, due to sulphur pockets and difficulties with control of the "burn-off", associated partly with lack of sufficient instrumentation to detect "hot spots". Possibly in the above incident, the "burn-off" period during which the excess air is controlled should have been extended before passing onto the "free air" cooling down period. The difficulty remains in deciding at which point "burnoff" is satisfactory completed and "cool-down" can start.

1169207 September 1976

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

Abstract

On the 7th September 1976, at 06.00 hrs an explosion occurred in the incinerator system of the No.1 Sulphur Recovery Plant due to a carryover of LPG from the 3 / 4 - H 2 S Absorber Column on the Catcracker Unit via the Amine regeneration Column. There were no injuries to personnel but damage amounted to some £30,000 (1976), confined mainly to the unit stack and the incinerator air blower. The internal packing of the 3 / 4 absorber column required cleaning, and the column was therefore being taken out of service for water flushing. The flow of LPG to the H2S absorber column 1 was stopped, and diverted into the fuel gas system, and the column depressured to approximately 5 bars. The bottom level gauge on the absorber was unreliable due to blockage with deposits, and therefore an indirect system of measuring the drainage rate from the absorber was used.

Draining from the absorber column 1 commenced via the bypass valve of its bottom level control valve into the amine regeneration column 2 of the sulphur recovery plant. At the same time amine was drained from column 2 into the amine tank at such a rate as to keep the level in column 2 constant. By gauging the increase in level in the amine tank the operators were able to indirectly measure the loss in level of the absorber column 1, although the diameter of the latter was much less than that of the former. Approximately 1 hour after draining started, a high level alarm indicated in the amine regeneration column, and draining of amine from the absorber was therefore reduced to a minimum. About 1 minute later, the high flow alarm of the H2S flow from the regeneration column sounded. Draining of amine was ceased immediately, but it was too late to stop a large LPG carry over to the sulphur recovery section of the plant, which was still in commission. Liquid seals on the sulphur recovery section were blown gaseous and LPG was released into the sulphur pit. From here it was drawn into one of the air blowers via a line which had recently been installed to remove foul odour gases from the sulphur pit for disposal in the incinerator. The air blower 6,as well as removing foul gases from the sulphur pit provided combustion air for the incinerator and cooling air for the incinerator flue duct. LPG vapours were therefore carried forward from the sulphur pit into the incinerator and also into the flue duct. At the same time, LPG vapours travels through the reaction system into the incinerator, but these remained mainly in an unburnt state due to insufficient oxygen being available in the reaction system. Two eye-witnesses described two distinct explosions. The first explosion was in the blower 6, whilst the second some 3 seconds later occurred in the stack within the flue gas inlet area, causing a collapse of stack internal brickwork.

The investigating team considered that the first explosion was probably initiated by a flash back from the incinerator burner travelling back through the air line to the air blower. The second explosion was considered to have occurred due to a delayed autoignition of the induced LPG in the stack.

[heating, draining, incinerator, absorption, instrument/controller, autoignition, process causes]

Lessons

Recommendation made by the refinery include the proposal that the vent line from the sulphur pit should be fitted with a flame arrestor, and various improvements are also being considered to improve the drainage control from absorbers.

1240 29 August 1976

Source : EVENING GAZETTE, 1976, 30 AUG.
Location : Hartlepool; Co Durham, UK

Injured : 2 **Dead :** 0

Abstract

Firemen were dealing with leak from tank when titanium tetrachloride entered a nearby scrubbing tower and reacted with caustic soda (sodium hydroxide). The tower/column collapsed drenching the firemen with corrosive material.
[scrubber, spill]

Lessons

[None Reported]

9959 01 August 1976

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

A fire occurred in the area of a hot well of a vacuum still. During the evening before the incident occurred, there were operating problems with the new recovery plant and the low line pressure increased to about 6 psig which effectively blocked off the third stage ejectors discharge causing the material in the ejectors to blow into the hot well. There was sufficient material to vent out of the cover on the hot well and eventually flash from the nearby vacuum still heaters. In addition, the seal leg was blown and hydrocarbons were released to the atmosphere through the vent.
Timely action by the operators extinguished the fire with only minimal damage to some instrument leads and electrical wiring. Total repair time was about three days.
The following conclusions were made:
Water in the heater coils was the most probable cause of this vacuum tower damage incident.
[fire - consequence, gas / vapour release, high pressure]

Lessons

The following recommendations were made:
1. Never start up a vacuum tower under full vacuum conditions.
2. Have coil outlet temperature indicators on all coils outlets.
3. Double pipe coils on the final pass should be eliminated and replaced with correct size single pipe.
4. Anytime an interruption of feed, heat, etc., is encountered in a vacuum tower and the furnace temperatures and coil outlet temperatures drop below 300 degrees F, pump the tower completely out and follow a normal start-up procedure.
5. Sufficient bleeders should be installed in all steam lines to properly dry the steam before injection into the tower at any point. Bleeders should be readily accessible.

1215 12 July 1976

Source : CHEMICAL MARKETING REPORTER, 1976, 19 JUL.; CHEMICAL AGE, 1976, 23, JUL.
Location : Union Beach; New Jersey, USA

Injured : 9 **Dead :** 0

Abstract

Pressure build-up in a reaction vessel, a still, causing an initial explosion, released vapour that caused a second blast. Damaged unit was a general purpose plant.
[high pressure]

Lessons

[None Reported]

1168405 May 1976

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

Abstract

Extra loads are often placed upon refinery separator systems during unit shutting down and commissioning periods. Frequently, the oil draining from plants at these times will be light material evolving considerable release of vapour at the separators, and this is increased if the atmospheric temperatures are high. If air conditions are still, the dispersion of vapours from the surface of the separators will be slow. The following incident has all of the above features, plus the added disadvantage of the separators being in a depressed location relative to the surrounding ground area.
On the night of 5th to 6th May, 1976, just after midnight, an operator was found unconscious on the gangway spanning the API oil separators. He was rescued promptly by other operators and the fire brigade, and given oxygen. He was later transferred to the local hospital where he regained consciousness and was released after a few days.
The separators are divided into two parts with an intervening gangway bridge from which the first section skimmers can be manually operated. The weather was very warm, with peak temperatures on the afternoon of the 5th of up to 35 degrees C, and with almost no wind, (3 m/s velocity). The No. 2 Catalytic Cracker had just been recommissioned, and it is probable that there had been some abnormal draining of hydrocarbons. Immediately after the incident, checks were made for hydrogen sulphide (not found present), and for oxygen levels, which varied between 18 - 20%. Tests with flammable gas detector did not indicate an explosive mixture, but later detailed chromatographic tests showed substantial levels of hydrocarbon in the vicinity of the incident. These chromatographic tests gave levels of between 20,000 - 50,000 m 3 of hydrocarbon measured at the gangway level over the net two days with similar warm atmospheric conditions. As the weather cooled, and the wind increased, this reduced to a concentration of 2300 mg/m at gangways level, and between 100 - 900 m 3 measured at "nose level."
The refinery drew the following conclusions:
1. At the time of the incident and in the following days, the hydrocarbon content in the atmosphere above the separators reached abnormally high levels, far beyond the Belgian Threshold Limit Values (T.L.V.), and that the operator was exposed to this atmosphere
2. The concentration at "nose level" was estimated to have been about 6000 mg/m 3 at the time of the incident; in normal weather and plant operating conditions, the concentration of hydrocarbon at "nose level" is much lower than the T.L.V. This was also confirmed by previous surveys in 1973 and 1974.
3. Remedial actions taken on the night of the incident, were that personnel using the separator gang-way were equipped with breathing apparatus and accompanied by an assistant equipped with a radio set for quick communication to emergency services. These rules are to be maintained.
4. A mechanical device for operating the skimmer will be fitted, greatly reducing the necessity for access to the gangway. Installation of a gas alarm to detect high hydrocarbon levels is also being considered.
[operational activities, separator, additional chemical present, asphyxiation, hydrocarbon]

Lessons

There can be wide variations in the siting and layout of main oil-water separators refineries, and the conditions pertaining at this refinery would certainly not be applicable to all. The incident, however, can serve as a warning of the potential hazard in separator areas, and refineries should survey their own separators and review associated procedures for personnel involved in their operation and maintenance, in the light of this incident.

1011014 February 1976

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

Chlorine gas was released from the absorption section of a chlorine manufacturing plant. The release was quickly stopped by the addition of caustic soda. Two men were treated for slight exposure to chlorine.
The section of the plant involved was designed to absorb (in caustic soda) any excess chlorine from the manufacturing process. In this incident, there seems to have been a substantial leak of gas from the high pressure chlorine line through a pressure control valve. Over a period of some hours, this resulted in depletion of the caustic soda in the system to the point where breakthrough occurred.
Plant operators failed to diagnose the source of the problem, and disregarded readings from a chlorine flow recorder which they believed to be faulty. In addition, there were serious discrepancies in the recording of caustic soda concentrations.
The investigation concluded that proper response from the operators would have prevented the chlorine release.
[venting, scrubber, gas / vapour release, incorrect chemical concentration, relief valve, leak, testing inadequate, operator error]

Lessons

It was recommended that:
1. monitoring of caustic soda concentrations needed to be improved
2. operators needed better information on the reliability status of instruments
3. operators needed additional training to emphasise the importance of maintaining correct operating conditions

1296125 January 1976

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

Shortly after producing and centrifuging a batch of benzoyl peroxide, smoke was observed as the operator was removing the cake with a plastic trowel. The operator raised the alarm and called the fire brigade, then isolated the electrics and directed water onto the filter cake. As the fire brigade arrived on the scene it was found that the decomposition was restricted to a small quantity of material.

After applying the first load of water it was found that the isolation of electrics had knocked off the agitator in the second reactor, which was at the stage of which benzoyl chloride was being added. The operator immediately donned breathing equipment and closed off the benzoyl chloride valve and dumped the batch.

[processing, plant / property / equipment, centrifuge]

Lessons

[None Reported]

1167011 November 1975

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

An oil precipitator on the discharge line of this starting air compressor in a LPG recovery unit was found to be glowing red.
The compressor was immediately shut down. The overheating caused flaking of paintwork, and the oil precipitator buckled at its inlet nozzle. The compressor was a 2 stage oil lubricated reciprocating compressor with an intercooler, supplying the starting air for the gas compressors in the LPG recovery unit. The compressor is switched on automatically, when the air pressure drops to 13.5 bar, and is switched off at a starting air pressure of 17.5 bar.
After opening up the oil precipitator and its associated pipework, residual coke was found on the internal surfaces; the thickness of the coke was in excess of 2 mm. The refinery concluded that the formation of coke took place by the carryover of lubricating oil, and that the coke was ignited by the hot air discharging from the compressor at 160 degrees C.
[processing, precipitator, compressor, residue, inspection inadequate, overheating, damage to equipment]

Lessons

The oil precipitator will be inspected regularly for coke at intervals not exceeding 500 hours.

9356 04 November 1975

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

Abstract

A fire occurred on an extruder spin away duct. Polyethylene and cardboard deposited from filters ignited spontaneously during shut-down.
[fire - consequence]

Lessons

[None Reported]

11441November 1975

Source : NEW SCIENTIST, 27 NOVEMBER, 1975.
Location : , WEST GERMANY

Injured : 0 **Dead :** 2

Abstract

Two men were scalded to death by boiling water that was released from a pressurised hot water system on a nuclear reactor during repair work to a valve. The reactor was a Boiling Water Reactor, installed in 1967,with a power output of 250 MWe. In BWRs the water flows up the reactor core, where it boils. Steam and water are separated, with the steam being fed to the turbine and the hot water returned to the reactor. However, some of the water from the separators is siphoned off from the main flow and sent to a purifying unit to remove radioactive contamination. The valve from which the water escaped was in this secondary separation circuit, and was being repaired during reactor shutdown. The water supply to the valve was not blanked off or otherwise securely isolated.
[burns, fatality, reactors and reaction equipment, isolation inadequate, leak]

Lessons

[None Reported]

1266912 July 1975

Source : ICHEME

Location : ,

Injured : 2 **Dead :** 0

Abstract

A fire occurred during cleaning of a light gas oil pump strainer when a gate valves ahead of the strainer released hot light gas oil which most probably autoignited on the hot equipment in the immediate vicinity of the hydrocarbon release. On employee suffered severe burns and another was slightly injured.
An investigation into the incident found that coke in the suction line of the light gas oil pump prevented the gate valve from being totally closed and this provided inadequate isolation of the suction strainer. Subsequent to the fire the valve was inspected and found to be in good condition. Traces of coke were found around and under the gate.
The source of the fire was leaking hot light gas oil vapours from the suction valve to the light gas oil pump which most probably autoignited on hot surfaces in the pump row.
Adequate emergency shutdown procedures were employed.
[fire - consequence, mechanical equipment failure, autoignition, burns, injury]

Lessons

[None Reported]

9953 18 June 1975

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

An incident occurred on a vacuum tower pipe still. Subsequent inspection revealed that most of the trays had been torn loose from their supports and displaced in the tower. Water was initially assumed to be the cause of the incident, but when the ensuing investigation failed to reveal a plausible explanation for water entering the system, other possible causes were considered.
After investigation into the incident, it was concluded that the damage was probably caused by the vaporisation of a slug of flushing oil that entered the tower through the bottoms pump suction line. A leaking valve allowed the flushing oil to accumulate in the system, but the slug entered the tower due to the failure of not following procedures for blocking-in the idle bottoms pump.
[contamination, damage to equipment, design or procedure error, processing]

Lessons

[None Reported]

1008 05 April 1975

Source : CHEMICAL AGE, 1975, 11 APR. AND 25 APR.; CHEMICAL NEWS, 1975, 11 APR.; THE TIMES, 1975, 19 APR. HSE REPORT, HMSO, 1976. ISBN 0118803336.

Location : Ilford, Essex, UK

Injured : 3 **Dead :** 1

Abstract

An explosion occurred in the process plant of a factory as a result of an uncontrolled release of caustic electrolyte. The plant was severely damage in the explosion.
The explosion occurred in the oxygen separator drum, which ruptured releasing a large quantity of caustic solution, which splashed over the operator. The operator suffered severe caustic burns and later died from his injuries.
An investigation into the incident found that the oxygen separating drum of the process plant exploded due to the ignition of an explosive mixture of hydrogen and oxygen inside the plant.
[separation, fatality, spill, caustic soda, injury]

Lessons

[None Reported]

1257231 March 1975

Source : ICHEME

Location : Takaishi City, JAPAN

Injured : 0 **Dead :** 0

Abstract

An explosion occurred at the filter means of a furnace on a meramine plant. The incident occurred after the furnace was started to heat the filter means of the plant (which serves to remove from the formed meramine impurities including catalyst used for reaction), a warning signal was seen at the flame eye provided for monitoring the conditions of burner combustion. The burner was turned off.
After the valve was closed, the burner was turned on again and while the valve was progressively opened by hand an explosion occurred at the filter means.
The cause of the incident is due to insufficient air supply to keep complete combustion. As a result, a detonating gas was formed.
No one was injured in the explosion.
[heating, operational activities, process causes]

Lessons

[None Reported]

9951 09 March 1975

Source : ICHEME
Location : , USA

Injured : 1 **Dead :** 0

Abstract

A control valve in a second stage high pressure separator liquid level control valve manifold failed, resulting in a serious fire in the area of a hydrocracker and reformer. The fire lasted about forty five minutes. Although the fire damage was minimal the unit operating foreman suffered serious burns over 35% of his body. Inspection of the valve showed that it had eroded through the base of the valve resulting in a hole.
[damage to equipment, burns, mechanical equipment failure, fire - consequence, material of construction failure]

Lessons

[None Reported]

9863 1975

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

At start-up of a crude oil fractionation unit a heavy leak developed on the inlet flange in one of the group of stab in exchangers in the vacuum column. The oil was above its autoignition temperature and so a fire resulted. The fire worsened the leak.
There was no obvious cause but calculations showed that owing to higher temperature differences which were likely to occur during start-up, the pipework had inadequate allowance for thermal expansion.
[joint leak, fire - consequence, vacuum distillation column, blowout, thermal expansion, design inadequate, hydrocarbon]

Lessons

1. Design allowance for thermal expansion stresses must include shutdown and start-up as well as normal operating conditions.
2. The pipework was modified.

911 07 July 1974

Source : DAVENPORT J.A, A SURVEY OF VAPOUR CLOUD INCIDENTS, CHEMICAL ENGINEERING PROGRESS, 1977, 73, SEP., 54-63.; LENOIR E.M & DAVENPORT J.A, A SURVEY OF VAPOUR CLOUD EXPLOSIONS SECOND UPDATE, PROCESS SAFETY PROGRESS, 1993, 12, (1), 12-33.; EUROPEAN CHEMICAL NEWS, 1974, 12 JUL.

Location : Koln, WEST GERMANY

Injured : 3 **Dead :** 0

Abstract

Corrosion on a 80 mm pipeline from a vinyl chloride monomer (VCM) hydrogen chloride separator released vinyl chloride monomer and cloud ignited in cracking furnace after 10 to 20 seconds.
[cracking]

Lessons

[None Reported]

9350 22 April 1974

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A chlorine gas incident. A discharge of chlorine and caustic liquor occurred from a scrubber stack whilst a chlorine car was being off loaded. Discharge occurred because the vent valve on the off loading line was jammed partially open.
[spill, unloading]

Lessons

[None Reported]

1257028 March 1974

Source : ICHEME

Location : Otake City, JAPAN

Injured : 0 **Dead :** 0

Abstract

An incident occurred when an air separator compressor for liquid oxygen production was shut down for repairs to the piping for cooling water, the cooling medium contained in the cold box blew off through deformed portion of the outer shell of the box.
No one was injured in the incident.
[repair, explosion / pressure release, material of construction failure]

Lessons

[None Reported]

869 13 February 1974

Source : AMMONIA PLANT SAFETY VOL.17, AICHE, 1975, 145
Location : Joplin; Montana, USA

Injured : 0 **Dead :** 0

Abstract

A dust collector was installed to collect dust at points in an ammonium nitrate plant. A fire occurred in the collector but was contained and only damaged the internals. Prior to the fire the dust collector had been taken out of service and was being cleaned in preparation for repair. Dust was removed from the bags. At the shift change a fire was discovered which was extinguished in 30 minutes. The source of ignition was attributed to a 200 watt light.
[fire - consequence]

Lessons

1. Do not use high powered spot lights around flammable materials.
2. Use only low voltage (24 volts or under) within a confined metal compartment or tank.
3. Establish an awareness of the hazard of unsafe use of portable electrical equipment.

864 February 1974

Source : DOOYEWEERD E, EXPLOSION IN AN EAST ASIAN UREA PLANT, AMMONIA PLANT SAFETY VOL.17, 1975, 152-153.
Location : , EAST ASIA

Injured : 0 **Dead :** 0

Abstract

In this plant, after conversion of the major part of the carbon dioxide into urea, the offgasses from the reactor consist of ammonia, carbon dioxide, and inerts (hydrogen, oxygen and nitrogen). Prior to venting this gas into the atmosphere it is washed with a carbamate solution. This absorption is carried out in a high pressure scrubber. An explosion occurred in this high pressure scrubber. The internals were damaged without affecting the vessel itself as it was designed to take an explosion. A second explosion occurred in April 1974 and also damaged the internals. The source of ignition was attributed to oil traces in the absorption part of the scrubber.
[damage to equipment, fire - consequence, reaction vessel]

Lessons

[None Reported]

1158809 January 1974

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A fire at an oil refinery separator was quickly extinguished, but caused damage to the concrete walls of the separator, two walkways and nearby equipment. The source of the ignition was probably glass from a halogen spotlight which fractured as a result of thermal stress. Vapour from the separator could have either been ignited by sparks from grass weeds catching fire, or by the hot pieces of glass themselves.
[fire - consequence, damage to equipment, hot surface, separation]

Lessons

The use of halogen lights should be discontinued.
Fine mesh safety gauzes should be fitted on all lamps on lighting towers, so that any glass fragments from cracked covers or imploding bulbs are contained.
The annual weed killing and removal programme should be extended to include the separator area.

1117109 January 1974

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

A fire occurred on an API separator. Nobody was injured but damage sustained by the concrete walls of the separator, two walkways across the separator and nearby equipment was estimated to cost some 2,000 pounds. Within about ten minutes of ignition the fire was completely extinguished, burning on half of the separator having ceased within five minutes due to lack of fuel, the fire in the remaining half was put out by the refinery fire brigade.
Investigations carried out later the same day in daylight strongly suggested that the source of ignition was a broken cover glass from a halogen spotlight, mounted on a lighting tower some 10 metres above ground level, located east of the separator. The hot cover glass (greater than 250 degrees C) had fractured, probably as a result of thermal stress, and on striking the ground, spread over an area of about 8 metres in diameter, some pieces of glass entering the separator basin. Grass/weeds caught fire and it was concluded that vapour from the separator was ignited by sparks from the burning grass carried by the wind or by direct ignition from hot pieces of glass (sample of surface oil tested after the incident had a low flash point).
[separation, separator, light, stress, hot surface, fire - consequence, gas / vapour release, damage to equipment]

Lessons

The following recommendations were made:
1. Discontinue the use of halogen type lamps.
2. Fit fine mesh safety gauzes on all lamps on the lighting towers to contain any glass fragments from cracked cover glasses or imploding bulbs.
3. Extend the annual weed killing/removal programme to include the separator area.

1121518 June 1973

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

A fire occurred on a vacuum distillation unit caused by oil under high temperature and pressure leaking from the suction strainer on the vacuum residue pump and igniting spontaneously. The fire was extinguished by the refinery fire service within 5 minutes of their arrival. The fire resulted when a joint on the suction strainer failed when it was overpressured. There had been operational troubles with the residue pumps during the preceding shifts and the escape of oil occurred when the suction and discharge valves were closed while the 'warm up' line, which bypasses the discharge and non-return valves, was open. The suction strainer pots on the two residue pumps on the vacuum unit were locally designed and manufactured, to enable operators to open them quickly with a 'tommy bar', and clean the strainers. The suction strainers construction was adequate to meet normal operational conditions, but could not stand the full discharge pressure from the parallel pump; it is believed that this is what occurred due to maloperation of the pump 'warm up' system.
There were no personnel injured in the incident and although damage was of a relatively minor nature, the plant was off-stream for 5 days.
The strainer pots assemblies fitted to the residue pumps were replaced by new ones which meet the specification of the line system.
[distillation, distillation, strainer, overpressurisation, joint failure, fire - consequence, spill]

Lessons

[None Reported]

734 1973

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

Abstract

Water trapped in the gasket area of a flushing oil line to this vacuum distillation column bottoms, froze and ruptured the gasket. This accumulation of water was attributed to the intermittent use of the flushing oil.
The leaking oil ignited and the subsequent fire was extinguished in fifteen minutes.
The unit was only-off stream for approximately two hours, but on re-commissioning "long flame" fires were observed on several vacuum heater tubes.
Damage of £6000 (1977) was mainly for the subsequent repair of the tubes.
[distillation, vacuum distillation column, additional chemical present, gasket failure, leak, fire - consequence, water]

Lessons

The addition of a low point drain to draw off water from the flushing oil was recommended.

112251973

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

A major fire which occurred at the base of a vacuum distillation column resulted in serious damage to two adjacent banks of fin-fan heat exchangers, cable runs and extensive areas of column clad-ding.

Two bottoms residue pumps, associated with the vacuum column were in use at approximately 80% of their capacity. During the night shift of 4th July, 1973, the seals on one of the pumps started to leak and fire occurred which was extinguished with steam and dry powder. The pump was therefore taken out of service. Almost immediately after the operators had blocked in the residue pump, the relief valve on the column lifted followed by a large leak and fire around the remaining running residue pump.

The major fire alarm was raised, and the fire fought with water monitors by the refinery personnel, later assisted by mutual aid participants and the local authority brigade. The fire was under control and extinguished within one hour.

Investigation after the fire showed that the section line had been torn open over a length of about 60 cm wide by 10cm. Also other parts of the lines had holes in them. The material of the bend in the section line seemed to be 10mm thick at the top side, where ultra sonic testing had always been carried out.

A test carried out at the bottom side showed that this part the thickness was only 4mm. Other parts of the suction line showed variations in thickness. The vacuum column bottoms line was constructed of carbon steel and was about 10 years old. Ultrasonic testing of it had been practised at selected points, by cutting pockets in the metal cladding covering the line. Lines in other parts of the unit had already been replaced in chrome steels.

An explanation given for the incident is that the capacity of the one running residue pump was insufficient to hold down the level in the vacuum column to the normal operating position. As the level rose, vacuum was lost, the relief valve lifted and eventually the static head of oil in the column was such that it caused the failure of the badly corroded pump suction line.

One feature of this fire was again the unwelcome part played by the updraft through the fin-fan cooler banks, and the difficulty in fighting fire in the confined areas adjacent to column bases.

[distillation, vacuum distillation column, line, pump, fin fan cooler, corrosion, leak, fire - consequence]

Lessons

The installation of fixed water monitors on the unit was recommended.

715 1973

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

Aluminium smelter.
[fire - consequence, smelting furnace]

Lessons

[None Reported]

1048507 August 1972

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A combination of inadequate design and mal-operation of a styrene plant allowed a water-benzene separator drum to become over-full, causing a discharge of benzene from the vent. This was ignited, probably by electrical equipment in the vicinity. The resulting fire caused considerable damage. The separator drum high level alarm had operated, and at the time of the event, unsuccessful attempts were being made to reduce the level. However, operating personnel were not unduly worried by the situation as there had been similar (un-ignited) discharges several times before.
It was known at the time that the capacity of the pumps used for removing the contents of the drum was inadequate.
[venting, fire - consequence, benzene, damage to equipment, separator, overflow, static, incorrect equipment installed]

Lessons

A number of recommendations emerged from the inquiry. There were two major groupings, relating to the design of vents and to electrical area classification.
All vents should be positioned to discharge away from the centre of the plant. If there is any possibility of liquid discharges, appropriate blow-down separators or drain lines to seal pots should be installed. The discharge point of vents should take into account the possibility of nearby sources of ignition.
The height of vents above the plant must be adequate.
When considering area (electrical) classification, both normal and abnormal operating conditions should be recognised, as well as continuous and discontinuous venting operations.
Additionally, the inadequate design of the plant should be rectified.

4764 07 February 1972

Source : ICHEME

Location : ,

Injured : 2 **Dead :** 0

Abstract

At 0330 hours on the 7th February, 1972, a fire occurred in the vicinity of the filter of an atmospheric residue pump on a crude distillation unit. Because of flame damage occurring to overhead instrument cables, the crude, DHT and fractionation units were shut down as a precautionary measure.
The fire was extinguished in about 15 minutes by the shift fire fighting crew during which time two operators suffered slight burns.
The overall damage to equipment was not extensive and the crude and DHT units were re-commissioned following replacement of certain instrument and electrical cabling.
At the time of the fire the crude unit was operating at maximum feed rate for a test run and both residue pumps were in operation. On the evening of the 6th February a slight leak from the mechanical seal of the steam driven residue pump was noticed but it was decided to keep the pump operating under strict control and a steam lance was positioned as a precautionary measure.
At 0230 hours the leakage appeared to have increased, and the decision was taken by the shift supervisor to shut down this pump. Feed was cut to the Crude Unit and the pump was subsequently shut down and valve isolated. At 0330 hours there was an outbreak of fire in the vicinity of the pump filter. The shift supervisor present at the time of outbreak reported that the ignition originated from the gully trap adjacent to the filter. He tried to extinguish the flames with a l0 kg. dry chemical powder unit but without success. Flame lick around the base of the filter caused leakage of hot residue from the top cover flange of the filter, thereby augmenting the fire. The refinery's auxiliary firemen were successful in controlling the fire using portable dry chemical powder extinguishers but it was not finally extinguished until 0345 hours after the arrival of the major fire-fighting vehicle and the use of two 70 mm foam lances.
The magnitude of the leakage of hot residue from the mechanical seal was not considered sufficient to result in the accumulation of hot material in the drainage system where the fire is reported to have originated. In addition, ignition did not occur at the seal where the temperature of the leakage would have been about 350°C. No burning took place round the pump or on the pump bedplate. It was also confirmed that prior to the outbreak of fire, one hour after valve isolation of the pump and filter, no hot residue draining operations were carried out following valve isolation of the pump and filter.
It can only be assumed that light hydrocarbon vapours were present around the gully trap. The source of ignition is not known.
Subsequent tests since the occurrence have not indicated the presence of explosive mixtures in the vicinity of the drainage system associated with the residue pumps.
[fire - consequence]

Lessons

[None Reported]

524 1972

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

Two vehicles were loading gasoline at a gantry when the attention of one of the drivers was distracted with the result that a small quantity of product, about 140 litres, was spilled.

Operations were immediately discontinued and the gasoline was flushed away into the drainage system using water hoses. During this process there was an outbreak of fire accompanied by a low rumbling sound which was caused by a low intensity explosion in the drainage system. Shortly afterwards a more violent explosion occurred in the oil/water separator.

No-one was hurt and neither the vehicles nor the gantry were damaged in any way. However, some insulation on the electric cables in the drainage tunnel was burnt and required repair.

A thorough investigation, in which the local police assisted, was immediately put in hand. At first it was thought that the cables in the drainage tunnel, which also carried the gantry supply pipes, might have been at fault but this was conclusively disproved. An eye-witness came forward from the adjacent competitor's depot who said that he saw a flash at a welding machine located more than 50' (15m) from the gantry but quite close to an opening which connected with the tunnel drainage system. It was concluded that this machine was the source of ignition. Instructions had been given on the work permit that welding was to cease during vehicle loading but it appears that the machine itself was inadvertently left running.

The supply pipes, together with some electric cables, are housed in a covered tunnel, large enough for a man to work in, which runs between the rail siding and the gantry. At the bottom of the tunnel there is an open drain which collects any rain water, or product spillage, from both the gantry and rail siding areas. The drain terminates in a pipe to the oil water separator. This arrangement was installed at the request of the local authorities largely due to their very stringent environmental requirements.

The accident was primarily caused by the welding machine which, although it was outside the minimum safety distance from the gantry was close to an opening connecting with the main drainage system and illustrates the importance of sealing drains when hot work is to be carried out.

[fire - consequence, human causes]

Lessons

More far-reaching aspects of the incident are the clearly unsatisfactory features of the tunnel/ drainage system, a good example of the conflict between environment and safety.

It was fortuitous that the explosion was not very much worse and attention was immediately given to redesigning the drainage system.

557 June 1971

Source : OIL PAINT AND DRUG REPORTER, 1971, 28 JUN, 3.
Location : Havre, FRANCE

Injured : 0 **Dead :** 0

Abstract

Fire in effluent scrubbing system for titanium dioxide plant.
[fire - consequence,

Lessons

[None Reported]

542 31 March 1971

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 1

Abstract

In this plant hydrogen cyanide was produced as a by-product, and burned in a furnace with other residues. Any remaining wet waste would then be drained into a specially constructed settling pit, equipped with a plastic curtain to minimise fumes. At the time of the incident, the pit contained a high concentration of hydrogen cyanide because of an unrecognised filter failure. In addition the plastic curtain had blown away in a gale four months previously and had not been replaced. A contractor working near the area at this time was overcome by the toxic release. Fatality.
[processing]

Lessons

[None Reported]

464 23 April 1970

Source : OIL AND GAS JOURNAL, 1970, 4 MAY
Location : Beaumont; Texas, USA

Injured : 2 **Dead :** 0

Abstract

Explosion and fire involving a propane caustic scrubber in a refinery alkylation plant.
[fire - consequence, refining]

Lessons

[None Reported]

9871 1970

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

The casing of a hot oil pump cracked at the suction nozzle. This was found to be due to excessive stress from the suction piping. Since the original design a heavy suction strainer had been installed and two of the original spring hangers were ineffective. One had been disconnected and the other was carrying no load due to maladjustment. As the oil was above its autoignition temperature a fire resulted.
[Hydrocarbon, modification, strainer, rupture, fire - consequence, damage to equipment, design inadequate, inspection inadequate, oil - hot]

Lessons

1. The design and installation of any modification to a plant should be reviewed as carefully as the original design.
2. The condition and adjustment of spring hangers requires auditing on a regular basis. Maladjustment is often not obvious on casual inspection.

1017417 February 1969

Source : ICHEME

Location : Michigan, USA

Injured : 0 **Dead :** 0

Abstract

A severe explosion occurred which shook the refinery and, after investigation, it was discovered that the separator box area was on fire. The separator box area contains the confluence of the refinery sewers, an oil recovery and drying process, two API separators, two air flotation units, a sludge handling system, effluent water pumping station, slop oil storage tanks, storm water facilities, plus the building and auxiliaries that involved in these operations. The explosion originated in the basement pump room.

[oil, separation, separator, pump, sump, fire - consequence, explosion]

Lessons

The reason for the explosion is not known. But it could be that the gaseous atmosphere in the basement room came from vapour flooding from the sump into the building or from a failure or leak of the slop oil system charging the slop oil to the process unit. The circuits energised in the basement at the time were lighting, sump pump, effluent water sampler and the effluent water pump. Failure of any part of these could have produced a spark. Failure of the slop oil charging system at grade level could have ignited and the resulting flame front carried to the basement. Ignition could have been sourced from the pump or lighting circuits or from the switchgear room, had the pressurising system failed.

Plans for rebuilding the facility are not complete as yet, but the company does not contemplate putting the slop oil system in a building or rebuilding a basement pump room. The use of non-explosion proof switchgear and relying on a gas-free atmosphere system is a practice to be avoided if practical.

417 14 February 1969

Source : VINYL CHLORIDE POLYPEROXIDE EXPLOSION, ACCIDENT PREVENTION BULLETIN, THE SOCIETY OF THE PLASTICS INDUSTRY, 1969, 14 FEB.

Location : ,

Injured : 1 **Dead :** 0

Abstract

This incident occurred during routine cleaning of filters and lines in the recovered vinyl chloride monomer (VCM) system adjacent to the polyvinyl chloride polymerisation plant. Approximately 1 hour after removing line sections immediately before and after the pump, the explosion occurred inside the idle vented pump. An investigation revealed that an unstable material had contaminated the entire recovered vinyl chloride monomer system. Analysis of the material showed it to be vinyl chloride polyperoxide.

Causes of the accident were:

1. The explosion in the pump was caused by the ignition of leaking vinyl chloride monomer via the decomposing vinyl chloride polyperoxide and compounded by the shock sensitivity of the polyperoxide.
2. The unstable polyperoxide was formed from the excessive concentration of oxygen in the recovered vinyl chloride monomor system introduced by water and probably air leaks.
3. The recovered vinyl chloride monomer was stored for an unusually long period, 20 days, allowing the polyperoxide concentration to attain high levels.
4. The concentrated impurities in the recovered vinyl chloride monomor accelerates the oxidation of vinyl chloride.

[contamination, polyvinyl chloride (PVC)]

Lessons

1. Recognise the ease of forming dangerous, unstable polyperoxides in recovered vinyl chloride monomer systems by the oxidation of vinyl chloride in the presence of a) free radical initiators, b) acetaldehyde, c) acetylene, d) ferric chloride or e) HCl plus H2O plus steel.
2. Prevent oxygen from entering the system by:
a. Pressure and/or vacuum testing equipment periodically.
b. Minimizing usage of water with dissolved oxygen.
c. Purging equipment after cleaning with an inert gas.
d. Monitoring oxygen concentration in gas stream after compressor.
3. Minimize the formation of peroxides by:
a. Inhibiting the recovered vinyl chloride monomer with an antioxidant.
b. Not accumulating recovered vinyl chloride monomer in storage tanks.
c. Monitoring recovered vinyl chloride monomer liquid for peroxide content.

410 1969

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

Ethylene oxide filter left full of ethylene oxide and blocked in leading to polymerisation and explosion.
[flow restriction, processing]

Lessons

[None Reported]

9841 14 October 1968

Source : LOSS PREVENTION, VOL. 3.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Failure of a strainer allowed sand from brine filters to get into mercury cells in a chlorine plant. It appears that the sand obstructed flow and caused excessive hydrogen generation. An explosion occurred in the chlorine collection system.
[mechanical equipment failure, flow restriction]

Lessons

[None Reported]

9838 11 September 1968

Source : LOSS PREVENTION, VOL. 3.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A 200 gallon still exploded during distillation of a chloronitro compound. The cause was failure of a vacuum system which permitted the temperature to reach the self-accelerating decomposition level. This small still seriously damaged a large adjacent one which accounted for most of the plants profits. [explosion, damage to equipment, mechanical equipment failure]

Lessons

[None Reported]

9834 22 June 1968

Source : LOSS PREVENTION, VOL. 3.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Brine coolant leaked into a filter where phosphorus pentasulphide was being removed from a toluene solution of an organic insecticide. The reactor as inadequately vented but the filter was not an it exploded.
[explosion, reactors and reaction equipment, chemical - organic insecticide]

Lessons

[None Reported]

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.

9821 09 January 1968

Source : LOSS PREVENTION, VOL. 3.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A steam heated still was used to separate water and monochloro benzene from crude paranitrochloro benzene. The still was also used to recover product from waste streams resulting from purification of paranitrochloro benzene. After recovery of a batch of waste, the still was kept on total reflux for about an hour pending change over but it exploded before the change over was made.
[explosion, distillation]

Lessons

[None Reported]

8785 23 May 1966

Source : MCCAREY J.J, PETROCHEMICAL FIRE THREATENS GIANT REFINERY, FIRE ENGINEERING, 1966, AUG, 103-104.
Location : Philadelphia, USA

Injured : 19 **Dead :** 0

Abstract

Fire in a cumene still at a refinery. The still consisted of exposed high pressure pumps, valves, pipes, tubes, drums, tanks and controls. The lower portion of the unit was supported by steel beams and columns fireproofed by reinforced concrete. The upper portion was unprotected steel beams and columns. The unit manufactured cumene (isopropyl benzene).
The fire started at two high pressure pumps which were used to feed a mixture of cumene (liquid) and benzene (liquid) and (gas) into a nearby drum via a 6 inch stainless steel pipe under 500 psi pressure. Directly above the drum was a 6 inch stainless steel discharge pipe and gate valve. At approximately 6.45 pm the discharge pipe ruptured about 1 foot beyond the discharge valve. The escaping flammable liquid impinged on the drum and vaporised. Two work men shut down the operation, but were unable to shut down the valve because of its proximity to the rupture. Vapours were then carried to a fire box and ignited and flashed back to the cumene unit.
[refining, fire - consequence]

Lessons

[None Reported]

1007005 April 1966

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

A fire occurred in the API separator which spread to both cells and became quite large. The API separator was designed to remove separable oil when the oil enters the south end of the cell. The water level in the separator is controlled by a weir downstream of a oil retention baffle at the north end of the cells. Oil impounded by the retention baffle is skimmed into a collecting trough by operation of a skimmer.
Fifteen minutes after the fire started, a refinery fire truck arrived and discharged foam into the separator. A County fire department truck soon arrived and discharged foam into the east cell. The equipment damaged in the fire mainly consisted of: wire, conduit, motor starters, cable and three quarter horsepower electric motors. Other damage consisted of spalled concrete walls, trench grating, pipe insulation and hand rails.
[fire - consequence, damage to equipment, separation, short circuit]

Lessons

The exact source of ignition is unknown but it is thought that it was a short in the electrical feeder to the west cell of the skimmer for the following reasons:
1. There was a history of cable wear and periodic replacement
2. The east skimmer was shut down at this time
3. There has also been a history of other electrical failures and excessive friction of moving equipment.

Recommendations are as follows:
1. The electrical system will be revised
2. The spring loaded reel used to take up and play out the feeder cable will be removed
3. The feed cable will enter the north end of the separator and will be supported by rings from a messenger cable.
4. The rings will be replaced about 10 feet apart and the cable will hang in loops as the skimmer moves towards the north. This should eliminate wear on the cable and minimise breakage associated with malfunction of the spring loaded take-up reel.

315 09 July 1965

Source : VERVALIN C.H (ED.), FIRE PROTECTION MANUAL, 2ND ED., GULF, 1973, PG 92; ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

Failure of pump packing or of a brass valve in a 1/2 inch steel pipeline carrying oil at 175 psi and 150 to 175 F released oil that ignited at exposed parts of a 600 pound steam regulator in an absorption gasoline plant. Employees discovered the fire almost immediately and used two dry chemical extinguishers to try to control it. They were making progress when they noticed that the heat had caused the head of an oil-to-oil heat exchanger to start leaking around the seals, adding additional fuel to the fire. The employees then tried to put a mechanical foam line in operation, but the rapidly intensifying heat forced them to leave. [fire - consequence, processing, valve failure, pump failure]

Lessons

[None Reported]

283 17 July 1964

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

Explosion in ethylene oxide plant. Ethylene oxide vapour desorbed from the eo scrubber cycle water contaminated the air inlet to the unit.
[contamination, processing]

Lessons

[None Reported]

257 03 April 1963

Source : ADCOCK C.T, VAPOUR RELEASE AND EXPLOSION IN A LIGHT HYDROCARBON PLANT, CHEMICAL ENGINEERING PROGRESS, 1967, 63, 8, 54-57.

Location : Plaquemine; Louisiana, USA

Injured : 0 **Dead :** 0

Abstract

Failure in a top sight glass on a separator on the feed to the dehydrators ahead of the methane distillation column was believed to be the cause of an explosion and fire on an ethylene plant. It operated at 500-600 psi and 60-80 degrees F. 30 secs after the gas was heard to be escaping there was a minor explosion which was followed by a second. A severe fire ensued which destroyed the unit. 250000 gallons of ethylene fed the fire.
Estimated loss $4,000,000 (1963).
[gauge glass failure, separation]

Lessons

[None Reported]

214 18 August 1961

Source : RENDOS, OIL SEPARATOR EXPLOSION IN AN AIR-SEPARATION PLANT, AMMONIA PLANT SAFETY, 1963, VOL5, 25-27.
Location : Acton; Massachusetths, USA

Injured : 0 **Dead :** 0

Abstract

A violent fragmentation occurred in a high pressure 2500 psia nitrogen system installed in an air-separation plant causing heavy damage. The vessel ruptured at 10700 psia. Ignition of lubricating oil started in the 6th stage cylinder of the compressor while it was handling waste gas containing 18-19% oxygen. Ignition was from friction and started an explosion wave through plant items to the separator.
[damage to equipment]

Lessons

[None Reported]

9852 1961

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

Abstract

When commissioning a new distillation unit, rapid plugging of the reboiler heater change pump suction strainers with construction debris and scale made it difficult to keep a continuous flow to the furnace. By the time the strainer on one pump was cleaned out the on the other was plugged.
The operator continued to fire the furnace as he expected to restore the flow imminently. On one occasion the flow stopped for four minutes which was enough to overheat and rupture the heater tubes.
[strainer, furnace tube, creep, rupture, fire - consequence, damage to equipment, design inadequate, operator error, naphtha]

Lessons

1. Operators were instructed and new procedures provided to endure that furnace firing was cut as soon as flow was lost in the tubes.
2. In the long term all fired heaters were either:
· fitted with shut down system to shut off the heater fuel when low flow to the heater was detected.
· fitted with a heater outlet temperature control on the fuel to the burners. In this case the thermowell had to extend down the heater tube far enough to be in the firebox.

202 29 September 1960

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

The explosion occurred in a continuous flash still used to concentrate oxidate to 75-80% cumene hydroperoxide. The focus of the explosion was a vertical exchanger heated by steam. The unit had been operating normally until the pressure increased. The vacuum could not be improved so supplies of steam and oxidate were stopped. After 3-4 mins. two explosions occurred. The first ruptured both heads of the heat exchanger and the second travelled horizontally as a ball of fire. The damage was confined to the flash still. The basic cause of the explosion was believed to be an increase in the exit pressure of the heat exchanger, probably caused by an unusually high liquid level in the base column. This slightly increased pressure may have increased the boiling point to a temperature of incipient decomposition, making it difficult to obtain a vacuum. When steam and the feed were cut, concentrated cumene hydroperoxide settled in the exchanger tubes where it could be further heated by the hot metal. This accelerated the decomposition to the point where the ends of the exchanger ruptured.

[processing, high pressure, continuous reaction]

Lessons

As a result of the explosion, the following corrective measures were taken.

1. A permanent lowering of the liquid level in the flash still.
2. Installation of a thermocouple in one of the tubes of the heat exchanger to measure the temperature at the point where this was a maximum.
3. An automatic steam dump valve was installed to release the pressure on the steam side of the exchanger whenever the steam supply was cut off.
4. A cumene flush system was installed to flood the exchanger.

189 11 July 1959

Source : VERVALIN C.H (ED.), FIRE PROTECTION MANUAL, 2ND ED., GULF, 1973.
Location : Ube, JAPAN

Injured : 22 **Dead :** 11

Abstract

An explosion occurred in an ammonia synthesis plant gas separator. A few minutes later there was a second explosion in another separator. When the primary explosion occurred, in No.1 separator's cold box, investigators found no wool insulation from the cold box in the surrounding debris. The corner of the cold box was torn open 12 to 15 inches. Two hours later, a secondary explosion destroyed all the cold boxes' walls. This completely disintegrated all parts of the unit not ripped by the first blast. The investigating committee arrived at the following theories as to the cause of the explosions.
With respect to the first explosion.
1. No. 2 countercurrent tower split internally during the gas separating process and released crude gases from the unit which burst into flame.
2. An outlet pipe welded to the bottom of No. 2 countercurrent separator of the gas came off, allowing crude gas to escape and catch fire.
3. Foreign articles accumulated at the bottom of No.2 countercurrent tower, inducing the explosion.
4. A combination of two or more of the above.
With respect to the second explosion.
The outer tower of the carbon monoxide evaporator next to the No. 2 countercurrent tower was damaged by the primary explosion's impact, and gas liquid leaked out onto the insulation, making it highly inflammable. Fatality.
[separation]

Lessons

The following measures were taken in construction of the new units to prevent a recurring explosion.
1. All joints and welding seams were inspected and weak joints reinforced. All outlet pipes were screwed into the body and reinforced with back welding, rather than simply jointed to the body as before.
2. All exhaust lines had service pressure strength of 35 psi.
3. The pressure tower was constructed of stainless steel.
4. Wider spacing was allowed between boxed equipment.
5. The unit was remote controlled.
6.The new No. 2 countercurrent tower was for alternate use.
7. The former inflammable wool insulation for pipes and the cold box was replaced with nonflammable material (slag wool).
8. Pipes and equipment were coated with nonflammable foam glass, instead of the former carbonised coke.
9. Cold boxes were separated from other general manufacturing equipment.
10. Spray and steam type fire extinguishing facilities were installed throughout the plant.

9558 09 July 1957

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A fitter burning the last bolt to remove a manhole cover from a 5m3 ammonia liquor filter drum. Torch about one inch away ignited the gas coming out of the drum. The explosion blew cover off.
[drums, hot work, hot surface]

Lessons

[None Reported]

162 20 March 1957

Source : SILVER L, SCREENING FOR CHEMICAL PROCESS HAZARDS, LOSS PREVENTION VOL 1, AICHE, 1967, 58-64.
Location : Rahway; New Jersey, USA

Injured : 0 **Dead :** 3

Abstract

An explosion occured during the vacuum distillation of 1'-pentol (cis-3-methyl-pentene-2-yne-4-ol-1), an intermediate in the synthesis of vitamin A. The distillation was carried out in a 50-gal. jacketed stainless steel vessel equipped with a packed column. Data obtained previous to the explosion had indicated the compound to be relatively stable, although it slowly polymerised at temperature above 120 degrees C. The normal temperature of distillation was 50 to 70 degrees C. There was a possibility that a small amount of aqueous caustic soda, which was used occasionaly to clean the equipment, may have been drawn into the vessel accidently.
[contamination, vacuum distillation column, fatality]

Lessons

A programme for screening for potential hazards has since been adopted and is discussed in this article

138 22 July 1955

Source : NATIONAL FIRE PROTECTION ASSOCIATION, 1956 VOL 49, 309; VERVALIN C.H, HPI LOSS INCIDENT CASE HISTORIES, HYDROCARBON PROCESSING, 1978, 57, FEB., 183-201; GUGAN K, UNCONFINED VAPOUR CLOUD EXPLOSIONS, ICHEME, 1979.

Location : , USA

Injured : 0 **Dead :** 0

Abstract

Incident at a gasoline absorption and compression plant. The rupture of 150 mm pipe carrying butane at 3.5 mpa from the process tower to the cooling tower was believed to have preceded an explosion and fire that damaged all outside processing equipment including towers, pressure vessels and piping. Congestion of equipment and lack of water spray protection contributed to the loss which would have been still greater but for two employees who shut valves at considerable danger to themselves.
[separation]

Lessons

[None Reported]

132 1955

Source : BOOTH, G, PROCESS CHANGES CAN CAUSE ACCIDENTS, LOSS PREVENTION, 1976, 10, 76-79.
Location : Grangemouth; Scotland, UK

Injured : 0 **Dead :** 0

Abstract

O-nitrotoluene was being recovered by distillation under vacuum in a 1000 gallon jacketed still. The residues were held at 150 degrees C and air admitted. An exotherm took place causing an explosion. The still cover ruptured and the escaping vapours ignited.

Lessons

[None Reported]

116 22 December 1952

Source : LEWIS D J, CASE HISTORIES OF PAST ACCIDENTS, THE CAUSES AND CONSEQUENCES
Location : Bound Brook; New Jersey, USA

Injured : 21 **Dead :** 5

Abstract

A dust explosion occurred in a plant handling phenolic resin. The explosion started in a hammer mill which had an overheated bearing. Hot particles passed through ducting to the filter where the initial explosion occurred. Collections of dust on various floors also ignited as a secondary explosion and seriously damaged the building. Fatality.
[milling, bearing failure]

Lessons

[None Reported]

9844 1952

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

Abstract

In checking the safety relief valve logic for proposed modifications to one pair of coking units an existing fault was found. A cross connection had previously been installed between the distillation tower overhead systems of the two units. In doing so a valve had been installed in the line from the condenser to the overhead receiver. This isolated the receiver from the safety relief valve on the fractionator which had originally protected it. Now there was no protection for the receiver in case of fire if the valve was closed.
[gate valve, near miss, hydrocarbons, design inadequate]

Lessons

When any modification is made to a unit, however small, the safety implications must be reviewed as carefully as for a new unit.

99 06 March 1951

Source : 100 LARGEST LOSSES 9TH EDITION, MARSH & MCLENNAN PROTECTION CONSULTANTS LTD., 1986; NATIONAL FIRE PROTECTION ASSOCIATION, 1951-1952, VOL 45.

Location : Kobuta, USA

Injured : 0 **Dead :** 0

Abstract

A potentially very serious fire occurred in the refining section of a of a butadiene unit. The primary cause of the fire was leaking packing gland on a pump at a butadiene still. In attempting to change to the adjacent spare pump the operator opened a 6 inch valve without first closing a half inch bleeder valve in the line between the two pumps and approximately 4 inches form the 6 inch valve. The butadiene vapours released were probably ignited by an open flame at a chemical heater located 185 feet from the area. The fire burned for a total of five and a half hours and was fully extinguished after it had subsided by gradually cutting off the sources of fuel.

The operator and shift millwright received second degree burns.

[gas / vapour release, fire - consequence]

Lessons

[None Reported]

4326 Date Unknown

Source : LOSS PREVENTION BULLETIN, 112, 22.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A shutdown system was being tested by applying nitrogen pressure from a cylinder to check the correct operation of an alarm gauge at the base of a chlorine still.

With valve A closed, the pressure was supposed to be increased until the alarm operated. On this occasion there was insufficient nitrogen in the cylinder to activate the alarm so the operator vented the test line in order to attach a new cylinder. He omitted, however, to close any of the upstream valves B, C, or D and so vented the entire line, including a certain amount of chlorine which was trapped between A and B.

The operator, a contractor, was a competent person but unfamiliar with the system and incorrectly reasoned that he was venting only nitrogen. He was unaware that he was responsible for the lack of chlorine which became apparent and affected his breathing.

[testing, operator error, gas / vapour release]

Lessons

The following recommendations were made:

The particularly worrying aspect about this incident was that if valve A, the main chlorine isolation valve, had failed a very large quantity of chlorine could have been released.

Actions taken to prevent a recurrence were:

1. The procedure was modified to include a prior check that the cylinder contained enough nitrogen pressure to carry out the test.
2. The standards of training and experience required by those working on high hazard systems were defined and incorporated in the site instructions.

4990 Date Unknown

Source : ICHEME

Location : ,

Injured : 5 **Dead :** 0

Abstract

An epoxy resin is manufactured by the addition reaction of a primary/primary diamine and epichlorhydrin. A thermally unstable chlorohydrin intermediate product results, which is dehydrochlorinated with caustic soda to the desired epoxy compound. The resin formed in this step is dissolved in methylethylketone, the residual NaCl filtered off, and the solvent distilled off under vacuum at 125 degrees C.

Immediately before the required temperature was reached during distillation, an explosion occurred in the raw resin. Although both rupture discs of the reactor were blown, the entire dome of the vessel was lifted off. A secondary fire broke out, and five men sustained injuries and burns.

[amine, still, fire - consequence, injury, damage to equipment, runaway reaction, chemical missing]

Lessons

Due to an oversight, insufficient NaOH was charged for dehydrochlorination. Thus a substantial quantity of the thermally unstable intermediate was left. This led to the explosion during distillation.

5278 Date Unknown

Source : LOSS PREVENTION BULLETIN, 029, 137.
Location : ,

Injured : 0 **Dead :** 0

Abstract

The inner cone of a cyclone dust separator was clamped with its own flange between the upper flanges of the cyclone. Since the cyclone was earthed the inner cone was also earthed. A check revealed the flanges of the cyclone required reinforcing, so that the equipment would have the mechanical strength to withstand an internal dust explosion. When the modified cyclone was reassembled, the inner cone was no longer electrostatically bonded to it, but was completely isolated by non-conductive gaskets. Shortly after start-up sparking was observed on the outside of the apparatus between the flange of the inner cone and the flange of the cyclone due to electrostatic charging of the dust.
[lack of earthing, separation]

Lessons

[None Reported]

7643 Date Unknown

Source : LOSS PREVENTION BULLETIN, 134, 7-9.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A fire occurred on a carbon bed adsorber. The replacement of the carbon was completed and the adsorber beds were then deemed ready for pressure testing. This was carried out by closing the manual steam isolating valve to avoid the programmable logic controller (PLC) opening any incorrect connections, and pressurising with instrument air to 2 bar(g). Some leaks were repaired at this time. The Number 2 adsorber bed was in the correct step in the sequence for pressure testing the regeneration step, so the steam which had been on for some time was isolated manually, and the bed was pressurised to 2 bar(g) with instrument air and left for a period of two hours. The temperature of bed Number 2 rose rapidly from 138 degrees C at the start of the pressure test, but stabilised at about 150 degrees C, slowly rising a few more degrees over the next 2 hours. At this point, the PLC cycle was stepped on manually to allow the pressure testing of bed Number 3. This vented bed Number 2 and placed it on primary duty, so that it now had a large flow of air passing through it. The temperature of bed Number 2 dropped as soon as it had it had been vented, and shortly afterwards, the temperature rose rapidly, exceeding 450 degrees C. The maximum temperature was not recorded as the thermocouple failed at 454 degrees C.
This high temperature was spotted by the operators, on seeing the outside of the lagging on bed Number 2 glowing red hot. Realising that there was a bed fire, the operators investigated and in conjunction with the Fire Service, opened the bed and slowly applied water to the top of the bed to quench the embers. Whilst the fire in bed Number 2 was being extinguished, it was realised that bed Number 1 was on fire, and attention was subsequently switched to extinguishing bed Number 1. This was because the hot combustion products from the primary bed Number 2 were passing into the secondary bed Number 1, as arranged by the sequence of valves controlled by the PLC.
[adsorption, separation, fire - consequence, process control & instrumentation, computer]

Lessons

The following recommendations were made:
1. Those operating and maintaining the carbon bed adsorber system need to appreciate the potential hazards associated with carbon bed adsorption systems.
2. Immediately prior to making any changes to a carbon bed adsorber system, the effect of the changes on the safe operation should be assessed, and the reasoning behind the changes should be documented accurately.
3. Consideration should be given to the fitting of a form of over-temperature trip on the steam used for regeneration of carbon bed adsorbs.
4. Since the early detection of combustion in a bed can save the considerable damage that occurs before it is apparent externally that the bed is on fire, consideration should be given to the installation of carbon monoxide detectors on the outlets of the beds.

7503 Date Unknown

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

Injured : 0 **Dead :** 0

Abstract

A single phase solution resin was made from its monomeric ingredients in a white spirit solution. On completion the batch was drummed off through a fine 'full flow' filter.
A severe noise emanated from the filter (described as crackling like an old valve radio). Flow was stopped and the earthing of the filter and pipework checked. All was shown to be well earthed. However, to make doubly sure, a copper strap was wrapped around the filter and bonded to earth and every flange was strap bonded. The crackling reduced a little but was far from stopped.
The filter, originally at the end of the packout line was relocated as far away as possible when the problem was first `heard'. This had little, if any, effect on the filling operation. If the earth continuity of each drum was not perfect, a spark would ignite the contents. Some production staff believed it would even when the earthing was perfect.
Some time later one drum ignited whilst being filled and a small fire started. It was quickly extinguished. Further checks revealed no damage and drumming was cautiously resumed, without further incident.
[drums, fire - consequence]

Lessons

[None Reported]

8085 Date Unknown

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

The neutralisation pit on the alkylation unit caught fire when LPG was carried over from the relief gas scrubber and escaped to atmosphere.
The vapour was ignited by the nearby isostripper reboiler fired heater.
The unit was being recommissioned when an isobutane/HF (hydrogen fluoride) leak occurred at a flange on the isostripper condenser which necessitated a shutdown.
At the time of the incident, the isostripper was being depressured via the column's reflux drum to flare through the relief gas scrubber. The pressure in the gas scrubber increased and lime water followed by LPG was forced into the lime water tank and neutralisation pits. The LPG vaporised and escaped from the vent on the lime water tank and from the neutralisation pits via the overflow. The vapours were ignited at a nearby heater (pilots and some gas burners in commission). The municipal fire brigade was called in and the fire was extinguished within half an hour. No one was injured in the incident.
[fire - consequence]

Lessons

When the safety of the system is dependent upon instrumentation, it is important that such devices are reliable and subjected to detailed analysis so that all possible modes of failure have been identified and minimised in the design. Means should also be provided to ensure that such devices can be regularly tested. Some recent incidents have indicated that faults have only come to light when a demand has been placed on the protective system.

11133Date Unknown

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

Release of flammable gas from zinc dialkyldithiophosphate filter feed vessel. The filter feed vessel formed part of a plant designed for the manufacture of a range of thiphospate additives. Under normal conditions, the contents of the tank were stored at the correct temperature for filtration and no cooling or heating was required.
The tank had previously been used to store phenate additives prior to filtration. Phenate additive solutions required heating to lower the viscosity prior to filtration and this was achieved by means of a 120psig steam heating coil. The steam heating coil was not required for thiophosphate production and so the line had been blanked off.
At some point as part of an unplanned maintenance activity the blank on the steam line was removed. The most reasonable explanation for this is that steam was required to reheat a batch of zinc dialkyldithiophospahte that had cooled to below its filtration temperature.
On the day leading up to the incident, a batch of zinc dialkyldithiophosphate was added to the filter feed vessel at around 90 degrees C as normal. Nine hours later a plant operator noticed fume being evolved from the top of the vessel and noted that the temperature indicator on the tank was reading 207 degrees C. The building was evacuated at this point. Two operators re-entered the building wearing breathing apparatus and stopped the vessel agitator. They noticed that the steam spindle valve on the heating coil to the tank was in the closed position, but that the isolation valve upstream of this was fully open. They closed this isolation valve and upon checking in the filter vessel found the contents to have solidified. Very little hydrogen sulphide, which is a by-product of zinc dialkyldithiophosphate production, was observed to have been produced during the operation.
The vessel was among other on the thiophosphates plant that vented to the site boiler combustion chamber. This vent system allowed hydrogen sulphide gas to vent away from the tanks and adding sufficient steam into the vent header prevented back-flow.
Following the disturbances at the thiophospates plant, the site boiler was found to be steaming at a recorded maximum. As a result of this, the sour gas from the plant was redirected to the site stack. Approx. 2 hours later, the thiophosphates plant informed the boiler-house operator that the incident was under control and requested he direct the sour gas to the boiler
Over the next 24 hours, the steam supply to the coils was blanked, the temperature of the vessel was checked regularly and some of the liquid below the solid layer in the tank was drummed off.
25 hours after the initial #incident# was thought to be over a load roar was heard coming from the vessel and fumes were observed in the area. Although the temperature gauge indicated the tanks contents were steadily cooling in the period before the #roar#, a second and third roar was heard. Blue gas, which had the appearance of a blue flame, was observed and so the local Fire Brigade was called. At this point the cooling water supply to the vessel was opened. An hour later the violent eruptions had appeared to cease and the second #incident# was declared over.
The cause of the initial incident was identified as the passing steam valve. The cause of the second eruption was thought to be a gas layer, which had become trapped underneath the solid crust of the vessel contents suddenly being released when the tank was manually dipped. The temperature gauge had been rendered useless by the initial incident, but the operators did not realise that the readings were not representative in view of the solid layer formed. Had the operators taken the decision to cool the vessel after the initial incident, then the later incident is unlikely to have occurred.
[gas / vapour release, storage tanks, evacuation, overheating]

Lessons

The following observations/recommendations were made after the incident:
1. A full safety audit of the plant was scheduled.
2. The steam supply to the vessel was permanently disconnected and thiophosphates were not to be manufacture vessels capable of being heated in future.
3. The operators were trained that in the event of future incidents involving thermal runaway immediate steps were to be taken to cool a reacting mass, as temperature indication cannot be relied upon in these circumstances.
4. The company took steps to place high priority on the maintenance of high temperature and high hazard processes and ALL of the associated equipment.
5. Communications between the thiophosphates plant and the site boiler-house were criticised and steps were taken to improve the communication process.
6. The company updated the emergency procedure to make it less ambiguous as to when to call a full emergency.

2084 Date Unknown

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

A filter vessel used in the determination of oil content of slack wax contained a solidified mixture of solvent (methyl ethyl ketone) and slack wax. A laboratory worker added chloroform to the vessel and placed it on a warm water bath, with the intention of cleaning the vessel. On removing the vessel from the bath the mixture suddenly began to boil, and the liquid issued out of the two open connections in the vessel onto the worker's hands. The mixture ignited from the gas flame under the water bath and the man received burns to the hands.
[laboratory work]

Lessons

[None Reported]

4574 Date Unknown

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

Abstract

A fitter was instructed by his superior to repair a drain valve on the 1 1/2" foul water line from the Hydrofiner LP Separator. He was shown the valve location by an operator and it was confirmed to him that the line was not under pressure. However, a work permit was not issued. When the valve bonnet and spindle were removed, foul water containing H2S (hydrogen sulphide) was released from the line under pressure, catching the fitter on the chest and his assistant in the face. After copious washing with water neither suffered ill effects.
[spill, permit to work system inadequate]

Lessons

[None Reported]

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).

11903Date Unknown

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

On the early start-ups of a new crude oil vacuum distillation unit several internal explosions occurred as oil temperatures were raised above 100 degrees C. These damaged the column internally and the unit had to be shut down to repair them. The cause was found to be pockets of water left in dead ends from hydrostatic testing or steam purging. When hot air finally came in contact with the water, vaporisation was almost instantaneous due to the turbulence produced.
[water, hydrocarbon, start-up, vacuum distillation column, damage to equipment, safety procedures inadequate]

Lessons

Start up instructions must be very detailed and closely followed to ensure that all water is purged out of a unit before oil temperatures are raised above 100 degrees C. Precautions should include:
· Drawing of all low points in vessel and piping.
· Running both normal and spare pumps.
· Purging with oil any piping only used occasionally in normal operation, such as slop becycle lines.

11889Date Unknown

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

Due to carry over of water or emulsion from a crude unit desalter sudden vaporisation occurred in the down stream heat exchanges. This raised the pressure and popped the heat exchanger relief valves. The resultant severe vibration in turn caused a screwed nipple and valve on a heat exchanger drain to become disengaged from a coupling. The consequent crude leak was ignited by contact with a hot pipe.
[settling, separator, blowout, fire - consequence, excessive vibration, operator error, water, crude oil]

Lessons

1. Screwed pipework is prone to failure under vibration as many other incidents confirm.
2. Operators must be made fully aware of the dangers of sudden vibration. They should take action to prevent it even if this reduces throughout or disrupts steady operation.
3. Correct sizing and piping design can minimise chattering of relief valves.
5. Small bore piping must be properly supported to prevent vibration damage.

11844Date Unknown

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

Modification to a hydrocracker compressor resulted in seal oil flow increasing by more than 1000% sour gas was carried into the seal system and caused a build up of iron sulphide. Due to an addition of antifoam much of the iron sulphide went into suspension and this plugged both seal oil filters. The compressor shutdowns actuated, but one relay failed to shutdown the fresh feed pump. The cold feed backed into the recycle gas heater through a faulty non return valve and thermal shock opened a flange joint.
[hydrogen, non-return valve, gas liquid separation, filter, blowout, fire - consequence, modification procedures inadequate, safety equipment failure, reverse flow]

Lessons

1. Modifications to proven designs should not be approved without a full review of the possible consequences.
2. In this case there had been indications of problems before the incident occurred. The dose of an antifoam was then five times the normally effective dosage, in response to seal oil foaming problems.
3. The shutdown relay had corroded because it was not adequately protected from a temporary water pray system.
4. Non return valves can not be relied on to prevent reverse flow as previous experience on this plant and many others have demonstrated.

11824Date Unknown

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

A fluid catalytic cracking unit was being restarted after a 2.5 hour shut down due to an electrical fault. During the shutdown oil had leaked into the reactor and some of the oil soaked catalyst then leaked through the side valve into the regenerator. The catalyst there had fallen to a temperature which would vaporise but not ignite the oil. When air was fed to the regenerator a flammable mixture was formed and this was ignited by a spark in the electrostatic precipitator. [gas oil, start-up, cracking, precipitator, catalytic cracker, explosion, power supply failure, spark, design fault, safety procedures inadequate]

Lessons

1. A double block and bleed valve system was fitted on the gas oil feed lines.
2. The operators were provided with more detailed procedures for these circumstances.

11759Date Unknown

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

During start-up of an HF alkylation unit a butane pump suction strainer plugged. Valves were closed to isolate it but did not seat properly due to a heavy scale deposit. When the strainer cover flange was unbolted, the deposit on the valve seats broke loose causing a heavy release of butane resulting in an explosion and fire.
[blowout, explosion, fire - consequence, fouling, valve failure, safety procedures inadequate]

Lessons

1. Before opening up any equipment for maintenance, ensure that it has been vented down to atmospheric pressure.
2. In doing this, remember that infrequently used drains may be plugged.
3. On heavy plugged strainers, it is necessary to check that both inlet sides have been depressured.
4. As HF alkylation units are prone to scaling, plug valves, where the seats are protected from scaling when open, are nowadays used in critical services.

7052 Date Unknown

Source : LOSS PREVENTION BULLETIN, 021, 74.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A level indicator on a still base was reading "empty", although there was ample evidence that there was a level in it. The level indicator was of the radioactive type in which the source is on one side of the still and the detector on the other side. When the still is nearly empty, more radiation falls on the detector. Radiography of pipe-welds was in operation 70 yards (64m) away from the still and the gamma-ray source was shining in the direction of the still detector. This detector could not distinguish between the two sources of radiation and therefore indicated a low level in the still.
[level meter/control, instrumentation failure]

Lessons

At first sight the chance of this happening again seems so remote that preventative measures can be ignored. On the other hand in some circumstances a false reading could be dangerous. Before a Permit to Work is issued to carry out any radiography the issuing supervisor should therefore check round to see if there are any radioactive instruments in the area which might be affected. In addition, radiographers should be issued with a list of places on the site where radioactive instruments are used.

11907Date Unknown

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

In a light hydrocarbon vapour recovery unit after 20 years satisfactory operation, severe hydrogen blistering appeared in the top of the adsorber column. Ruptured blisters to a depth of one third of the vessel wall thickness were present. It was found that the water wash on the feed to the adsorber had been discontinued 6 months before due to a faulty rotameter. This water wash was there to remove cyanides and sulphides from the feed to the adsorber. These were the cause of the blistering.
[hydrogen cyanide, sulphides, separation, modification, absorption, damage to equipment, near miss, modification procedures inadequate, hydrogen blistering]

Lessons

1. Modification to operating procedures should not be implemented before an analysis of potential hazards has been made.
2. Hydrogen probes were installed in the vessel and the water wash flow was controlled so that rise in the probe pressures was minimal. There was then no further hydrogen blistering.

7067 Date Unknown

Source : LOSS PREVENTION BULLETIN, 021, 85.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A fire occurred at the suction filter of a recycle gas compressor in a catalytic naphtha reformer.

At the time of the incident the filter was being boxed up following the routine installation of new filter cartridges. The source of flammable material was high purity hydrogen recycle gas leaking through the filter isolation block valves and to atmosphere through the partially closed cover of the filter casing. The source of ignition was impact sparks produced when a steel filter clamp was struck by a steel bar during the tightening operations. Note that the minimum ignition energy of hydrogen in air is 0.02 mJ which is much lower than for hydrocarbons.

The fire was extinguished using a 150 lb, dry chemical extinguisher and no damage resulted.

At the time of the incident, the plant had been on stream for about three hours and the recycle gas contained an unusually high concentration of hydrogen (estimated to be 90%).

The significant feature of this incident was the ignition of hydrogen rich gas at ambient conditions by the impact spark produced by steel striking steel. From the observed condition of the filter and steel bar, the ignition mechanism was not considered to have been a thermite reaction (impact of rusty steel on an aluminium painted surface).

[mechanical spark, fire - consequence, maintenance]

Lessons

[None Reported]

7071 Date Unknown

Source : LOSS PREVENTION BULLETIN, 021, 71.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A filter had to be dismantled for cleaning. The inlet side was isolated, emptied and proved clear. The operator, as usual, assumed that the exit side would also be clear as any liquid left in it would have passed backwards through the filter into the inlet side.

The operator therefore removed the top cover and then tried to remove the filter element. It was stiff, so he tried to ease it out with a bar. It came suddenly, hitting the equipment overhead.

There was trapped pressure on the exit side of the filter and this blew out the filter element. The filter was choked and so the pressure could not be released through it.

Lessons

Before opening up a filter assume it may be choked and vent both sides. All filters should be fitted with drain and vent connections so that this can be done safely. A filter cannot be treated like a piece of pipe, it is more like a closed valve. This is particularly true if the filter has a process job to do and is not just there as a precaution to prevent damage to a pump.

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.

7102 Date Unknown

Source : LOSS PREVENTION BULLETIN, 018, 17.

Location : ,

Injured : 0 **Dead :** 0

Abstract

It was required to dehydrate a 600 g, sample of 3-phenoxy benzoic acid containing ca. 30% weight by weight by azeotrophic distillation. Toluene (2,000 g) was added to the wet acid in 5 litre spherical flask which was equipped with a condenser and separator and heated by an electric iso mantle. On addition of the toluene to the wet acid, water was observed to separate very rapidly. The contents of the flask were not agitated. The toluene solution of the acid commenced boiling at ca. 115 degrees C and after some five minutes had elapsed, the stopper on a spare arm of the flask and the condenser and separator were blown off. The contents of the flask were ejected to the ceiling some 2.5 metres above bench level. At 115 degrees C, the vapour pressure of water is 1268 mm Hg (0.692 bar gauge).
[operation inadequate, explosion, spill, laboratory work]

Lessons

It is very desirable to agitate in such cases. The laboratory technician had not been instructed to fit an agitator and was not warned of the potential dangers. Fortunately there were no naked flames and no one was smoking in the laboratory.

11658Date Unknown

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

A service station was extensively damaged by an explosion and fire after a faulty "O" ring seal around the top of a kerbside dispenser filter unit had allowed gasoline to drain from the dispenser via unsealed cable ducting to a switch room. Ignition was probably caused by the tripping of a non-flameproof master switch.
[fire - consequence, seal failure, damage to equipment, leak, spill]

Lessons

[None Reported]

7112 Date Unknown

Source : LOSS PREVENTION BULLETIN, 026, 49.

Location : ,

Injured : 0 **Dead :** 0

Abstract

An organic substance was crystallised from toluene, centrifuged, washed with water, the moist mass was then milled in a rotating mesh separator, sieved and the product obtained. Both the separator and the product were electrically earthed.
The separator discharged was covered and sealed with polyethylene film and a stream of air was passed through the machine to collect fines in the synthetic fibre dust sack.
In the course of this milling operation, the product suddenly caught fire. After a short time, the fire extinguished itself.
No-one was injured and material damage was slight.
The cause of the fire will never be known with certainty but it is possible that an electrostatic charge could be the source of ignition.
Partly-fused organic material was found between the rotating screen and the fixed housing of the separator. The analyses also show that the milled material, despite the washings with water, contained 1-2% toluene. It is possible that the encrusted material overheated and then ignited the toluene/air mixture.
[fire - consequence, overheating]

Lessons

[None Reported]

7123 Date Unknown

Source : LOSS PEVENTION BULLETIN, 035, 10.
Location : ,

Injured : 1 **Dead :** 0

Abstract

An operator had completed mechanical cleaning of a filter in the charging dome of a paddle drier and was flushing it with cold water which ran down into the drier. When he loosened the cover of the dome, the cover was lifted half-a-meter by the internal pressure and the operator sustained first degree burns in his face by the escaping steam.
Prior to the cleaning operation, the steam heating of the drier had been switched off, but its contents were still at a temperature of about 140 degrees C. Thus the incoming flushing water vaporised immediately.
[high pressure]

Lessons

For changing, or cleaning filters, the same safety precautions have to be applied as for discharging the plant i.e. it must be cooled until the temperature falls below 100 degrees C.

7130 Date Unknown

Source : LOSS PREVENTIONBULLETIN, 035, 4-5.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Originally, the inner cone of a cyclone dust separator was clamped with its own flange between the upper flanges of the cyclone. Since the cyclone was earthed, the inner cone was also earthed. A check revealed that the flanges of the cyclone had to be reinforced to withstand a possible internal dust explosion. When the modified cyclone was reassembled, the inner cone was no longer electrically bonded to it, being isolated by a non-conductive gasket. Shortly after start-up sparking was observed on the outside of the cyclone between the flange of the inner cone and the flanges of the cyclone due to electrostatic charge generated by the dust.
[lack of earthing, modification procedures inadequate]

Lessons

This is an example of a near miss which illustrates the hazard of a non-earthed conductive element of a comparatively high capacity in an environment where static electricity can be generated. It also emphasises the dangers of hazards which can be introduced into a plant when a plant modifications are made without proper hazard analysis, even when such modifications are intended to improve the safety of the plant.

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.

6843 Date Unknown

Source : LOSS PREVENTION BULLETIN, 002, 4.

Location : ,

Injured : 0 **Dead :** 0

Abstract

While a suspension of trichlorohydroxydiphenyl ether in petroleum spirit was being fed to a 3m2 vacuum filter, a fire broke out which spread to a second filter. The cause of ignition was the discharge of static electricity from the jet of suspension to the body of the filter.
[fire - consequence]

Lessons

Filtration in an inert atmosphere was later adopted.

7691 Date Unknown

Source : HUMAN ERROR, ICHEME, SAFETY TRAINING PACKAGE, 008, 61-63.

Location : ,

Injured : 0 **Dead :** 1

Abstract

An incident occurred when an operator opened a door to a filter on a catalyst before blowing off the pressure. Unfortunately he was standing in front of it and was crushed between the door and part of the structure and was instantly killed. Fatality.
[operator error, maintenance]

Lessons

The following recommendations were made:
1. Whenever someone has to open up equipment which has been under pressure, using quick release devices:
· Interlocks should be fitted so that the vessel cannot be opened until the source of pressure is isolated and the vent valve opened (one way of doing this would be to arrange for the handles of ball valves on the steam and vent lines to protect over the door handle when the steam valve is open and the vent valve closed).
· The design of the door or cover should be such that it can be opened about .25 inch (6 mm) while still capable of carrying the full pressure and a separate operation should be required to release the door fully. If the cover is released while the vessel is under pressure, this is immediately apparent and the pressure can be allowed to blow off through the gap or the door can be released.
2. The pressure gauge and vent valve should be located near to the door so that they are clearly visible to the operator when he is about to open the door. They were located on the floor above.
3. The handle on the door should be modified so that it can be operated without the operator having to stand in front of the door.

13021Date Unknown

Source : LOSS PREVENTION BULLETIN 149, 23,; CHEMICAL SAFETY SUMMARY, 1984, 55 (219).

Location : ,

Injured : 0 **Dead :** 0

Abstract

Oleum was stored in an outdoor 40m3 tank. For daily use the acid was pumped into a smaller indoor tank with a volume of 17m3. The latter tank was equipped with two safety devices; an inductive sensor, which shut off the filling pump when the right level had been attained in the tank, and a capacitive sensor, which acted as a protection against overfilling. The two systems worked independently of each other.

On the day in question the operator has started the filling pump to the 17m3 tank, after which he had left the room even though the instructions did not permit this when filling was taking place.

The inductive sensor was not functioning as it had slid away some millimetres from the float ball, and consequently no signal was generated. Evidently the capacitive sensor was not functioning either. The reason for this was corrosion of the instrument in a difficult atmosphere.

In the absence of the operator and as the two safety devices were not in order, oleum overflowed into a scrubbing system. When the acid came in contact with the sodium hydroxide solution in the scrubber a violent reaction occurred and approximately 50 litres of oleum were thrown out of the scrubber chimney. Fortunately, no one was injured in the incident.

[gas / vapour release, unwanted chemical reaction, material transfer]

Lessons

The following actions were taken to prevent a recurrence:

1. Operators have been given written instructions not to leave the tank when filling is taking place.
2. The capacitive sensor had been exchanged for an acid resistance type.
3. The inductive sensor has been glued to the tube.
4. Another inductive sensor has been attached to the tube just below the present one in order to enhance safety.
5. The filling pump has been coupled parallel to a blinking light so that operators are aware that the pump is running.
6. The instruments, as well as other key safety instruments, are to be included in the preventative maintenance system.

12689Date Unknown

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

High solids separator discharged hydrogen sulphide laden water into a common sewer leading to a separator. The incident occurred whilst an electrician was installing a vortex breaker on a pump in a concrete chamber. An entry permit was issued with all tests at satisfactory levels. No respiratory protection was required.
Causes:
The operating personnel failed to isolate sour water from hydrogen reformer and level control on sour watermelon opened discharging hydrogen sulphide laden water to sewer. Hydrogen sulphide flashed from water backed into concrete pump chamber.
Closing the valving at the sewer may have prevented this incident from occurring.
[isolation inadequate, operation inadequate]

Lessons

[None Reported]

6817 Date Unknown

Source : LOSS PREVENTION BULLETIN, 004, 5-6.
Location : ,

Injured : 0 **Dead :** 0

Abstract

This incident prompted an investigation of the use of condensate and de-mineralised water on the plant. Cold condensate was employed for gas absorption, any deficiency in condensate supply being made up by the more expensive de-mineralised water. The engineer in charge of services (steam, water, etc.) supplies, reported a 20% deficiency in the de-mineralised water balance.
A water flowmeter was found inoperative. The plant manager reported that he had the range of the instrument change twice and still the meter recorded virtually zero. The instrument was checked and it was found, when the plant was shutdown, that there was no orifice plate in orifice carrier.
Following this incident, a critical examination of the use of condensate and de-mineralised water was made throughout the works and it was concluded that with one exception, condensate would replace de-mineralised water, provided the quality was monitored continuously. Stringent quality levels were set.
[instrumentation failure]

Lessons

[None Reported]

6818 Date Unknown

Source : LOSS PREVENTION BULLETIN, 004, 8.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Solids were separated from acidic liquors on batchwise operated filters. Solvent was added to filter cake and live low pressure steam was admitted to the filter below the fixed bed. The 6 inch normal bore steam line conveying steam to the battery of filters failed. The plant was shutdown for repairs incurring two days downtime and considerable production loss. On this occasion some 30 feet of mild steel line was destroyed. Fortunately, no-one was injured. Subsequent investigation revealed that this incident had occurred previously, but had not been fully reported and investigated.
[steam failure, plant shutdown]

Lessons

Corrective action involved the installation of double block and bleed valves in stainless steel in the steam line to each filter.

6821 Date Unknown

Source : LOSS PREVENTION BULLETIN, 003, 18-19.
Location : ,

Injured : 0 **Dead :** 1

Abstract

About 50 litres of a suspension containing sulphide liquors overflowed from a fixed bed vacuum filter onto the floor of the manufacturing area. The floor was flushed with water into the plant drains where hydrogen sulphide escaped into the working area through the filtrate discharge pipework of a centrifuge connected to the same drainage system. A process worker fell unconscious to the floor, and although symptoms of hydrogen sulphide poisoning quickly disappeared, the man died three days later from injuries sustained in the fall.

Lessons

[None Reported]

6833 Date Unknown

Source : LOSS PREVENTION BULLETIN, 003, 4.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A carbate heat exchanger failed and allowed cooling tower water containing chromate to leak into a line which fed concentrated brine to mercury cells for electrolysis. The chromate ion in the brine caused massive evolution of hydrogen in the cell. The mixture of hydrogen and chlorine burned inside an electrostatic precipitator and damaged it as well as adjacent equipment.
[damage to equipment]

Lessons

[None Reported]

6842 Date Unknown

Source : LOSS PREVENTION BULLETIN, 002, 4.
Location : ,

Injured : 0 **Dead :** 1

Abstract

A fire occurred whilst washed solvent toluene was being transferred from a crystalliser into a stainless steel centrifuge via a Teflon pipe. The fire spread to the area surrounding the machine.
The source of ignition was static discharge within the centrifuge, which at the time of the incident was not equipped with an inert gas purging system. Fatality.
[fire - consequence, charging reactor, material transfer]

Lessons

[None Reported]

6951 Date Unknown

Source : LOSS PREVENTION BULLETIN, 011, 3-5.
Location : ,

Injured : 0 **Dead :** 7

Abstract

An explosion and fire occurred in a company's reforming unit. The explosion was so severe that a building comprising an office, control room and substation was almost completely demolished. The explosion was caused by an uncontrolled oxygen/gas detonation. The gas reforming plant reformed methane-bearing gas to carbon monoxide and hydrogen over a nickel catalyst under a considerable pressure. On the morning of the explosion, two reformers were in operation. The feed gas for both of these reformers was routed via a feed stream. The dual feed stream arrangement was a feature of an original 5-reformer plant. This was required for 4 and 5 reformer operation, which was the mode of operation in the early years, but utilisation progressively decreased later to only 1 or 2 reformers.

The four gas/steam valves were open and 1 was closed. One of the reformers was then taken out of commission because more of the feed gas was now being diverted to other sections of the plant. The operator then closed off a valve with the result that the feed gas to the other reformer was also shut off. He was under the impression that the closed valve was open. The oxygen trip came into operation and stopped all oxygen to the reformer. The four gas/steam valves were then shut by hand. In the meantime all available operators started investigating the cause of the trip-out.

A short while later the explosion took place in the gas/water separator situated next to the building and control room as well as in the product gas line to the synthesis plant.

Several factors contributed to this incident:

1. Inadequate monitoring and control safeguards against explosive mixtures, taking into account the human element.
2. Human errors, arising from inadequate communication and impulsive and uncoordinated problem evaluation and decision making.
3. Changes in the method of operating the reformers over the years , e.g. fewer reformers utilised and more on-off operation due to varying factory conditions.

Fatality.

[reforming equipment, fire - consequence, operator error, processing]

Lessons

The following corrective actions were taken:

1. Minimum gas flow on the trip system raised (feed gas/steam ratio to reformers).
2. Installation of an additional flowmeter on the main gas line to each reformer to activate an additional oxygen trip of all four oxygen streams.
3. All start-up operations to be co-ordinated from the control room only.
4. Only one very able person to do the evaluation, co-ordination and communication in all actions.
5. When the oxygen trip comes into operation the reformer is not to be restated until the cause of the trip has been fully established and corrected.
6. Unnecessary valves to be removed from the feed gas lines and only C,D, or E reformers to be used as long as the demand for reforming capacity is low.
7. The control room to be situated outside the plant proper (or safe distance).
8. Overall philosophy of running the reformers to be changed, with the aim of reducing start-ups and shut-downs to a minimum.

6849 Date Unknown

Source : LOSS PREVENTION BULLETIN, 002, 4.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Two minutes after charging a batch of granulate into a fluid bed drier, an explosion occurred causing considerable material damage. The inflammable materials were alcohol vapour and fine sugar powder. In the drier, dust was separated in a big bag filter made of metal grid covered with nylon fabric. There was an explosion damper on the outlet of the filter. There was an additional fine dust filter situated in a separate room after the bag filter. This was provided to reduce pollution. The exits of three other driers were connected together discharging directly to atmosphere. The filter bags were cleaned and washed several times a week. The fine dust filters were changed every two to three months.

No personnel were injured, but the plant sustained the following damage:

1. The hose pipes on the primary filters were blown out of the fittings, literally turned inside out and partly torn to pieces. The large plexi-glass plate in the lower manhole was blown out of the fitting.
2. The inspection cover plate of the fine filter was blown out.
3. Two walls made of 10 cm. thick plaster board in the room housing the fine filter were destroyed and the 3 square metre window was blown out with the flame.
4. The granular material in the drier glowed in several places on the surface but extinguished itself.
5. Small quantities of materials blown out of the drier burnt on the floor.
6. Traces of fire were observed in the drier and in the fine filter.
7. No fire broke out.

An investigation of the accident disclosed the following:

1. The material in the drier (120 kilograms) contained 12 litres of ethanol.
2. The fine dust consisted mainly of sugar.
3. The explosion occurred one to two months after start-up.
4. The fine filter was two and a half months in operation.
5. A nut detached itself from the manhole of the drier and was found in the alcohol wet granules. The nut fell onto the filter bag support and into the filter bag 5 cm. diameter made of nylon cloth (without earth wire grid).
6. At the start of a batch, the whole drier was full of alcohol air mixture.

We believe that ignition from an electrostatic charge was the probable cause for the following reasons:

1. The drying plant was in accident-free operation for three and half years and similar plants were in operation for over two years.
2. The nut was found in the nylon filter bag loaded with dust which was not earthed. The fabric could be charged electrostatically in a dust laden stream of air. The nut charged to the potential of the fabric could have stretched the filter bag to the vicinity of the earth part of the drier causing a spark and ignition of the air alcohol mixture.

It was not possible to replace the fine dust filter with wet de-dusting equipment. For the protection of personnel, the room containing the fine dust filter was constructed in the form of a bunker equipped with a large explosion vent in one wall and site glasses on the drier were covered with wire mesh. All nuts were protected by strong washers and all metallic parts were earthed.

[lack of earthing, dust explosion, batch reaction, damage to equipment]

Lessons

Static electricity is particularly hazardous with a flammable solvent, which has a relatively low ignition energy, and is present with powdered solids which act as static electricity generators when moved.

6860 Date Unknown

Source : LOSS PREVENTION BULLETIN, 001, 3.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Before start-up of a new plant, a temporary filter was installed in the compressor suction to catch any dirt that had been missed by the very thorough cleaning of the plant. The filter was located between the compressor and the low suction pressure trip.
The filter blocked with residual dirt and air was sucked into the compressor, either through leaking glands or leaking joints. The air-gas mixture exploded and this caused several joints to leak. The leaking gas ignited, causing considerable damage and several weeks delay in plant start-up.
Two compressed air lines were melted by the fire and the escaping air caused a localised fierce fire of such intensity that calcium silicate lagging protected with cement was melted. Severe damage was also caused to a concrete wall which had been made from pebbles. Limestone or blast furnace slag would have been better.
[explosion, fire - consequence, damage to equipment]

Lessons

[None Reported]

12058Date Unknown

Source : UNUSUAL INCIDENTS AND THEIR LESSONS, INSTITUTION OF GAS ENGINEERS JOURNAL, FEBURAY 1973.
Location : , UK

Injured : 0 **Dead :** 0

Abstract

During a cold spell in winter, difficulty was being experienced in operation of burners on a high pressure reformer plant due to fine particles of rust in the fuel blocking the fuel filters. A modification was proposed, which involved packing one of the filter baskets with fine steel wool. During this work a fire occurred which, despite operation of the shutdown system caused extensive damage.
The fire was caused by a release of naphtha fuel from the loosened cover of one of the filters, which had not been properly isolated before it was loosened. This had sprayed onto the furnace top and ignited. The intense heat caused bolts on another vessel to expand leading to further leakage of flammables feeding the fire.
[cleaning, isolation inadequate, fire - consequence, damage to equipment]

Lessons

1. Filters dealing with low flash point materials should be positioned at ground level and away from sources of ignition. Spillages should be contained in trays or bunds.
2. Each plant should be supplied from its own pump, rather than from a common service line.
3. Trip shut off valves should be positioned upstream of filters.
4. Alter baskets should be cleaned and left ready for service when shutdown.
5. Process personnel must check filters are safely isolated, before opening them.
6. Pressure gauges and draws on filters are not recommended as they are a weak point. A vent cock on the filter cover is preferred as a method of proving the filter is isolated and not under pressure.

6864 Date Unknown

Source : LOSS PREVENTION BULLETIN, 001, 15.

Location : ,

Injured : 0 **Dead :** 1

Abstract

An explosion occurred in an air eliminator located at the marine terminal loading facilities of an oil refinery. The flow heavy fuel oil component on a fuel oil blend had just started when the cover on the strainer, located between the air eliminator and Brodiemeter, blew off. A maintenance operator standing by to tighten the bolts in the strainer cover, in case of leaks, was fatally injured. There was only slight damage to equipment.

From the investigation that followed, it was apparent that:

The explosion had taken place in the air eliminator. The ball float had collapsed and on it was found comparatively large amounts of soot. The circumference of the air eliminator vessel had been extended 12 mm. There was no sign that any combustion had taken place in the strainer and the wire mesh basket was undamaged. The cover bolts from the strainer were tested for hardness and tensile strength, and calculation showed that a pressure in the filter of the order of 2200 psig would have been necessary for complete bolt failure. The bolts failed partly due to tensile stress and partly due to shear stress and the actual pressure that would be generated by a simple combustion explosion initiated at atmospheric pressure. It would be possible for a flammable hydrocarbon vapour/air mixture to be formed in the air eliminator during routine oil removal between shipments, by the backflow of vapours from the sump tank. This tank may have contained slop oil as light as gasoline. The opening of the strainer just before the explosion may have allowed sufficient air to enter the system to create a flammable concentration. The investigation could not conclusively determine the source of ignition which caused the explosion. Pyrophoric iron sulphide or coke deposits, and electrostatic discharge mechanisms were considered at length but rejected. The final conclusion was that adiabatic compression of the vapours in the air eliminator, as the vessel was rapidly filled and pressurised by heavy fuel oil, had generated a temperature above auto-ignition. The resulting explosion, initiating at a pressure approaching 150 psig, was sufficient to fail the strainer cover bolts.

This incident demonstrates that a compression ignition explosion hazard may exist where equipment is rapidly filled or pressurised, without prior purging out of air, from a high-pressure hydrocarbon source. The following conditions are necessary for such an explosion to occur:

1. The equipment has not been purged of air.
2. The equipment is pressurised with hydrocarbon while air remains trapped inside.
3. The pressure of the hydrocarbon source is sufficient to compress the vapour space and rise the final temperature to auto-ignition temperature or above.
4. The rate of pressurisation must be rapid, so that the heat of compression results in the vapour space reaching auto-ignition temperature, rather than heat being conducted away through the vessel wall.
5. The composition of the hydrocarbon air mixture must be such that the vapour space is in the flammable range under final conditions of pressure and temperature.

Fatality.

[unwanted chemical reaction]

Lessons

The following recommendations were made:

1. Purge air out of equipment before admitting hydrocarbon. This, of course, completely eliminates the problem and purging by nitrogen, steam, etc. is normal practice for commissioning plants and major vessels. It is not proposed that purging should be arbitrarily introduced for every individual item of equipment returned to service after maintenance, but purging is recommended, particularly for larger items of equipment, where conditions could favour compression ignition, and where recommended procedures 2, 3 and 4 below are not applicable or do not give sufficient protection.
2. Fill equipment with hydrocarbon from a low pressure source. Where a choice is available, normal procedure should be for the lowest pressure source of hydrocarbon to be used for filling equipment which has not been purged of air.
3. Admit hydrocarbon slowly. Filling hydrocarbon into equipment which has not been purged of air should be carried out slowly to minimise the temperature rise.
4. Vent air as hydrocarbon enters. Admission of hydrocarbon to equipment containing must be accompanied by venting of air at high points, (a) to reduce the rate of pressure build-up, and (b) to eliminate the hydrocarbon/air mixture as rapidly as possible.

6866 Date Unknown

Source : LOSS PREVENTION BULLETIN, 001, 4-6.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A cascade of reactors was fed with warm strong mineral acid. A by-product of the reaction of the acid with an organic material was a gas which passed to a gas scrubber to recover any entrained organic material. The scrubber was fed with the acid reactant.
An additional reactor was added to the train and while preparations were being made to establish this new unit, the existing reactors were brought on line. Suddenly the bursting disc on the new reactor failed despite the fact that the reactor was not in operation. A large quantity of acid was ejected.
The process operators had noticed the rising level in the reactor, as shown by the level indicators, but had ignored it because the reactor was not in operation. The bursting disc failed due to hydraulic pressure and examination showed that acid trickling down the walls of the off gas scrubber had entered the new reactor via the off gas line from the reactor to the scrubber. The off gas line was a directly rising line from the reactor to the scrubber and finished flush with the internal wall of the scrubber.
[reactors and reaction equipment, spill, bursting disc failure]

Lessons

An inverted U pipe projecting into the scrubber would have avoided this incident.

6888 Date Unknown

Source : LOSS PREVENTION BULLETIN, 006, 14.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A gasket failure on the top cover of a hydrotreater cold separator drum released hydrogen which was ignited from the plant furnace. The resulting fire was quickly extinguished and damage was minor. The gasket failed as a result of overpressure, estimated at 50 kg/cm2, compared with 38.7 kg/cm2 design pressure of the drum.

The overpressure resulted from solid ammonium chloride deposits which plugged the crinkled wire mesh screen installed in the drum up-stream of the vapour outlet connection. This caused the screen to be forced up into the vapour outlet piping, essentially blocking it. The pressure control valve and safety valve protecting the drum were located in the vapour outlet piping downstream of the screen, and were thus unable to relieve the pressure in the drum.

[overpressurisation, fire - consequence, solids deposition, separation]

Lessons

This incident demonstrates that a crinkled wire mesh screen must not be installed between a safety valve and the equipment it is protecting. This case, the safety valve should have been installed directly on the drum, upstream of the screen, rather than on the outlet piping.

6891 Date Unknown

Source : LOSS PREVENTION BULLETIN, 006, 17.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A steam heating coil of a batch vacuum distillation column was being withdrawn from the boiler for cleaning. The boiler had been emptied, but had not been cleaned, nor was it inerted, as it contained only materials of high flash point, normally considered perfectly safe.
Air entered the boiler when the vacuum was broken. The ignition source may have been heating caused by frictional contact of the coil and the coil branch on the boiler.
The explosion caused rapid ejection of the coil.
[design or procedure error]

Lessons

A safe procedure would have been:
1. Break the vacuum with nitrogen.
2. Cool down well below flash point,
3. or better, clean the boiler with steam or water.
Care is however needed in the use of water, which should not be used until the boiler temperature is below 100 degrees C, otherwise rapid evaporation will occur. The real cause of this explosion was the failure to realise that materials above their flash points which are normally safe at ambient temperatures become as dangerous as hydrocarbons such as petrol, and must be treated with respect.

6921 Date Unknown

Source : LOSS PREVENTION BULLETIN, 012, 14.
Location : ,

Injured : - **Dead :** 3

Abstract

During the final stages of distillation of crude 4-chloro-2-methylaniline (CMA) which was being stripped from high boiling residue under vacuum, the still exploded killing three operators and injuring several others. The crude CMA was manufactured by the chlorination of o-toluidine hydrochloride using CuCl2 (copper) as the catalyst. The catalyst was recovered by neutralisation and filtration of the crude product. Some catalyst was however carried with the crude product to the distillation plant.
Considerable laboratory investigations were carried out after the accident to establish the cause of the explosion. The studies revealed that CMA residue in contact with air at the distillation temperature CMA reacts with CuCl2 evolving HCl.
The source of the leak was a ball valve on a branch to the still. Since the residue has a tendency to creep up the wall of the still it is likely that the thermometer pocket was exposed and did not indicate the correct temperature. The residue would also block the vapour line leading to overpressure in the still caused by the evolved HCl gas.
The conclusion of the report describing the accident stated that the investigation that followed the accident should have been carried out before full scale operation of the process was undertaken. Moreover, several abnormal occurrences, e.g. overheating of residue, which did not result in an accident were apparently observed on previous occasions. These should have been investigated before manufacture was restarted. Fatality.
[design inadequate, injury]

Lessons

There are obvious lessons to be learned from this. The accident happened because the process and plant were designed with insufficient data. An extensive research work and investigation of the process had to be carried out after the accidents to elucidate their causes, work which should have been conducted before the design was undertaken.
To design a safe plant it is essential to:
1. Identify all components present in the process streams including all minor impurities which do not normally appear on the flowsheet.
2. Determine all the relevant physical and chemical properties of all the material and impurities.
3. Establish the reaction mechanisms and determine the kinetic and thermal data for all the reactions likely to occur.
4. Identify toxic, flammable and explosive hazards.
5. Explore the conditions well outside the normal operating range of concentration, temperature and pressure.

9633 Date Unknown

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

Injured : 0 **Dead :** 0

Abstract

Ammonia synthesis gas at 2000 psig was passed through a scrubber which was fed with weak aqueous ammonia. The liquid from the bottom of the column passed to a vertical hold-up tank with a 2 inch atmospheric vent. The level of liquid in the base of the column was controlled automatically. The control valve in the base of the column was controlled automatically. The control valve in this loop stuck in the open position. Liquid and gas from the column surged into the hold-up tank and ruptured it. The escaping gas was approximately 75% hydrogen and it ignited, causing a fire.
[control failure, fire - consequence]

Lessons

[None Reported]

7855 Date Unknown

Source : DUST EXPLOSION HAZARDS, ICHEME, TRAINING PACKAGES, 022, 4.13.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A filter unit in a plant processing polymer crumb suffered a major explosion. The force blew out the 4 rupture panels on the dirty side and 2 of the 3 discs on the roof of the filter unit. A serious fire ensued in the filter and around the plant due to ejected burning product. The fires were soon brought under control and extinguished without further incident.
The following conclusions were made:
It was clear from the damage that the explosion had originated in the lower half of the collector, beneath the grid. The most likely source of ignition was an electrostatic spark. The metal grid was loose fitting and not bonded to the earthed body of the dust collector. The powder had a high resistivity and deposits on both the grid and supports may have caused the grid to become isolated from earth. The mechanism for charge generation was the pneumatic transfer of material through pipework to the unit. Highly charged powder could raise the potential of the isolated metal until a spark occurred between the grid and the earthed filter body.
[lack of earthing, solids deposition]

Lessons

The following recommendations were made:
The primary recommendation was to secure the metal grid which separates the bag section from the lower plenum. It may be possible to remove the grid completely as its only function was to prevent fouling of the rotary valve in the event of a bag being detached. The grid mesh had to be widely spaced otherwise it would cause a restriction and impede flow to the explosion panels, in the event of ignition in the bottom plenum.
Tests needed:
1. MIE to evaluate electrostatic risk.
2. MIT to determine sensitivity of dust cloud.
3. Thermal stability tests to examine behaviour when heated.
4. 20 litrer sphere test for explosion relief design.
5. Train firing tests for assessment of fire/flame propagation (in the clean air ducting where deposition may occur due to seepage of dust).

7662 Date Unknown

Source : HAZARDS OF PLANT MODIFICATION, ICHEME, TRAINING PACKAGE, 002, 8.
Location : ,

Injured : 1 **Dead :** 0

Abstract

A flex was being used for a temporary supply of 7 bar (10 lbf/in2) steam to a still. A process worker was about to close the valve by which the steam entered the still when the flex burst and hot corrosive liquid came out and burnt the process worker.
After investigation the main causes were found:
1. The flex was of the wrong type, reinforced rubber. All metal stainless steel flexes should be used where corrosive liquids are present.
2. The flex was in poor condition.
3. The steam supply valve was isolated first which allowed hot liquid from the still to run back into the flex. The supervisor realised that the flex, installed by a previous shift was in poor condition, he was afraid that it would not stand the full steam pressure. He therefore, isolated it first and then shouted to the process worker, who was already in position, to isolate the still. Error of judgement.
4. The access was poor. The injured man could not get down the ladder because of the escaping liquid and had to wait while the supervisor fetched a ladder and helped him over the handrails.
[hose failure, spill, rupture, burns, distillation, injury]

Lessons

Avoid using flexes whenever possible when handling corrosive materials. If they have to be used:
1. See they are of the right type for the process material as well as for the service.
2. See they are in good condition.
3. See that operators understand that valves at the plant end of flexes must be isolated before valves at the service supply end.

7663 Date Unknown

Source : HAZARDS OF PLANT MODIFICATION, ICHEME, TRAINING PACKAGE, 002, 8-9.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A temporary start-up filter was put in a compressor suction line. Unfortunately, it was placed between the compressor and the low suction pressure trip. The filter choked, the compressor sucked a vacuum, some air was sucked in and this caused a decomposition reaction to occur further on in the process where the pressure was higher.
This caused two pipe joints to spring, the escaping gas ignited.
[gas / vapour release, fire - consequence]

Lessons

[None Reported]

7668 Date Unknown

Source : FIRES AND EXPLOSIONS, ICHEME, TRAINING PACKAGE, 003, 1-2.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A heating coil, normally connected to a steam supply, was being withdrawn from the boiler of a batch vacuum distillation column for cleaning. The boiler had been emptied but not cleaned or inerted as it contained only materials of high flash point, normally considered safe.
The cause of the explosion: The fuel was the material left in the boiler, which had not had time to cool below the flash point, about 80 degrees C. Air entered the boiler when the vacuum was broken. The source of ignition may gave been frictional heating caused by dragging the coil against the opening in the boiler. [friction heat]

Lessons

The following recommendations were made:
1. Break the vacuum with nitrogen and let the boiler cool well below the flash point of the contents before starting work or, better, clean the boiler with steam or hot water, the materials handled are soluble in hot water.
2. Do not put water into a vessel which is above 100 degrees C, or the rapid vaporisation of the water may cause damage.
3. Failure to realise that above its flash point, a safe material becomes as dangerous as petrol and must be treated with the same respect.

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.

7752 Date Unknown

Source : LOSS PREVENTION BULLETIN, 133, 17-18.

Location : ,

Injured : 0 **Dead :** 0

Abstract

An incident involved a crane performing a task on an ethylene unit when a flexible hydraulic line inside the engine compartment ruptured.
As the air filter was missing, some of this oil entered the open air inlet causing loss of normal control over the engine. The latter could not be stopped until all the oil had been lost, meanwhile some of the oil came into contact with the hot exhaust manifold and ignited. The resulting fire was quickly extinguished, the whole incident lasting approximately 5 minutes.
After investigation it was decided that the probable cause of the hose failure was one or both of the following:
1. The hose was incorrectly fitted to the vehicle.
2. The process of `swaging' the coupling onto the hose could, if overdone, have weakened it.
The following points support either of the above possibilities:
1. The hose was not hanging vertically, but was bent towards the front of the vehicle, which suggests there was very little slack.
2. When the fractured hose had been removed, it was noticed that the rubber sheathing had been damaged about 60 cm from the actual point of failure, and was caused by wearing against the casing of the torque converter.
3. When it was suggested that the new hose be fitted taking a slightly different route, not only did it hang free of the torque converter, but there was also more slack in it, such that it did hang vertically from the coupling.
4. This particular hose had failed previously and had been replaced, with the precise nature of the initial failure had not be established.
5. The process of swaging the coupling onto the hose i.e., squeezing the cylindrical portion of the coupling, so that its reducing diameter enables it to grip the hose, can, if overdone introduce internal stresses into the hose which could have either caused or contributed to the failure.
[fire - consequence]

Lessons

The following recommendations were made:
1. More care should be taken over the fitting of hoses to hydraulic equipment. If necessary an appropriate fitting course should be attended when new equipment is purchased.
2. Equipment items regarded as important but not essential to the operation of the machine, should be attached in such a way as to make their removal difficult. In this case the air filter could be attached by bolting to a flange.
3. All vehicles entering areas controlled by a permit to work should be checked visually by their drivers to ensure as far as is practicable the presence and correct fitting of equipment.

7754 Date Unknown

Source : LOSS PREVENTION BULLETIN, 133, 15-16.

Location : ,

Injured : 0 **Dead :** 0

Abstract

The incident occurred due to a fluorine fire in the base of a scrubber, resulting from an accidental high flow of fluorine to the scrubber. The incident, and the circumstances leading to it, are relevant to any scrubber system used for pyrophoric materials. Implementation of the recommendations could alleviate the possibility of similar incidents.

An operator noticed flames coming from the base of a fluorine scrubber tower, and immediately contacted the works fire brigade and the plant controller. The scrubber was a packed column type, using re-circulated potassium hydroxide solution to remove fluorine from process gases, prior to discharge to atmosphere. The fluorine that passed through the scrubber was generated in an electrolytic cell system. The Plant Controller immediately ordered the shutdown of the fluorine generating cells, and isolation from the scrubber. This had the effect of bringing on nitrogen purges and the fire burnt itself out in about 20 minutes, with minor damage to the scrubber base and none to any adjacent plant. Action from the fire brigade other than standby was not required.

After investigation it was found that:

The potassium hydroxide solution circulation pump feeding the scrubber was observed to be running at the time of the fire but of liquor to the scrubber was observed on the rotameter in the liquor feed line to the scrubber tower.

[fire - consequence,]

Lessons

The following recommendations were made:

1. A system of cell leak testing following valve isolation from plant or scrubber should be considered to ensure a satisfactory isolation has been achieved.
2. Plant management should improve plant monitoring arrangements to enable abnormal frequencies of events or actions which individually are normal to be identified.

The control valve on the scrubber recirculating line should be replaced with an alternative design less prone to blockage by debris.

7833 Date Unknown

Source : BARTON J AND ROGERS R, CHEMICAL REACTION HAZARDS, 2ND EDITION, ICHEME, 1997, APPENDIX 1, 193.
Location : ,

Injured : 0 **Dead :** 0

Abstract

During vacuum distillation an exothermic decomposition of dimethyl sulphoxide (DMSO) occurred, blowing the chargehole cover off the reaction vessel. The flammable contents released and ignited causing a second explosion which extensively damaged the building. The still had been shut-down to attend to a minor leak but the steam heating had been left on in error. The contents of the still were contaminated by accumulation residues from previous batches and the poor cleaning of the plant catalysed the exothermic decomposition of DMSO. The vessel had not vent.
[cleaning inadequate, design inadequate]

Lessons

[None Reported]

7847 Date Unknown

Source : MANAGING FOR SAFETY, ICHEME, TRAINING PACKAGES, 017, 4.59.

Location : ,

Injured : 0 **Dead :** 1

Abstract

A filter housing in a nitrogen housing circuit which provides seal gas to a turbo expander ruptured while an operator was pressurising the system. Fragments from the 360mm long by 100mm diameter cylindrical housing struck the operator inflicting fatal injuries.
Investigation revealed that the filter housing rupture was caused by overpressurisation of the housing to about three times its design pressure. The overpressure regulator in the circuit failed to maintain the system pressure within the design limits. Also the excess pressure could not be relieved by the pressure relief device because it had been inadvertently isolated from the circuit during a piping modification. Fatality.
[isolation inadequate, processing, modification procedures inadequate]

Lessons

[None Reported]

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.

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.

7858 Date Unknown

Source : DUST EXPLOSION HAZARDS, ICHEME, TRAINING PACKAGES, 022, 4.27.

Location : ,

Injured : 0 **Dead :** 0

Abstract

A wet type dust collector was located in the open air and was used to filter aluminium dust from a finishing machine. The water level in the collector had been reduced to prevent water splashing from the lid of the machine. An explosion occurred immediately the fan motor was started after maintenance causing burn injuries to the engineers standing by the open front of the unit.

The following conclusions were made:

Thermite sparks of the type produced when both aluminium and rust are involved are extremely energetic. The exothermic reaction initiated by the heat from the impact can raise the spark temperature to several thousand degrees Centigrade. Such sparks therefore are capable of igniting many dusts.

The sensitivity of powders to these sparks is difficult to determine. There is evidence to suggest that the ignition sensitivity of dust clouds to a variety of sparks (e.g. single impacts, grinding, flintstone etc.) can be predicted from both the MIT value and MIE value. However, great care is needed when applying these assumptions as anomalies have been found.

[thermite reaction]

Lessons

The following recommendations were made:

Recommended safety measures included resetting the water level to the required level to ensure that dust capture was more effective. The mild steel fan blades were also replaced with a non-sparking type. Procedures were instigated to clean the inside of the filter unit regularly, to avoid accumulation of aluminium dust. Steps were taken, additionally, to ensure that hydrogen would not accumulate within the filter unit.

Test needed:

1. MIE to evaluate electrostatic risk.
2. MIT to determine sensitivity of dust cloud.
3. 20 litre sphere test for explosion relief design.
4. Train firing test is not necessary as finely divided metals are known to be pyrophoric when moist.
5. Gas evolution test to define ventilation rates.

7859 Date Unknown

Source : DUST EXPLOSION HAZARDS, ICHEME, TRAINING PACKAGES, 022, 4.33.

Location : ,

Injured : 0 **Dead :** 0

Abstract

Explosion in cereal processing plant. An incident occurred which caused a suppression system to operate. The explosion in the filter unit caused the inspection door frame to open which allowed the release of flame into the workspace along with unburnt dust and suppressant.
The cause of ignition was identified as the milled material binding on the screen of the mill which, through self-heating, began to decompose and smoulder.
[decomposition, solids deposition]

Lessons

Tests needed:
1. MIE (minimum ignition energy) to evaluate electrostatic risk, e.g. (discharge from highly charged powder).
2. MIT (minimum ignition temperature) to determine sensitivity of dust cloud to hot surface ignitions.
3. Thermal stability tests to examine behaviour, e.g. (gas generation when heated).
4. 20 litter sphere test for explosion protection design.
5. Train firing tests for assessment of flame propagation risks from deposits of material in pipework etc.

7893 Date Unknown

Source : LOSS PREVENTION BULLETIN, 090, 9.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Problems were encountered with the discharge from a pilot plant, batch operated centrifuge containing an internal filter cloth. To check that it was running true, a fitter, therefore, disarmed the microswitch on the lid and leaned over to observe rotation of the basket. Whilst so doing he accidentally dropped a spanner into the basket necessitating a crash shut down.
[maintenance, plant shutdown]

Lessons

Equipment and pipelines should be thoroughly decontaminated before outside personnel are allowed to work on them. Only properly secured access equipment should be used and climbing on pipework, plant fittings, etc. should be prohibited. In addition to any protective gear required to guard against exposure to materials handled, personal protection should include appropriate foot and head wear. A strict standard of housekeeping is of paramount importance, hoses should be coiled and replaced immediately after use and never left trailing across part of the floor. Regular facility inspections are crucial as a means of monitoring compliance with company policy and codes.

7895 Date Unknown

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

An operator raised a hydraulically operated platform to the desired working height by moving the platform actuator to the 'raise position'. The task was completed and the operator tried to return to ground level by moving the actuator to the `lower position', but the platform did not respond. He then returned the actuator to the 'raise position' and the platform responded correctly, however another attempt to lower it failed.
The operator therefore returned the actuator to 'neutral' and opened the platform Emergency Lower Valve, but the platform slowly rose, approaching a dangerous position regarding operator safety and structural damage.
The operator attracted the attention of a colleague who stopped the hydraulic pump. There was no Emergency Stop Control fitted on the platform.
After an investigation it was found:
The incident arose because of a design shortcoming and a blocked filter.
The effect of the blocked filter was that when the accuator was in the 'neutral' position the pressure relief valve (PR) opened due to the high back pressure caused by the blocked filter. If the actuator was moved to the 'lower' position the combination of the blocked filter and the restriction at the PR valve allowed sufficient back pressure to remain trapped in the return line to hold the platform at the same level.
If the accuator was moved to 'neutral' and the Emergency Lower Valve opened the high pressure in the return line due to the blocked filter is maintained by the pump and backs up to the elevator ram causing the platform to raise.
[design inadequate, tools & access equipment, flow restriction]

Lessons

Return lines from emergency lower valves on this type of system should go directly back to the hydraulic fluid reservoir and not via the filter or any component which could cause a significant flow restriction.
Daily/before use service and operability checks of the hydraulic elevating mechanism should be made.
In addition to following manufacturer's maintenance recommendations, the hydraulic oil reservoir should be purged of water at least annually, and at the onset of winter freezing conditions.
An Emergency Stop which can be operated from the platform should be fitted which will cut off the power to the hydraulic pump engine or motor.

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]

8784 Date Unknown

Source : STATESIR W.A, EXPLOSIVE REACTIVITY OF ORGANICS AND CHLORINE, LOSS PREVENTION VOL 7, AICHE, 1973, 114-120.
Location : ,

Injured : 4 **Dead :** 0

Abstract

A filter in liquid chlorine service violently exploded and propelled shrapnel up to 50 feet away. About 160 lb of chlorine were released to the atmosphere, exposing four employees to chlorine fumes.
Liquid chlorine was to be fed from a ton cylinder through a polypropylene cartridge type filter at ambient temperature to a positive displacement pump, and then through a steam-heated vaporizer to a process. Prior to the explosion, new polypropylene filter elements had been installed. At 2.30pm the filter exploded releasing a white cloud (probably HCl) followed by a large evolution of chlorine gas. Steel shrapnel from the exploding filter case caused varying degrees of damage to nearby equipment and building facilities. Chlorine was shut off at the ton cylinder by two men wearing breathing apparatus. Inspection of the area revealed significant amounts of carbon residue on the pieces of shrapnel and on the concrete floor in the nearby vicinity of the filter.
[gas / vapour release, processing, runaway reaction]

Lessons

The following conclusions were drawn and recommendations made:
1. In the opinion of the explosion experts who examined the pieces of shrapnel and evidence of carbon, the explosion was determined to have been a high level deflagration, not a detonation.
2. The explosion may have developed up to 10,000 lb/sq in. in order to cause rupture to the filter.
3. The explosion was a result of a runaway chemical reaction between chlorine and the polypropylene filter element. The reaction was probably initiated by Zinc Chloride. Analysis of the filter core indicated a high concentration of Zinc Oxide present as a filler in the polypropylene which had apparently chlorinated to Zinc Chloride. Furthermore the polypropylene was found to contain traces of many other metal elements which could have contributed to catalyzing the explosive reaction.
4. Chlorine feed system materials of construction to be restricted to steel, stainless steel, nickel alloy, polymerised tetrafluoroethylene and glass. Chlorinatable organics, including partially chlorinated hydrocarbons and moat polymers, must not be used for chlorine service.
5. Although the single diaphragm positive displacement pump was determined to be in proper operating condition and did not contribute to the cause of the incident, the investigation revealed that a double diaphragm pump with an inert fluid between the process and the oil to be specified for this system to prevent possible reaction of chlorine with the hydrocarbon oil used in the pump.

9619 Date Unknown

Source : MANUFACTURING CHEMISTS ASSOCIATION 1966 VOL. 2, CASE HISTORY 645.; LOSS PREVENTION IN THE PROCESS INDUSTRIES, F. LEES.
Location : ,

Injured : 0 **Dead :** 0

Abstract

The loaded basket of a 48inch suspended type centrifuge suddenly became unbalanced and in consequence the shaft flew out and broke the outlet pipe of an adjacent centrifuge. The investigation indicated that the imbalance had been caused by a sudden escape of cake from one side of the basket due to a hole in the cloth.
[centrifuging, leak]

Lessons

[None Reported]

9628 Date Unknown

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

Injured : 0 **Dead :** 0

Abstract

A vacuum system failed on a small still distilling a chloronitro compound. This allowed the temperature to rise and give a self accelerating decomposition. A large still adjacent to the small one was seriously damaged.
[distillation, damage to equipment]

Lessons

[None Reported]

9658 Date Unknown

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

Injured : 0 **Dead :** 0

Abstract

During plant commissioning a temporary filter was put in a compressor suction line. The filter was located between the compressor and the low suction pressure trip. The filter blocked, the suction pressure fell below atmospheric, air was sucked in and a decomposition reaction occurred further on in the process where there was a higher pressure. Two pipe joints sprung and gas escaped and ignited. The resulting fire caused £100,000 damage and delayed the commissioning many months.
[low pressure, gas / vapour release, fire - consequence, damage to equipment]

Lessons

[None Reported]

7154 Date Unknown

Source : LOSS PREVENTION BULLETIN, 042, 16-17.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Shattering of a glass condenser. The plant was operating at 75% rates with three precipitators on line and everything appeared normal. The No.3 precipitator was operating at 50% rate under standard conditions except for a slight increase in body pressure, by about 10 to 20 m bar (4 inch to 8 inch W.G.).
At about 14:30 an operator in the plant control room heard a bang from the vicinity of No.3 precipitator. On investigation he discovered that the top of the No.3 precipitator vents condenser had shattered and hot water at 95 degrees C was issuing from the broken condenser. He immediately shut down the precipitator by isolating all the feed streams and stopped the water circulation pump.
Damage was limited to a fracture in the 5 m2 (50 ft2) of a glass condenser. No personnel sustained injury.
[damage to equipment]

Lessons

[None Reported]

7479 Date Unknown

Source : LOSS PREVENTION BULLETIN, 095, 6.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A spray drier was fitted with adequately dimensioned, self-closing pressure vents, which, in the case of a dust explosion developing in the drier, could open and immediately close again.
The spray drier and also the relevant filter were earthed in accordance with regulations and the filter bags were electrostatically conductive. All the electrical equipment coming in contact with the product was designed to be proof against dust explosions.
Diverter plates were placed in the region of steps leading to the installation, these were to ensure that workers finding themselves on the steps could not be injured by any flames from the pressure vents. As a further measure, the firm had placed chains with plates at all exits leading from this servicing stairway to the stages and these notices prohibited access to the stages while the drier was in operation.
Although it was believed that all measures had been taken for safety against dust explosions, a dust explosion did occur in the spray drier and in the filter, and the pressure vents in the spray drier duly reacted. The cause of the explosion is not quite clear, it was presumed that a dust deposit was ignited by a smouldering fire.

Lessons

[None Reported]

7178 Date Unknown

Source : LOSS PREVENTION BULLETIN, 049, 10.

Location : ,

Injured : 1 **Dead :** 0

Abstract

Failure to follow lock-out procedures. An operator was replacing a roller chain, key and sprocket for a set of squeegee rolls on a metal scrubber and had failed to lock-out and tag the power to the cleaning line metal scrubber.
The squeegee rolls are powered in two ways.
1. Jog position by motor drive on squeegee rolls.
2. By metal running over the rolls when in the run position.
The operator had his finger on the sprocket when the assistant operator jogged the machine. The operatorss middle finger on his right hand was caught between the chain and sprocket. The finger was so badly crushed that it had to be removed by amputation.
[maintenance, isolation inadequate, inadequate guarding, injury]

Lessons

The important lesson of this injury is that engineers, supervisors and other professional people may subject themselves to severe injury by not taking all the precautions necessary, especially those relating to locking-out equipment, keeping guards in place and keeping out of dangerous areas.

7193 Date Unknown

Source : LOSS PREVENTION BULLETIN, 051, 16.
Location : ,

Injured : 0 **Dead :** 0

Abstract

An amine was produced by reduction with a nickel catalyst, and the production melt purified by clarification through a filter at 135 degrees C. On completion of the filtration, the filter was blown through with compressed air to remove residual melt. During this process the contents of the collecting vessel ignited.
On evidence of the colour of its metal parts, the filter must have attained a temperature of over 500 degrees C. A temperature rise was apparently caused by finely divided catalyst residues. Glowing particles or spontaneous ignition finally lead to the fire.
[separation equipment, fire - consequence, high temperature]

Lessons

[None Reported]

7197 Date Unknown

Source : LOSS PREVENTION BULLETIN, 053, 22.
Location : ,

Injured : 1 **Dead :** 0

Abstract

Six workers were removing gravel from the sand filter of a spin bath. Because hydrogen sulphide was present the entry permit stated that breathing masks must be worn. One of the men, whom it was subsequently found had never been trained in the use of the breathing equipment, happened to be one of the two delegated to work inside the filter filling buckets. He put the mask on without adjusting it or regulating the volume of air supply and went into the filter. Starting to shovel, he felt dizzy and weak. He looked to tell his fellow worker not to get in, lifting the mask at the chin. His fellow worker turned around and saw him lying on the gravel without the mask. Another man, without using the emergency mask, got into the filter and with help lifted him outside.
This accident, like so many others, could have resulted in two fatalities. The injured man had not been properly trained and the supervision was inadequate. Also the vessel entry permit was not properly used, the filter should have been inspected by a supervisor and should have been adequately ventilated. [entry into confined space, breathing apparatus, training inadequate, injury]

Lessons

[None Reported]

7264 Date Unknown

Source : LOSS PREVENTION BULLETIN, 078, 9.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Two men who were using a new breathing apparatus trolley unit suddenly found their air supply was cut off whilst they were working inside a tank. Fortunately they were able to escape without any ill effects.
After investigation, it was found that PTFE tape had been applied over the end of the air supply valve thread, obstructing the outlet. Excess pieces of tape were also found partially blocking a filter.
[entry into confined space, safety procedures inadequate]

Lessons

The following recommendations were made:
1. Use tape sparingly, one or two turns should be sufficient.
2. Wind tape in the direction of the thread.

7270 Date Unknown

Source : LOSS PREVENTION BULLETIN, 083, 25-26.

Location : ,

Injured : 0 **Dead :** 0

Abstract

The failure of a gauge glass on a filter resulted in a high pressure release of relatively pure hydrogen and entrained lube oil. The vessel operated at 103-107 bar g at 149 degrees C maximum. Rapid response by operators had upstream compressors shutdown and isolated. Probable failure of the glass was thought to be a burr on the surface of the gauge glass gasket, creating stress resulting in the brittle fracture failure of the glass. The manufacturer received the failed gauge glass, installed the new glass and pressure tested the glass at 345 bar for twenty-four hours without failure. The burrs were left on the gasket surface. It was suggested that the failure was caused by a damaged glass. Near miss.
[gauge glass failure, reaction vessel]

Lessons

The following recommendations were made:
To identify and retrofit all vessels with gauge glasses operating above 34.5 bar in non-fouling service with excess flow valves. The necessity of hydro-testing gauge glasses prior to installation be made.
It should be taken into account that not only the pressure but equally the volume of the product itself and the location of the drum equipped with level glasses should be considered when retrofitting excess flow check valves. Also the gauge glasses with magnetic followers for example are an appropriate loss prevention measure.

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.

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.

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]

7622 Date Unknown

Source : LOSS PREVENTION BULLETIN, 130, 19-20.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Glowing embers in fluidised bed drying operations.
The drying operation occurred in two stages. In the first the moist product was broken down into lumps of around 1 cm diameter, and dried in a continuous process in a fluidised bed drier. To assist the flow of the chips along the bed, a number of additives (totalling much less than 1% of the output from the dryer) in a solution were mixed with the chips before they went into the drier. In the hazards assessment for the process, no adverse interactions between any ingredient in the solution or between the product and any ingredient were found.
The dried chips were further processed before being sprayed with another set of additives (also amounting to much less than 1% of the product) and then dried again, this time with a smaller chip size than previously. Again, no adverse chemical interactions were found prior to commissioning.
The first incident occurred when the filter elements in a polishing filter on the output side of the primary dust collectors were changed. Surprisingly, the embers were not seen whilst the filter elements were being changed, but over eight hours later when the discarded cartridges were found to be smouldering in the skip outside the factory building.
The second incident occurred whilst drying fine material recovered from the primary dust filters. This resulted in a lower grade of product, which was still saleable and reduced waste. Due to an oversight, the temperature of the fluidised bed was not reduced for the different feed, and glowing embers were observed by operators halfway down the bed a short time after processing began.
The third lot of charred powders were found by a commissioning engineer whilst a new drier was being brought on-line. The first runs were conducted with (expendable) recovered fines. A blockage occurred in a hopper underneath a dust filter, and some (cold) charred material was found in the blockage.
[heating, near miss, testing]

Lessons

Standard battery tests did not spot the problem, because all materials tested were plant samples, and the principal components of the problem reaction were massively diluted and apparently separated in the process. A new testing regime was needed which tested not only the mixtures expected to arise on plant, but also all those which could arise, even if they contain materials which are intended to form only a tiny fraction of the product.
Even tiny changes in formulation can give rise to wholesale changes in the properties of the product. The effects of formulation changes on the hazardous properties of materials were checked to ensure that the basis of safety for the process remained valid.

10418Date Unknown

Source : LOSS PREVENTION BULLETIN, 141, 11-13.;
Location : ,

Injured : 0 **Dead :** 0

Abstract

A fire and explosion occurred within a mixer unit which was being used to mix polystyrene powder with dyestuff.
The incident involved a generation of flame and pressure, alarming personnel situated up to 100m from the unit. Damage was caused by heat and pressure to the filter, fan and ducting enclosed by a wood and glass partition. The mixer had been used with the product for about five weeks, prior to this PVC powders had been processed through the unit. The polystyrene and the particles, generated before the powders entered the mixer. No injuries were sustained by any of the personnel present.
The cause of the incident:
The ignition of the fine powders was caused by an unknown source. Though possible ignition sources included:
1. Smoking materials being carried into the fume exhaust located near the mixer.
2. Tramp metal in the mixer.
3. Static electricity in either the mixer and / or filter. This uncertainty over the source of ignition, let to the investigation being unable to clearly establish the actual cause of the incident.
The severity of the fire was increased by the fan continuing to run during the incident, enabling the filter stockings to burn and melt. While the ignition probably occurred in the filter or the mixer.
[mixing, fire - consequence, damage to equipment, dyestuffs]

Lessons

An investigation made a number of recommendations which were divided into three main areas:
Reduction of the likelihood of ignition sources being present by:
1. The prohibition of smoking.
2. The installation of magnetic separators to remove tramp metal.
3. Reconsidering use of polyester filter stockings.
The provision of explosion protected by:
1. Installation of explosion relief on the filter, ducted to outside the building.
2. Installation of rotary valve at base of filter to protect product bin.
3. Fan motor and switchgear being suitable for use with an explosible dust.
4. Ensuring partitioning is strong enough for the purpose, non-combustible and unglazed.
With some additional general points involving:
1. The potential improvement in housekeeping by the reduction dust escaping from the system.
2. The need to ensure that flammable cleaning liquids are not stored in the vicinity of the unit.

7532 Date Unknown

Source : LOSS PREVENTION BULLETIN, 104, 27.

Location : ,

Injured : 0 **Dead :** 0

Abstract

An operator on a hydrodesulphuriser unit was on the plant when the hydrogen disulphide alarm sounded. He felt dizzy at the same moment and ran from the area. At the plant boundary he collapsed, but regained consciousness almost immediately and walked to the panel room unaided.
Investigation revealed that the source of hydrogen disulphide was the vacuum drier ejector condensate separator vessel which vented to an atmospheric pressure header which discharged at a safe location. Over pressuring of the vessel was prevented by means of a water filled swan neck arrangement.
Disturbance of plant operation had given rise to abnormally high gas flows, but the effect was increased due to restriction of the vent header discharge due to a partly blocked vent line and flame arrestor. As a result the seal on the gas/liquid separator was blown and hydrogen disulphide containing gas was released.
The vent gas header system had a history of internal corrosion, as was to be expected in view of the presence of hydrogen disulphide, oxygen and moisture.
Although the immediate vent line from the separator to the header was steam traced, no such provisions existed for the header itself, where the same conditions could be expected. This section was subsequently found to be partially blocked with corrosion products and sulphur.
[gas / vapour release, seal failure, overpressurisation, incorrect flow rate, separation]

Lessons

[None Reported]

7534 Date Unknown

Source : LOSS PREVENTION BULLETIN, 092, 13-14.

Location : ,

Injured : 0 **Dead :** 0

Abstract

Operators were starting their shift when they noticed that both the caustic soda solution base tanks, which feed the AHF (anhydrous hydrofluoric acid) vent scrubbers, were empty. Each of the two base tanks had been charged with approximately 2.5 m of freshly prepared 4% caustic soda solution at the end of the previous week, and the vent scrubber system had been left circulating for the weekend's operations.

During the weekend, approximately 4 m of 4% caustic soda solution was discharged from the base tanks of the AHF vent scrubber system at the tank farm. Some 1.3 m of the scrubber solution was transferred to another storage system via the manual vent lines. The fate of the other 2.7 m solution is unknown but it seems that it was either pumped to the effluent treatment plant lime slurry tanks or discharged to the acid drain from one of the base tank drain valves.

Lessons

The following recommendations were made:

1. All valves situated between the bases of the two AHF vent scrubbers and the two scrubber base tanks to be replaced by distance pieces, such that wrong operation of these valves could no longer lead to "backing-up" of caustic soda solution into the vent systems.
2. The outlet valves from the two base tank to be removed and replaced by distance pieces to ensure that the caustic solution flow to the scrubbers may not be interrupted by wrong operation of these valves and both tanks will run in parallel serving one scrubber.
3. The scrubber not in use at any time to be spaded off from the caustic soda solution system at the scrubber circulation pumps outlet manifold.
4. The full output from the scrubber pump to be delivered to the vent scrubber in use and to be kept closed, thus ensuring maximum possible wetting of the scrubber rings.
5. The No. 1 scrubber re-circulating pump be spaded from the vent scrubber system and be dedicated to delivery of 27% caustic soda solution to the effluent treatment plant. The No. 2 scrubber pump will continue to be dedicated to the vent scrubbers. Only when maintenance is necessary to either pump will the process supervisor have the spade removed.
6. The scrubbers should only be operated when venting is taking place and an operator is in attendance. The scrubbing system will be shutdown at other times.
7. The tank farm operating instructions for the AHF vent scrubber operations to be re-written to incorporate the recommendations and the operators be trained fully using this new instruction. All valves and plant should be suitably labelled, in line with these new instructions.

7535 Date Unknown

Source : LOSS PREVENTION BULLETIN, 092, 11-12.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A leak occurred at the base of a seal pot, beneath the vent scrubber in an outside compound, the fire brigade were dispatched to the scene.
When the fire brigade arrived at the scene, plant personnel were attempting to isolate the source of the leak and soon afterwards the leak was stopped when valves inside the plant had been closed. As the leak was stopped an observable fume appeared to be confined to the building compound area, it was not necessary to declare a site emergency.
After the leak of HF (hydrofluoric acid/hydrogen fluoride) fume had stopped, it was noticed that nitrous fumes had started to emerge from a neutralising pit in the scrubber area. This was a result of acid from the original leak entering the pit and reacting with a normally alkaline solution of sodium nitrite. Bags of sodium carbonate were emptied into the pit to neutralise the acid and prevent further fume emission. When this was done, the whole area was then hosed down to ensure that it was safe.
The plant was shut down and later that day a new seal pot was fitted to the base of the scrubber tower.
The plant was restarted several days later after various checks had been performed and work carried out to replace the items which had failed or had been damaged as a consequence of the incident.
After the investigation the following conclusions were drawn:
1. The leak was due to corrosion failure of a mild steel stub at the base of the scrubber seal pot.
2. The corrosion in the scrubber seal pot was due to excessive quantities of HF being carried over into the scrubber, immediately prior to the incident and on several previous occasions.
3. Prior to the incident the carry over of HF into the scrubber had increased from the normal levels because of flooding in the vents condenser and pipework system. Under flooded conditions it is possible in certain circumstances for liquid anhydrous hydrofluoric acid (AHF) to be transferred over the lute in the vent system to the vents scrubber.
4. The flooding occurred because the return valve to the No. 1 AHF feed tank was not sufficiently open. This stop valve takes the overflow liquid from the constant head tank and the liquor return from the vents condenser. Seizures in this type of valve have frequently occurred in the AHF feed section.
5. The inability to vent pressure from the AHF feed tanks and the overflow tank in the hours prior to the incident was a consequence of the flooding in the vent system.
6. The routine vent scrubber sampling rate of twice per shift is not adequate to allow a sufficiently prompt response when abnormal conditions occur.
7. On a number of occasions during recent months, pressures in the AHF stock tanks have approached or equalled the operating limit.
[gas / vapour release]

Lessons

The following recommendations were made:
1. Consideration to be given to changing the stop valves to valves of a type which give positive indication of the open and closed position and provide for easy operation.
2. Consideration to be given to:
Removal of valves from the head tank overflow lines, installing separate return lines to the AHF feed tanks from the vents condenser and Linking in the vents condenser drain lines.
3. The frequency of monitoring the alkalinity of the vent scrubber to be increased. Consideration to be given to providing an on-line monitoring facility.
4. The relationship between the typical pressure encountered during normal operation, the high pressure alarm and the operating limits for the AHF feed tanks should be reviewed.
5. Residual pressure in the AHF feed tanks which cannot be relieved through a normally operating vents condenser will attribute to flooding of the vent system unless some other cause is immediately evident. For these circumstances appropriate corrective action must be defined, included in operating instructions and acted upon when the high pressure alarm is activated.
6. Consideration should be given to providing a level monitoring facility in the outlet from the vents condenser to the vents scrubber to provide positive indication of flooding.
7. If it is necessary to make temporary repairs on leaking pipework until the plant can be shutdown to make a permanent repair, then consideration should be given to providing custom built temporary repair kits.
8. Consideration to be given in providing plant personnel with additional advice to assist them in recognising those occasions when a complete plant shutdown for repairs and/or investigations is called for.
9. To minimise the potential for communication errors at the Emergency Control Centre (ECC) consideration to providing dedicated links to the ECC from all toxic gas release alarm systems. The alarm indicator board in the ECC could then display the location of the plant where the toxic gas release alarm had been activated.
10. Consideration to be given to a review of the Emergency Procedures involving toxic gas releases, to deal with an incident which is intermediate between a building emergency and a site emergency.

7544 Date Unknown

Source : LOSS PREVENTION BULLETIN, 092, 27-28.

Location : ,

Injured : 1 **Dead :** 0

Abstract

An operator was injured when he was burned with hot ethylene glycol.
The operator had received instructions to sample the ethylene glycol remaining in the ester-interchange (EI) vessel via the monomer filter.
The operator proceeded to prepare the line for sampling by obtaining the key to the filter inlet valve. He then proceeded to the line where he prepared the filter housing and began to take the ethylene glycol sample.
When he requested the valve to be opened, the hot ethylene glycol sprayed out of the filter housing and onto him.
With no protective equipment on he was burned by the ethylene glycol.
After investigation of the incident it was revealed that there were many coincidental occurrences which might have contributed to the glycol leak.
1. Training was insufficient for the task.
2. Supervision was minimal in a situation where it should have been maximum.
3. Poor judgement was exhibited by the operator in utilising a used gasket and not wearing full protective clothing.
The following recommendations were made:
The system of management must be improved such that supervisors and operators are properly trained to do their job, recognising hazards even on unfamiliar tasks.
[management system inadequate, spill, burns, injury]

Lessons

[None Reported]

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]

7575 Date Unknown

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

Injured : 0 **Dead :** 0

Abstract

A maintenance planner requested a contractor to arrange for a repair to be carried out to the drain leg branch on a filtration system. The task was given to the contractor's tradesman who was shown the pipe to be repaired by the planner, who stressed that the job was to be finished quickly.
Later that day, a plant operator found the tradesman working on the spigot without having reported to the plant control room for a Permit to Work. He reported the incident to the plant supervisor, who in turn informed the planner and plant manager.
Maintenance had been carried out on the filter the day before, and the equipment had been isolated for this work. The drain branch was open as the valve had been removed. The contractor had assumed that the filter was still isolated when working on the spigot the next day. On inspection of the pipework by the supervisor, it was found that the contractor had sawn off the drain branch completely.
Although the tradesman was a very experienced foreman of the contractors, he admitted that he had been in error in not obtaining a Permit to Work. He believed the filter was safe to work on because the valve had already been removed from the drain branch.
Near miss.
[contractor error]

Lessons

Actions to be taken to prevent a recurrence:
1. Contractors to inform the company in writing of the actions they are taking to prevent a recurrence regarding the individual concerned together with all their site employees.
2. Contractor to receive safety induction training session.
3. The quality of the induction training package is to be reviewed.

7579 Date Unknown

Source : LOSS PREVENTION BULLETIN, 104, 7.
Location : ,

Injured : 0 **Dead :** 0

Abstract

A blockage had developed in the liquid line linking a high pressure separator with a low pressure degasser. An operator attempted to clear the blockage by isolating the line from the separator, and flowing condensate back from the degasser to atmosphere through a drain point. The discharge condensate and some liquid impurities were collected in a plastic bucket with a metal handle. This procedure did not completely free the line, so the operator applied higher pressure from the separator. A violent discharge of condensate occurred which spontaneously ignited after a few seconds. As the high pressure flow had splashed condensate over a wide area, and this had also caught fire, the operator had to retreat. The fire burned for six minutes until extinguished by prompt action on the part of the staff on the installation.
The cause of ignition was most probably an electrostatic spark.
The underlying cause of the accident is organisational. Blockages occur regularly in this liquid line, and the procedure of low and then high-pressure flushing via the drain point had been allowed to be performed as a routine. The hazards had not been appreciated and there was no written procedure.
[fire - consequence, design or procedure error]

Lessons

The following recommendations were made:
1. Draining to atmosphere of liquids from equipment under higher than atmosphere pressure should be avoided. Venting of gases which contain entrained or condensed liquids should also be avoided. Such gases should be passed through a knock-out facility at atmospheric pressure before being emitted in a controlled manner at a suitable location.
2. Where flammable liquids of low conductivity have to be discharged into a container, care must be taken to prevent dangerous charges of static electricity developing.
3. Facilities should be provided to allow safe and controlled clearing of piping which is susceptible to blockage in operation. Drain designs should include close systems to cater for draining operation of such liquids.
4. Operational procedures must be in writing, must not be allowed to contain unsafe acts, and must be approved at an appropriate level of management.
5. Plant operators should be trained in the appropriate procedures before being allowed to undertake any given operation.