12088 30 March 1999

Source : CHEMICAL ENGINEERING IN AUSTRALIA, JUNE-AUGUST 1999.
Location : , AUSTRALIA

Injured : 0 **Dead :** 0

Abstract

An acid plant and plant smelter were put out of action when a blower taking the off-gasses from the smelter to the acid plant failed causing severe damage to the blower, the blower building and some equipment surrounding the area.
The failure of the sulphur dioxide blower appears to have been caused by failure of the liners in the mist precipitators during start-up, giving off combustible gases.
[mechanical equipment failure, damage to equipment, gas / vapour release, gas - flammable]

Lessons

[None Reported]

1197226 December 1996

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

Approximately 6 tonnes of cold glacial acetic acid leaked from a pump gland for up to an hour. The leak went directly to the site drain and into the site effluent system.
[mechanical equipment failure, spill]

Lessons

[None Reported]

1108907 November 1996

Source : ICHEME
Location : , FRANCE

Injured : 0 **Dead :** 0

Abstract

An off-site crude unit charge pump operating in parallel with another, caught fire from the mechanical seal about one and a half hours after a common alarm had sounded. The initially small fire spread to the adjacent pumps and the crude unit was shut down for 24 hours until one of the pump's electrical wiring and instrumentation could be repaired. The cause of the vibration leading to the seal failure is either motor bearing failure or coupling failure due to loss of alignment, and there was evidence of cavitation an hour before the initial vibration alarm.
On this refinery the Crude Distillation Unit control room is fed from three identical crude oil feed pumps (A), (B), (S) located off-site in the crude tank farm area about 1 km from the unit. In normal operations two pumps are running in parallel with one spare. Each pump is fitted with a common alarm for six bearing temperatures (two on the electric motor, four on the pump itself) and a vibration detector. At the time of the incident (A) and (S) were running. Analysis of flow recordings and tank levels shows a reducing flow rate as tank level (1) fell. This was a usual event and the new tank (2) was placed in service at 05:50 hrs., about an hour before the first common alarm. Vibration analyser charts show evidence of cavitation in (S) at 05:50 hrs. and this disappeared after the tank change. The common alarm sounded in the control room at 06:48 hrs. Because no vehicle was available and because the alarms were considered unreliable, it was left to the day operator to check the alarm on his rounds, about one and a half hours later. By this time the pump operation had deteriorated seriously, crude was leaking and the fire developed. It was promptly extinguished by the fire crew but the crude unit was shut down until the electrical wiring for one of the other pumps was restored allowing start-up.
Two potential immediate causes have been identified. These are:
1. Rupture of the coupling membranes.
2. Failure of the bearing on the coupling side of the motor due to lack of oil or mechanical misalignment.
[fire - consequence, mechanical equipment failure, excessive vibration, design or procedure error, fire - consequence, refining, pump bearing, plant shutdown, lubrication failure]

Lessons

The following recommendations were made:
1. Operators must respond to alarms, no matter if they may be nuisance alarms.
2. Equipment does have a limited performance capacity, and operating at extremes places operations at risk.
3. Monitoring devices must be maintained in proper working order, especially those for remote operating areas where operator surveillance is less frequent.
4. Mechanical integrity must be maintained by use of the correct part of the equipment, as designed by the equipment supplier.

6791 18 December 1994

Source : SEDGWICK LOSS CONTROL NEWSLETTER, 4TH QUARTER, 1994.
Location : Martinez; California, USA

Injured : 0 **Dead :** 0

Abstract

Small fire in hydrocraker at a refinery resulting from gasket failure in lubricating oil system.
[fire - consequence, refining]

Lessons

[None Reported]

6766 16 November 1994

Source : SEDGWICK LOSS CONTROL NEWSLETTER, 4TH QUARTER, 1994.
Location : St Croix, VIRGIN ISLANDS

Injured : 0 **Dead :** 0

Abstract

A blown pump seal caused a fire. Substance crude oil.
[seal failure, fire - consequence]

Lessons

[None Reported]

6685 31 August 1994

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

Injured : 0 **Dead :** 0

Abstract

Fire occurred when pump seal failed on coker unit. Substance involved heavy gas oil.
[fire - consequence, seal failure, processing]

Lessons

[None Reported]

7581 09 January 1992

Source : LOSS PREVENTION BULLETIN, 107, 17-20.
Location : ,

Injured : 0 **Dead :** 0

Abstract

An incident occurred in the regenerator section of a Fluid Catalytic Cracker Unit (FCCU) 50 hours after a unit shutdown. The shutdown was not planned and was caused by mechanical failure of the regenerator airblower.
FCCU regenerators are large vessels containing beds of fluidised catalyst in which air is used to burn off both carbon, referred to as coke, and hydrogen based material trapped in and on aluminium silicate catalyst which has a porous structure. The air flows into the regenerator through a two, tier air grid system from an airblower.
Two days before the incident, the airblower tripped out due to activation of the airblower vibration shutdown monitoring equipment. The vibration was caused by a mechanical failure of one of the air blower rotor discs.
This initiated automatic shutdown of the unit. As a result the regenerator fluidised bed slumped and steam was automatically injected into the catalyst bed. The air blower rotor assembly was inspected through a small manway inspection door, visually confirming that the rotor was damaged and would have to be repaired. At the same time the decision was taken to enter the regenerator/riser/reactor circuit to undertake other necessary repair work.
Over the subsequent 2 days operations staff prepared the regenerator for manway removal. It was recognised that catalyst temperature would be higher than usual. Previously when the air blower had tripped and the manways to the regenerator, riser/reactor and ductwork, including the waste heat boiler (known as the cat circuit) had been opened, the equipment had been gas tested and entered without incident. During the preparations a large butterfly valve and a critical flow nozzle were removed from the ductwork to the flue. These were normal procedures in preparing the cat circuit for entry. The removal of these items reduced the draught of the flue on the regenerator and would have contributed to an oxygen deficiency in the regenerator.
After all the necessary blinds had been inserted, operational procedures permitted the regenerator manways to be removed to allow the final vacuum truck removal of remaining catalyst.
On the day of the incident, work commenced to remove one of two manways on the regenerator, at the base about 9 m above ground level. A small manway was opened first to ensure that there was not a residual mound of hot catalyst resting against the large manway door that might have slumped onto those on the access platform. This manway was opened as the system was considered to be an air system open to atmosphere by virtue of the flue connection.
Work then proceeded to open the large 1.5 m manway. With one bolt remaining on the large manway, some witnesses reported a rumbling noise inside the regenerator. It was immediately followed by an orange-red flash which came out of the left side of the manway, from where the penultimate bolt had been taken.
Simultaneously a flame front and hot particles exited from the small manhole on the other side of the regenerator platform.
The flame and pressure front passed through the regenerator into the downstream flue ductwork. Where the duct was broken and plant items removed flame fronts and hot catalyst exited.
After a period of a few seconds, there was a louder secondary noise which emanated from the waste heat boiler and associated flues which sustained structural damage.
The following conclusions were made:
This unique incident was due to the ignition of hydrogen, light hydrocarbon gases and carbon monoxide. These gases were generated by contact of unregenerated catalyst with steam in an oxygen deficient atmosphere. Removal of a manway to allow access for vacuum truck removal of catalyst allowed oxygen re-enrichment of the internal atmosphere and the re-establishment of conditions that permitted ignition. Lighter-than-air combustible gases were trapped in a reservoir created by the internal configuration of the plant. The opening of the manway caused some gases to be dispersed into the ductwork prior to the ignition.
[catalytic cracker, blower failure, fire - consequence, oxygen enrichment, fluid cracker]

Lessons

[None Reported]

1031131 August 1990

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A fire occurred on a gasoline product pump. The pump fired due to a thrust bearing failure allowing the shaft to move forward and open up the mechanical seal. The situation was exacerbated by the fact that the seal quench water was isolated to both pumps. The fire resulted in limited damage to equipment and unit shutdown for four days.
Examination of the pump identified the likely failure chain:
1. The double row angular contact ball bearing at the pump drive end (thrust) was not an interference fit on the shaft.
2. Vibration caused fretting at the bearing locknut releasing the clamping force, allowing the bearing inner race to spin on the shaft.
3. The released locknut allowed the shaft to move 3 mm axially and the seal wedge leaked gasoline into the mechanical seal to secondary packed gland interspace.
4. Gasoline was released from a fracture in the seal flush drain line at its screwed connection to the seal interspace, plus any leakage via the packed gland.
5. The spinning inner race on the thrust bearing generated heat by friction.
6. Ball bearing clearance was lost and the bearing seized.
7. The inner race welded itself to the shaft.
8. The outer race rotated in its housing.
9. The pump was shut down ahead of the motor overload initiating a pump trip.
Although a bearing with an inadequate interference fit may run for many months without external signs of trouble, once the inner bearing race was free to move this chain of events would have progressed in minutes. The pump shaft at elevated temperature would have provided a ready ignition of the gasoline leak.
[pump bearing, pump failure, plant shutdown, fire - consequence]

Lessons

The following conclusions were made:
1. The pump thrust bearing assembly failed allowing the shaft to move forward and opening up the mechanical seal.
2. Seal flush water to both pump seals was isolated and the drain choked. The leaking seal was not contained in this closed system but leaked to atmosphere through a fractured drain line and the secondary packed glands.
3. The temperature of the failed bearing/shaft provided a source of ignition.
Recommendations:
1. Specify higher tolerance on shafts under bearings.
2. Check bearing fit tolerances of drawings of all pump shafts in use, and withdraw from stock all shafts identified to be in error.
3. Publicize the importance of checking bearing fit by measurement of shafts O/D.
4. Introduce a controlled instruction specifying the requirement to measure pump shaft O/D for bearing fit.
5. Change the mechanical seals.
6. Review the design of the seal flush water drain system to facilitate ready observation of its operation.
7. Fit blanks to pump drains.
8. Include checks on seal water flush flows in process pump check routines.
9. Initiate a scheduled fire hydrant valve operation check routine.
10. Gain advice and make recommendations on fire-fighting education for operating personnel and a policy for fire detection systems.

5038 03 July 1990

Source : THE HOUSTON POST, 1990, 4 JUL.; THE WASHINGTON TIMES, 1990, 4 JUL.

Location : Passedena; Houston; Texas, USA

Injured : 0 **Dead :** 0

Abstract

A fire occurred in a crude oil processing unit when valve seal or pump seal blew. Fire spread to overhead cooling unit.
[fire - consequence]

Lessons

[None Reported]

7904 1987

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A reflux pump was reported as not pumping, so it was decided to open up the pump to investigate. The pump was shut-down during the night shift and prepared for maintenance. The suction and discharge valves were locked closed and the pump depressurised to flare. The casing drain was also opened. The required Permit was handed to the pump foreman by the night shift operator.
The Permit did not call for a operations standby whilst work was in progress.
The senior process controller and process controller on the morning shift independently checked that the pump was depressurised. No ice was noticed outside on the lines. The process controller, not trusting complete isolation of the pump, pulled up the suction and discharge valves with a valve spanner.
The pump fitter started to work on the pump at approximately 07.40 hrs. He locked the motor stop/start switch and opened the casing drain further. When he did this a puff of gas vented, then stopped.
Once the pump was opened, it was found that the impeller and casing was full of ice and hydrate, and pieces of the wire mesh strainer were also found in the impeller.
After the pump had been removed it was noticed by the outside process controller that ice was forming on the outside of the suction line, downstream of the suction block valve. The suction and discharge valves were again taken up with a wheel spanner.
A fitter arrived to install a new strainer, and the suction bend was loosened and swung to one side, and he noticed that the suction bend and the bottom of the upstream suction block valve were full of ice. He informed his foreman. The ice was also seen by the outside process controller.
A steam hose was pushed into the line to melt the ice, and the fitter left to collect gaskets.
Shortly afterwards a white cloud was seen on the unit, and the operator ran to fetch a gas detection set in order to find the leak, but before he could do so the cloud ignited explosively.
The explosion was felt up to 150 m away, however the pressure wave was not strong enough to cause damage. The most likely ignition source was a fired heater, 40 m away.
The flash fire burnt back to and continued to burn around the pump, igniting hydrogen leaks nearby, which had either not been previously detected or were indirectly caused by the fire.
The fire caused the control system cables of an adjacent booster compressor to fail, which in turn caused overpressure of some equipment, and gasket and gland packings to leak.
The main fire was large, and although secondary fires were soon extinguished, assessment of the fire source(s) was difficult.
[fire - consequence]

Lessons

These included:
1. More fixed monitors to be installed and provision of portable water transfer pumps of the low head, self-priming high capacity type.
2. A review of work procedures, particularly when working on systems likely to cause deposition under valve seats.
3. Training and retraining on the properties of LPG and butane hydrate, symptoms of blockage, the Permit to Work System, isolation/handover of equipment, and general safety awareness.
4. The Emergency Plan functioned very well, e.g., pretraining resulted in minimum confusion and panic; the predetermined allocation of personnel to duties such as radio/communications controller, co-ordinator for the briefing centre, engineering support, historian/checklist reader at the control post, also worked well. Personnel involved in the incident carried out their nominated functions correctly. Outside assistance was promptly put on standby, briefed and directed as required.

Source : LOSS PREVENTION BULLETIN, 074, 23-27, 080, 31-34.
Location : ,

Injured : 1 **Dead :** 0

Abstract

During unloading of a road tanker filled with 89% nitric acid to a storage tank, it was noted by the pump operator that the nitric acid delivery was "warm". Unaware of the significance of this fact, the unloading operation went ahead, and he did not report the apparent high temperature of the nitric acid. The operator also observed that the nitric acid seemed "warm" when preparing for feed to the nitrator. He reported the apparent abnormal acid temperature to his foreman. None of the people involved with the nitric acid handling on the day of the accident knew what the normal temperature of the acid should be. There was immediate concern by the process operators that there was a chemical reaction occurring in the nitric acid storage tank. For this reason the nitric acid in the measuring tank was dropped back to the outside storage tank.

A rumbling noise was then heard coming from the nitric acid storage tank. A sample of nitric acid taken from the pump showed the presence of an abnormal brown oily layer in the acid. These observations were constructed as evidence that there was a chemical reaction occurring in the nitric acid storage tank. Because of the reactive nature of nitric acid, it was decided to drain the tank to the contaminated . When gravity draining was too slow, use of the transfer pump to speed up the emptying of the tank was attempted.

The transfer pump would not start, and two fuses in the motor circuit were replaced by the foreman. It is standard procedure throughout the plant for production personnel to replace blown fuses in motor circuits. The pump still would not start, and the foreman summoned an electrician to check the pump electrically. The electrician checked the three phases for grounding and electrical continuity. Electrically, the pump was fine. The fuses were replaced by the electrician. When the pump was restarted an explosion occurred.

The foreman present at the time suffered multiple fractures to both bones of the right leg below the knee as the pump exploded.

Laboratory work determined that the cause of the explosion was the reaction between the nitric acid and the copper windings of the pump motor. Nitric oxide gas was formed, generating high gas pressure within the pump. The welds on the stator housing gave way and hurled the end flange at high velocity towards the foreman. In addition, there was a chemical reaction between the silicone fluid which immersed the electrical windings of the pump and the nitric acid. However, this is unlikely to have significantly contributed to the explosion. It was decided that the polymeric material observed in the nitric acid samples taken prior to the explosion were probably the product of that reaction. The contaminated samples did not represent the nitric acid storage tank, but rather what was in the pump.

It is concluded that the rumbling noise heard coming from the nitric acid storage tank prior to the accident was probably from the nitrogen bubbler used for the level indication in the tank.

Subsequent to the accident, the supplier of the nitric acid indicated that the shipping temperature of the acid was likely to be warm, 55 to 60 degrees C (130 to 140 degrees F.)

The principle causes of this accident were:

1. Inadequate communication of maintenance information between the pump manufacturer and the user.
2. Improper installation of the pump.
3. Improper pump selection.
4. Personnel too close to dangerous situation.

[unwanted chemical reaction, high pressure, installation inadequate, canned pump]

Lessons

The following recommendation were made and actions taken after the incident:

1. Removed canned pumps from nitric acid service. The pumps were replaced with conventional centrifugal pumps equipped with a Teflon seal as recommended by the acid supplier.
2. Study of the storage and handling of nitric acid. A HAZOP on the existing system which included nitric acid reviving, unloading and transfer procedures and equipment was complete.
3. Establishment of better nitric acid specification and mechanisms to deal with deviations. The expected physical characteristics of all incoming raw materials should be common knowledge for both the raw material personnel and the operating departments. Expected values of pertinent physical and/or chemical properties to be reviewed for all incoming raw materials, e.g. the expected temperature of nitric acid deliveries. Raw materials must not be unloaded unless they meet these criteria. In the case of a highly reactive material such as nitric acid, the temperature of the acid at the time of delivery to be noted on the delivery papers by the supplier, and be compared to the temperature of the acid on receipt by the plant. This could prevent the addition of contaminated acid undergoing a chemical reaction being charged to a storage tank. Deviations from expected conditions would trigger a "no go" to the unloading operation.
4. Establishment of a maintenance service reporting mechanism for pump manufacturers and other contract maintenance services. It was concluded that communications between the Maintenance Department and suppliers or contractors performing maintenance work on equipment needed to be improved. Whenever a piece of equipment is serviced by an outside contractor, they are relied to report their findings relative to the conditions of the equipment, probable cause of failure, recommendations, etc. Deviations from the previous materials of construction must not be made without agreement by the company. It was recommended that the Mechanical Department established procedures to assure that the required communications were operative.
5. Other applications in the plant with canned pumps in service. The canned pumps used in other services around the plant were studied for potential hazard.
6. Specific recommendations for canned pumps. It was recommended that the fuse boxes for all canned pumps be "locked out". It was to be assumed that these pumps are used to pump hazardous materials, and that any electrical or mechanical failure to be investigated by a qualified mechanic. Bearing wear and direction of rotation indicators available form the manufacturer on existing pumps in the plant were to be installed. Consultation with the manufacturer was underway regarding installation of these devices.

3359 24 July 1985

Source : INSTITUTE OF INSURERS
Location : Montreal, CANADA

Injured : 0 **Dead :** 0

Abstract

Leakage of butane gas from a turbine driven pump followed by an explosion and fire. Leakage was caused by the pump drive shaft failure. The failure occurred at the motor end of the shaft sleeve which forms part of the mechanical seal. Initial assessment suggest that the shaft cracked. Mechanical equipment failure.

Lessons

[None Reported]

8019 23 April 1985

Source : ICHEME
Location : ,

Injured : 0   **Dead :** 0

Abstract

A tanker was being loaded with fuel oil. To achieve a higher filling rate a second transfer pump was lined up and remotely started from the control centre. One hour later the pump tripped and within a few minutes a fire occurred in the pumphouse which took one and a half hours to extinguish. No one was injured but the mechanical damage was extensive and repair costs are estimated at about £276,000 (1985).
Investigation revealed that on the previous day the standby pump had been reported to have a lube oil leak but this had not received attention. This probably resulted in the mechanical failure of the pump bearing. The pump vibration apparently caused a flange on the discharge pipework to open with the resultant oil spray being ignited by the hot pump bearings.
[bearing failure, excessive vibration, loading, fire - consequence, damage to equipment]

Lessons

The following recommendations were made:
1. Remote shutdown switches to be installed locally and at the appropriate control centre.
2. Remotely operable motorised valves with manual override (external to pumphouse installations) to be installed on all suction lines. Valves to be remotely operated from a wall mounted switch outside the pumphouse and from the appropriate control centre.
3. Fire detectors of the ultra violet flame sensing type to be provided. The system to alarm locally as well as to the appropriate control centre and to be fitted with audible alarms.

2319 20 January 1982

Source : 100 LARGEST LOSSES 9TH EDITION, MARSH & MCLENNAN PROTECTION CONSULTANTS, 1986
Location : Fort Mcmurray; Alaska, USA

Injured : 0 **Dead :** 0

Abstract

A severe fire in a hydrogen compressor building in a unifiner unit of an oil sands refinery reportedly started in a 1,500 psi lube oil system. Fire fighting was difficult because of 40 degrees F temperatures. The building reportedly housed three centrifugal hydrogen recycle compressors, a centrifugal natural gas compressor and two 4,000 horsepower reciprocating compressors.
[fire - consequence, lubricating oil system, refining]

Lessons

[None Reported]

2248 20 August 1981

Source : 100 LARGEST LOSSES 9TH EDITION, MARSH & MCLENNAN PROTECTION CONSULTANTS, 1986; AL-AMMEERI R.S, A VAPOUR CLOUD FIRE, HYDROCARBON PROCESSING, 1984, 64, NOV, 181-188.

Location : Shuiba, KUWAIT

Injured : 0 **Dead :** 0

Abstract

A fire originated in a pump manifold within the bund of six 160 kbbl floating roof tanks. Naphtha was being pumped into one of the storage tanks when the explosion and fire occurred. 30 minutes later the seal of the first tank caught fire followed by 5 others. A further 4 tanks were involved in the fire. The fire was eventually put out nearly six days after it started.

The cause of this refinery tank farm fire which destroyed eight tanks and damaged several others has not been disclosed. It appears to have originated at a pump manifold within the common dike serving six 160,000 barrel floating roof tanks containing petrochemical grade naphtha. Naphtha was being pumped into one of the tanks when the initial explosion and fire occurred.

About one half hour into the fire, the seal of the first tank caught fire. This was followed rapidly by two other seals. These spread progressively, eventually involving five or six tanks in the group. The sixth tank was empty and sustained severe damage.

A strong fire fighting attack was initially made by the refinery fire brigade, later assisted by nearby industrial fire brigades, military and public fire departments. As many as 75 pieces of mobile fire fighting equipment were used to supply up to 11,000 U.S gpm of water and foam solution during the fire which lasted five days and twenty hours.

In spite of heavy protective water streams, a strong wind and radiated heat caused the fire to spread into an adjoining row of four 72,000 barrel floating roof tanks containing intermediate products and to a fixed roof 32,000 barrel slop tank. This took place 64 to 103 hours after the fire began.

Wind driven flames caused the collapse of a heavily loaded unprotected steel pipe rack located between the two rows of three tanks. Water curtains set up between the tank groups and nearby process units at the 200,000 barrel per day refinery and petrochemical plant were effective. Damage was split 50-50 between liquid hydrocarbons and tanks and other equipment.

[fire - consequence]

Lessons

[None Reported]

2013 07 May 1980

Source : 100 LARGEST LOSSES, 9TH EDITION, MARSH & MCLENNAN, 1986.
Location : Deer Park; Texas, USA

Injured : 0 **Dead :** 0

Abstract

Vibration from a pump bearing failure in a cumene section of a phenol acetone unit caused the pump seal to fail. The released flammable liquids and vapours ignited. Process pipes opened adding fuel to the fire. Fin fan coolers elevated above the pipe rack collapsed, as did one process column.
[fire - consequence, excessive vibration]

Lessons

[None Reported]

9882 1978

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

Probably due to misalignment a large hot oil pump vibrated badly. In time this led to failure of the coupling, inboard bearing and seal. The oil was above autoignition temperature so the leak caught fire.
[hydrocarbon, pump bearing, pump gland, blowout, fire - consequence, maintenance inadequate, inspection inadequate, excessive vibration, flexible coupling failure, bearing failure, seal failure]

Lessons

[None Reported]

8337 02 March 1977

Source : ICHEME
Location : , FRANCE

Injured : 0 **Dead :** 0

Abstract

On the 2nd March, 1977 a fire broke out on a crude oil pump which takes suction from the desalter on the a crude oil distillation unit. The fire was extinguished by the unit operators in less than 2 minutes using trolley mounted fire extinguishers which were sited on the unit. There were no injuries to personnel, but damage which is estimated at between 350,000 degrees F and 700,000 degrees F, caused a 60 hour production stoppage to replace cables.
The crude oil distillation unit was running normally, with two crude oil pumps taking suction from the desalter. There had been no unit disturbances or mechanical upsets before the incident.
The vibration and bearing temperature alarms indicated a fault on the pump almost at the same time as an operator close to the pump spotted the leak, which was followed almost immediately by flame emission. The fire was intensified by the air coolers situated above the pumps but, due to the rapid intervention by the operators and a safety officer using 1 x 50 kg dry powder, 2 x 150 kg dry powder, and 1 x 60 kg C0 2 extinguishers, a more intense fire was avoided.
After the fire had been extinguished it was possible to isolate the pump at its suction and discharge valves. The seal leakage was not substantial but a secondary source of fuel arose from the failure of the pump discharge pressure gauge during the fire.
The damage to the motor and pump was not the result of the fire, but was caused by mechanical failure of the bearing; however adjacent instrumentation boxes melted, and the electrical and instrument cables situated in a cabletrack above the pump were burned.
The refinery have replaced the pump bearing with one of a stronger type, and are considering ways of providing increased fire protection for cables.
[distillation, pump, pump seal, bearing failure, leak, pump failure
fire - consequence, crude oil]

Lessons

[None Reported]

1300 1977

Source : LOSS PREVENTION BULLETIN, 115, 1-5; ICHEME SAFETY TRAINING PACKAGE, 023, CONTROL OF EXOTHERMIC CHEMICAL REACTIONS.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Explosion took off the top of the peri-acid batch nitration vessel. 60% of the cast iron top was taken off. The damage indicated an estimated pressure explosion of 6.9 bar. The cause of the accident was due, in part, to an inadequate impeller in the nitration reaction vessel, resulting in poor mixing of the reactor contents. On the day of the explosion the nitration was being carried out in accordance with the operator's instructions. Earlier, naphthalene had been sulphonated in the adjoining reaction vessel in accordance with the first section of the instructions.
Three unusual events occurred on the day of this incident:
1.The reaction mass took several hours to cool down to allow the nitric acid to be automatically admitted; compared with a maximum of 1 hour for normal operation.
2. Nitric acid was automatically added in 4 hours compared with 2-3 times that period under normal circumstances.
3. An exotherm occurred.
The accident occurred because the sulphonation mass was a much thicker consistency than normal. Heat transfer and mixing was not adequate because of the small impeller size leading to localised reaction and the first exotherm. When this exotherm occurred most of the material local to the agitator would be nitrated and would not react with further acid.
Continuing addition of acid would appear to have a cooling effect rather than causing complete nitration of the feedstock. This resulted in the acid control valve staying open to add even more acid. Later the nitration reaction vessel would have contained a thick un-nitrated mass outside the coils, and a well mixed mixture of nitric acid and nitrated material enclosed by the coil. The explosion was probably caused by the eventual mixing of these two masses by the moving impeller.
[operation inadequate, agitators and stirrers, exothermic reaction]

Lessons

The following recommendations were made:
1. Design modifications to impellers must take full account of the consequences of any changes. An adequate management of change procedure should be in place. In this case an anchor type agitator was replaced by a small diameter impeller. The replacement could not provide adequate mixing of the contents.
2. Operating instructions must be updated in the light of increased operating experience and the instructions must be easily accessible. Full training must be carried out so that operators and supervisors are aware of the hazards.
3. Individual alarm indicators must be provided for each group of vessels.
4. Venting must be specified on all reactions of this type.

9866 1975

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

Abstract

There were repeated failures of the mechanical seals on some high temperature distillation column reboiler heater charge pumps. The diesel which leaked was above its autoignition temperature so a fire always resulted.
The first solution to the problem was to fit a fire wall in front of the pumps with extended spindles on the suction and discharge valves. This enabled the leaking pump to be shut in safely.
However, the real problem was inadequate seals and high vibration from the drive train. When these were fixed the problem disappeared.
[diesel oil, normal operations, pump seal, fire - consequence, design inadequate, inspection inadequate]

Lessons

When any piece of equipment fails more than once in the same manner look for a design fault rather than just repairing it and treating the symptoms.
Vibration is a serious problem with rotating equipment and regular monitoring with measuring equipment will often detect an increase in time to correct the fault before failure occurs. Systematic maintenance records are helpful here.

111871974

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A marine transportation incident. A fire broke out in the pump room of a tanker following the overheating and seizure of a cargo pump bearing which caused the pump coupling to shear and the deckhead oil filled gas seal to fracture. Oil from the seal sprayed over the hot bearing surface and ignited.
The pumproom was battened down and ventilation stopped. Unfortunately the foam smothering system, when activated, failed to operate and the shore fire brigade were called upon to inject foam into the pump room Investigation into the failure of the foam system revealed that although the foam system had been serviced by a contractor a few days before, the small bore connection between the C02 metering valve and foam tank was blocked and the foam compound was off specification.
[marine tanker, pump bearing, fire fighting equipment, hot surface, fire - consequence]

Lessons

This incident illustrates the importance of proving that fire protection systems are in order and connections are clear when servicing. Foam stocks should be examined at six-monthly intervals and any precipitate should be redispersed.

1121714 August 1973

Source : ICHEME
Location : , UK

Injured : 1 **Dead :** 0

Abstract

A small vapour leak was detected on the outboard seal of the turbine driven residue pump of a crude unit. The spare (electric) pump was commissioned and the leaking pump shut down with a steam hose playing on the seal. After the changeover, the leak worsened and the escaping vapour ignited while the operators were isolating the pump by shutting the suction valve.
The fire was fought initially with 20 lb and 150 lb dry powder extinguishers, but efforts were hampered by the congestion of equipment and plant in the vicinity of the burning pump; the poor drainage on this particular unit also aggravated the situation by spreading the fire over a wide area.
The fire further escalated through the springing of flanges, lifting of thermal reliefs under heat, and was only extinguished after 45 minutes by using foam and water sprays coupled with shut down and isolation of the unit.
One person was injured when an electric motor fan blade on a burning pump flew off and struck him on the leg.
Damage was sustained by cabling and instrumentation lines and by pumps and pipework in the area of the fire. A delay of about a month is expected before the unit can be recommissioned and this cost penalty is far in excess of the estimated direct damage bill of £20,000 (1973).
The fire which should normally have been extinguished without difficulty spread over a wide area and created a serious situation due to two main causes:
1. The inaccessibility of the fire area to the fire fighting crews because of the congestion of plant equipment.
2. The drainage system was unable to handle moderate volumes of fire water.
[refining, pump seal, pump, seal, overpressurisation, leak, fire - consequence, injury]

Lessons

A number of recommendations were made to minimise a recurrence, including fitting steam quench facilities to the mechanical seals of the hot pumps on the unit.
1. Re-locating the desalter wash water tank to a safer position away from the pump alley.
2. Improving the fire protection of exposed main cables,
3. Directing the discharges of certain thermal relief valves away from high risk areas.
4. Long term action is being considered in the form of improvements to the unit layout.

1121624 July 1973

Source : ICHEME
Location : , HOLLAND

Injured : 0 **Dead :** 0

Abstract

A leak from the mechanical seal on a turbine driven residue pump at a refinery ignited and started a fire on the CDU. The seals on these pumps had been a constant source of trouble and previously a number of small seal fires had been experienced.
The initial attack on the fire was made by plant personnel using dry powder extinguishers but re-ignition occurred several times, further efforts with steam lances and more dry powder units successfully extinguished the seal fire. During this time, an operator started isolating the residue pumps, but before he could block-in the turbine driven pump, the joint of its suction filter cover failed and hot residue sprayed over the area, ignited and re-ignited the seal leak. The refinery fire crew tackled the fire with dry powder, but although this limited the fire it was not extinguished. The #Major Fire# alarm was raised and the unit shut down. The fire was finally extinguished by the combined use of dry powder, while the suction and discharge valves on the leaking pump were closed. No injuries were sustained and damage was mainly confined to instrument cabling sited over the pumps; the Unit was down for seven days, but production from the refinery as a whole was not affected because of reduced crude processing requirements.
Investigation of the pump suction filters revealed that they were only designed for a pressure of 4.2 bar, with the suction valve of one residue pump shut and the discharge valve open, a pressure of up to 25 bar on the suction trap might be possible from the other, running pump. To allow the unit to be recommissioned, the filter cover was welded to its body.
[refining, seal, pump, pump seal, seal failure, leak, design fault, fire - consequence]

Lessons

After discussion with the manufacturers, the refinery is to modify the pump seals.

1000227 March 1973

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

An centrifugal pump transferring butyl acetate from bulk storage into a packaging building caught fire.
45 gallon drums were being filled with butyl acetate in the filling building.
At 9:30 the operator noted that the flow rate significantly decreased and left the filling building to check the supply pump situated at the rear of the building. The operator noted that the pump was on fire and extinguished the flames with a hand extinguisher.
The cause was believed to be any one or a combination of the following:
1. Electrical fault.
2. Dry running of the pump due to:
· Air lock.
· Filter blockage.
· Failure of pump seal.
3. Faulty valve settings.
Following detailed examination the cause was concluded to have been due to a seal failure in the pump.
Damage was estimated at £500 (1973).
[butyl acetate, acetate ester, centrifugal pump, seal failure, fire - consequence, material transfer]

Lessons

The recommendations centred on the replacement of similar duty pump seals with seal manufactured from more suitable materials. Further to the modification all pumps should be easily identified so that unmodified pumps are not inadvertently transferred to acetate ester duties.

724 January 1973

Source : CHEMICAL AGE INTERNATIONAL, 1973, 12 JAN.
Location : Point Tupper; Nova Scotia, CANADA

Injured : 3 **Dead :** 0

Abstract

Pump gland leak caused fire.
[fire - consequence]

Lessons

[None Reported]

2897 1973

Source : ICHEME
Location : , UK

Injured : 0 **Dead :** 0

Abstract

A serious fire occurred on a Hydrocracking Unit when a backflow of feed through a shut down pump caused it to rotate at high speed in the reverse direction. The reverse rotation and acceleration of the pump impeller caused the connecting shaft between the motor and pump to fail, followed by rupture of the packing gland and gland/seal oil piping. The motor disintegrated, igniting the oil leak from the gland/seal oil system.
The fire took about 3 hours to extinguish, causing damage to the base of a fractionator column, pumps and motors, and extensive damage to electrical wiring and instruments. The drains in the immediate vicinity of the fire became blocked with insulation debris from the fractionator column, and this caused flooding. Water with an oil layer on top reached an adjacent process area where ignition occurred and caused further damage. Portable air driven pumps had to be used to limit flooding. A further feature of the fire damage was that the fractionator column, pipeline etc. insulation was of aluminum sheeting, which burnt off exposing large areas of bare metal. The impact of water jets also knocked off the cladding in some areas. Radiant heat from the fire also destroyed a 400 wire communication cable run, disrupting communications and some control systems.
The pump which failed had a suction pressure of over 12.4 bar (180 psig) and a discharge pressure of over 138 bar (2,200 psig) at a temperature of over 260 degrees C (500 degrees F), and was fitted with dual piston type check valves on the discharge side, and also a manually operated minimum flow-valve.
An additional automatic minimum flow valve situated in the pump discharge line was not in use due to long term control problems associated with the fractionator column.
When closing the manual minimum flow valve it had been found by experience that the low rate of flow caused a high discharge pressure in the pump and the pump gland packing would blow.
Therefore a change in operating procedure had been practised from 1969 to 1972, the procedure was to shut the pump down before closing the discharge valve and to rely on the dual check valves to prevent reverse flow until the discharge valve could be closed.
Investigation after the fire showed that both check valves had failed to close as required due to internal corrosion causing sticking of the discs in their guides.
[pump failure, damage to equipment, hydrocracker]

Lessons

1. Reinstate the automatic minimum flow valve facilities to allow the gear operated discharge valve on the pump to be closed before shutdown of the pump.
2. Instigate a regular programme of inspection of check valves.
3. Replace the fractionator tower aluminium insulation with stainless steel.

112271973

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A fire occurred at a petrochemical works occurred when the mechanical seal on a centrifugal pump failed releasing a jet of liquid hydrocarbon at 250 p.s.i.g. and -25 degrees F which ignited shortly afterwards.
Examination of a flameproof start switch mounted beside the motor driving the pump showed that the push buttons had been incorrectly assembled after maintenance and the length of the flame path was less than that specified. In addition about a one quarter pint of water was found in the base of the unit housing which analysis showed was not water from the fire fighting.
It was concluded that:
1. The water in the push button unit, in contact with live terminals, was undergoing electrolysis, generating hydrogen and oxygen as a stoichiometric mixture.
2. The electrical leakage across the insulating bushes was causing sparking in the form known as "scintillation", in which electrical breakdown and tracking is incomplete. This was found to occur with current as low as 12mA.
3. The energy of scintillation is sufficient to ignite a hydrogen/oxygen mixture causing recombination of the gases with explosive energy insufficient to damage the housing or be heard above normal background noise.
4. The enclosure was still flame proof with respect to the gases for which it was certified despite the incorrect assembly of the push buttons. It would not have been flame proof, however, for the hydrogen/oxygen mixture explosion
5. Heat energy escaping from the enclosure probably ignited the hydrocarbon mixture
[processing, pump, seal, pump seal, seal failure, maintenance inadequate, spark, fire - consequence]

Lessons

This incident shows clearly the need to ensure that water is not allowed to accumulate in flame proof enclosures.

1012010 February 1972

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

A leak occurred on a large pump handling several hundred tonnes per hour of light hydrocarbons. The leak was due to a flexible coupling failure, leading to bearing and seal collapse. The rotating shaft striking the pump casing produced sparks and a source of ignition. A fire resulted, but prompt fire-fighting limited the damage. However, problems were experienced with disposal of the large volume of water used.
[processing, damage to equipment, fire - consequence, pump bearing, pump seal, fire fighting equipment, bearing failure, seal failure, pump failure]

Lessons

General lessons from the fire-fighting were:
1. Better provision needed for disposal of water.
2. Value of dry powder extinguishers.
3. Use of sandbags to contain excess water.
4. Value of close liaison with local Fire Brigade.

Other considerations included:
1. Value of remote shut-off valves.
2. Value of 'spare' manpower.
3. Value of fire detectors.

1050109 December 1967

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

Vibration of a steam turbine in a thermal cracking plant, led to a fire initiating at a pump gland oil leak. Operators saw a ball of fire at the inboard (inlet) end of the pump. The oil lines to this pump could not be shutoff immediately because the isolation valve was 10 feet above ground level and access to it was hampered by flames. The cracking plant was shutdown. However, the fire spread rapidly and caused several other oil lines in the oven to rupture. The plant fire crew finally extinguished the fire after about two and a half hours.
[fire - consequence, plant shutdown, excessive vibration]

Lessons

The severe vibration of the turbine, which led to the fire, was probably due to the nut which holds the over speed trip pin in place, coming loose. This resulted in severe vibration, transmitted to the gas oil furnace charge pump on which the fire started.
The following recommendations to avoid recurrence:
1. Re-route various oil pipelines to reduce possibility of adding extra fuel to a fire.
2. Relocate suction isolation valves to a level at which they can be reached from ground level.
3. Install water spray headers above critical equipment.
4. Investigate (a) possible use of sparger rings round hot oil pump packing glands, (b) possible change of blowdown valve type.
5. Install turret type water supplies.
6. Make valves that have to be at height chain operated.

1065621 May 1966

Source : AMMONIA PLANT SAFETY, A.I.CHEME, VOL 9, 1967.
Location : , USA

Injured : 1 **Dead :** 0

Abstract

This report describes the mechanical failure of two high pressure centrifugal pumps pumping liquid oxygen.
In the first incident, a thrust bearing failure allowed the impeller to rub on the volute casing. This caused ignition, and resulted in one minor injury. A similar standby pump was also found to have an unserviceable bearing.
The pump manufacturer supplied a modified pump, in which a thrust bearing failure would not allow the impeller to rub. This pump failed on start up. The bearing had not failed, and the incident was thought to be due to a foreign object.
[oxygen (liquefied), material transfer, pump bearing, bearing failure, damage to equipment, pump failure, foreign object, mechanical equipment failure, fire - consequence, injury]

Lessons

A further modification was made to the pumps to increase clearances.

246 18 September 1962

Source : VERVALIN C. H, FIRE PROTECTION MANUAL, VOL 1, 2ND ED., GULF, 1973.
Location : Ponca City; Oklahoma, USA

Injured : 0 **Dead :** 0

Abstract

An explosion and fire occurred in a cone roofed tank containing leaded gasoline. The tank had been emptied prior to maintenance, spaded off on inlet lines and the manholes opened. An electrical driven blower was connected to a manhole and switched on. 4 hours after the blower was switched on the explosion occurred. Ignition was due to friction from a blade of the blower which had disintegrated.

Lessons

[None Reported]

222 1962

Source : VERVALIN C.H, FIRE PREVENTION MANUAL, 2ND ED., GULF, 1973, PG83.
Location : Mexican Gulf Coast, USA

Injured : 0 **Dead :** 0

Abstract

An explosion occurred in a tank containing residues of gasoline that had been emptied to repair a leak. The top manhead and gauge hatch were open as well as the four bottom manheads. The tank was being purged with an air blower at the time of the explosion. The 25 or 30 years old blower was driven by an explosion-proof 440-volt electric motor, mounted on a wooden platform and was blowing into the north manhead. The motor and tank were properly grounded. After the incident it was revealed that the maximum speed for this blower was 3,160 rpm. The five horsepower motor which was operating the blower had a full-load speed of 3,480 rpm. After the explosion, one blade of the blower was found inside the tank, another blade was in the housing of the blower, and two blades were not located. The unsupported shaft was bent, and evidence indicated that it was striking the blower housing. This could have caused friction sparks and/or heating of the metal to the point of ignition of the gasoline vapours. The direct cause of this explosion was the placement of a motor on the blower which had a speed greater that the recommended speed of the blower.
[friction heat, purging, incorrect equipment installed]

Lessons

[None Reported]

3851 Date Unknown

Source : LOSS PREVENTION BULLETIN, 116, 21.
Location : ,

Injured : 1 **Dead :** 0

Abstract

A canned motor pump in nitric acid service exploded, as a result of acid reaction with the copper motor windings, resulting in a lost time injury.
After investigation the following main causes were found:
1. The pump was installed improperly. Electrical polarity was reversed and the pump ran with backward rotation, contributing to bearing failure, imbalance and damage to the can.
2. A canned pump should not be restarted after automatic shutdown or malfunction until the cause is determined and corrected.
[explosion, installation inadequate, processing, injury]

Lessons

[None Reported]

7731 Date Unknown

Source : CONTROL OF CHEMICAL EXOTHERMIC REACTIONS, ICHEME, SAFETY TRAINING PACKAGE, 023, 3.1.
Location : ,

Injured : 0 **Dead :** 0

Abstract

An explosion took the top off a peri-acid batch nitration vessel. Nobody was hurt, but sixty per cent of the cast iron top was blown away by the explosion.
The damage near to the vessel was considerable, with the impeller landing on the floor below via an open well. The damage indicated an estimated pressure explosion of 6.9 bar.
The cause of the accident was due to an inadequate impeller in the nitration vessel, resulting in poor mixing of the reactor contents.
[reaction vessel, operation inadequate, damage to equipment, reactors and reaction equipment]

Lessons

The following recommendations were made:
1. Design modifications to impellers must take full account of the consequences of any changes. In this case an anchor type agitator was replaced by a small diameter impeller. The replacement could not provide adequate mixing of the contents.
2. Operating instructions must be updated in the light of increased operating experience and the instructions must be easily accessible.
3. Venting must be specified on all reactions of this type.

2525 Date Unknown

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

Abstract

An explosion occurred in a sulphur recovery unit at a refinery during regeneration.
The plant had been regenerating for roughly 24 hours, when a boiler leak was discovered in the tail gas thermal oxidiser waste heat boiler. The thermal oxidiser was shut down, and the waste heat boiler depressured, vented, and drained.
The thermal oxidiser blower was used to cool the firebox and waste heat boiler as the regeneration continued. Burns in each catalyst bed were well established and after operating for a further 8 hours pressure drop across the unit began increasing.
Increased back pressure caused combustion air to leak out of the main reaction furnace, so the main air blower speed was increased to force more air into the plant. In adjusting the main air blower speed, too much excess oxygen caused a high exotherm in the first catalyst bed. Operators increased natural gas to the main reaction furnace to consume some of this excess oxygen. Plant pressure drop continued to increase, and air flow continued to fall. The main reaction furnace flame became dark and smoky, and the decision was taken to shutdown the unit. Before shutdown was completed an explosion occurred.
Cause of the explosion was unburned natural gas from the front end mixed with purge air from the thermal oxidiser air blower. This mixture ignited at the stack gas heater.
The pressure drop was caused by plugging in the thermal oxidiser or waste heat boiler from either of two possible causes. Since the thermal oxidiser firebox was cold, it probably condensed the water produced from combustion, and the water from the quench steam in the main reaction furnace. A water balance calculation has shown that water condensation could fill the firebox with water in 12 hours, restricting flow from the front of the plant. The other possible cause of plugging was -sulphur deposition on the cold waste heat boiler tubesheet.
[catalyst regenerator, separation equipment, flow restriction, solids deposition, refining, incinerator, incorrect pressure, plant shutdown]

Lessons

Specific detailed procedures are required for any "Special Operation." The procedures must be completely thought-out to ensure that all potential hazards have been considered. Impromptu operations as seen from this incident can be extremely risky.

10463Date Unknown

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

Hot air for start-up of a catalytic cracking unit was supplied by an air blower feeding through a gas fired in line air heater. Faulty and/or inadequate instrumentation permitted heavy surging of the air blower which blew out the flame in the air heater. The fuel gas was on temperature control so the control valve now opened wide. The gas ignited possibly from the hot refractory causing an explosion which cracked the blower case.
[catalytic cracker, instrumentation failure, fire - consequence, gas / vapour release]

Lessons

1. Heaters of this type should be fitted with a fire eye to shut off the fuel gas in case of flame failure.
2. Large, high pressure air blowers require adequate surge protection independent of the normal plant control system.

9644 Date Unknown

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

Location : ,

Injured : 0 **Dead :** 0

Abstract

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

Lessons

[None Reported]

7666 Date Unknown

Source : ICHEME

Location : ,

Injured : 0 **Dead :** 0

Abstract

The shaft on a pump sited immediately under the main fractionation column at a refinery was observed to be running red hot. The unit was circulating gas oil at the time. While efforts were being made by personnel to rectify the situation, the pump seal failed causing gas oil to be emitted and ignited. The flames rose in such a direction that none of the personnel in the area was affected, however had the flames drifted in the opposite direction, several persons could have been subjected to serious danger. The fire was extinguished with fluoroprotein foam and steam lances.

[seal failure, separation equipment, fire - consequence, refining]

Lessons

[None Reported]

7006 Date Unknown

Source : LOSS PREVENTION BULLETIN, 017, 6-7.
Location : ,

Injured : 0 **Dead :** 0

Abstract

An explosion and fire in a small chemical works was precipitated by a fire in the lagging of a process heating fluid cycle. The fluid concerned was a straight mineral oil of low volatility which had contaminated a substantial run of pipework as a result of a defective pump gland. The first observation was of smoke arising from lagging remote from the fire, the second was that the heating fluid had exceeded the set temperature of 270 degrees C, by 50 degrees C, and the third was that flames had enveloped the pump and a considerable length of adjacent piping.

Although the flames were quickly dealt with, temperatures in the fluid cycle continued to rise and a short while later a small explosion occurred in the covered oil header tank of the heating fluid system which was housed within a building. This was accompanied by the release from the header tank of copious oil fumes which some few seconds later ignited and exploded with violence, severely damaging the building.

The explanation appeared to be that oil beyond its spontaneous ignition temperature had been forced by expansion back up to the header tank where its vapour ignited in contact with air. The subsequent explosion may have been caused by an adventitious source of ignition, of which there were many, as the electrical equipment in use in that area was neither flame proof nor non-sparking.

The situation was such as to lead to rapid disaster since the process heating oil cycle was closed loop of low capacity.

[lagging fire, pump failure, fire - consequence]

Lessons

[None Reported]

6844 Date Unknown

Source : LOSS PREVENTION BULLETIN, 000, 7.
Location : ,

Injured : 0 **Dead :** 0

Abstract

Transportation. It was desired to increase the throughput of a pipeline carrying a very flammable hydrocarbon and the Plant Manager decided to increase the pump speed and the impeller size to meet the requirement. It was pointed out to him that as the pipeline was approximately seven miles long, valves at the discharge end should be slow closing to avoid the risk of high pressure waves and the consequent development of 'water hammer'. The Plant Manager claimed that in the past he had closed discharge valves almost instantaneously and had observed no adverse effects. Before the pumps were up-rated, the transfer line was inspected and it was found that 30% of the pipeline hangers had been distorted and 20% of the hangers were not supporting the pipeline, allowing it to hang free. On the subsequent occasion the line might have fractured with serious consequences.
[damage to equipment, near miss]

Lessons

[None Reported]

6816 Date Unknown

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

Injured : 1 **Dead :** 0

Abstract

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

Lessons

[None Reported]

11500Date Unknown

Source : UNUSUAL INCIDENTS AT GAS WORKS AND THEIR LESSONS (PART III), COMMUNICATION NO. 564; TRANS. INST. GAS ENG.
Location : , UK

Injured : 0 **Dead :** 0

Abstract

Two fan-type boosters were installed in an exhauster house. One booster was working at full load when the casing split open and the building was enveloped in flames.
The gas supply was shut off at the holder outlet valves, which reduced the fire such that the building could be entered to shut the inlet and outlet valves on the boosters. Examination of the damaged machine revealed that the impeller blades had burst through the casing, causing sparks which ignited the gas. The blades and shroud were stripped from the backplates and the casing was split open for half of its circumference. The machine was about six years old, driven by an electric motor.
The impeller was of the overhung type. Bearings on the impeller shaft were found slack and considerable quantities of dust were discovered in the inlet pipe to the booster. The failure was caused by a combination of defects. The impeller probably became out of balance due to dust, the effect being exaggerated by the bearing slackness. Oscillating stresses such as this could cause failure of the shrouding with consequent disintegration of the whole assembly.
[material of construction failure, mechanical equipment failure, normal operations, damage to equipment]

Lessons

Incident highlights the need to have control valves outside any gas pumping house. If possible, connections should be such that supply can be maintained when boosting equipment is shut down. Particular attention must be paid to maintenance of bearings on overhung-type machines. Any vibration noted should be immediately investigated, and if necessary the shaft and impeller removed and rebalanced.

11775Date Unknown

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

A pump was on stand-by in a service pumping hot crude. When one of the two operating pumps tripped out it was started up by an automatic control. The pump seal failed and a fire and explosion resulted. There was severe damage to instrument and electrical wiring.
[start-up, pump seal, blowout, fire - consequence, explosion, seal failure, safety equipment failure, crude oil, damage to equipment]

Lessons

[None Reported]

11828Date Unknown

Source : ICHEME
Location : , USA

Injured : 0 **Dead :** 0

Abstract

Hot air for start-up of a catalytic cracking unit was supplied by an air blower feeding through a gas fired in line air heater. Faulty and/or inadequate instrumentation permitted heavy surging of the air blower which blew out the flame in the air heater. The fuel gas was on temperature control so the control valve now opened wide. The gas ignited possibly from hot refractory and the explosion cracked the blower case.
[fuel gas, start-up, heating, furnace, blower, pressure raising/reducing equipment, catalytic cracker, explosion, safety equipment failure, flameout, design inadequate, safety equipment failure]

Lessons

1. Heaters of this types should be fitted with a fire eye to shut off the fuel gas in case of flame failure.
2. Large, high pressure air blowers require adequate surge protection independent of the normal plant control system.

13050Date Unknown

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

In the exhaust air system of a laboratory building with many animal rooms, massive deposits had formed in the duct work and especially on the rotor of the central exhaust blower. To facilitate a clean-out, the blower was switched off and an opening cut into its housing using a 'sabre saw'. This started a fire within the blower, which spread quickly through the plastic ductwork and developed into a major blaze. Damage caused by smoke was very high.
[animal products, maintenance, cleaning, fire - consequence, solids deposition, cleaning inadequate, nitrate, ozone, ducting, blower]

Lessons

The suction grills in the animal rooms were not fitted with dust filters, and organic material like animal hair, dried excrement etc was sucked up and formed deposits in the ventilation system. The system had not been cleaned during 12 years of operation. To prevent the emission of bad odours, ozone was dosed into the system, causing the formation of nitrates in the organic material.
When the 'sabre saw' was used, it produced hot cuttings, which ignited the readily combustible deposits. Melted, burning, polypropylene dropped through vertical ducting and spread the fire throughout the building.

13141Date Unknown

Source : ICHEME
Location : ,

Injured : 0 **Dead :** 0

Abstract

In the exhaust air system of a laboratory building with many animal rooms, massive deposits had formed in the duct work and especially on the rotor of the central exhaust blower. To facilitate a clean-out, the blower was switched off and an opening cut into its housing using a 'sabre saw'. This started a fire within the blower, which spread quickly through the plastic ductwork and developed into a major blaze. Damage caused by smoke was very high.
[animal products, maintenance, cleaning, fire - consequence, solids deposition, cleaning inadequate, ducting, blower, nitrate]

Lessons

The suction grills in the animal rooms were not fitted with dust filters, and organic material like animal hair, dried excrement etc was sucked up and formed deposits in the ventilation system. The system had not been cleaned during 12 years of operation. To prevent the emission of bad odours, ozone was dosed into the system, causing the formation of nitrates in the organic material.
When the 'sabre saw' was used, it produced hot cuttings, which ignited the readily combustible deposits. Melted, burning, polypropylene dropped through vertical ducting and spread the fire throughout the building.