

IMPERIAL CHEMICAL INDUSTRIES PETROCHEMICALS DIVISION

SAFETY NEWSLETTER NUMBER 45

By Trevor Kletz

45/1 FIRES AND EXPLOSIONS IN RECIPROCATING AIR COMPRESSORS

Seventeen have occurred in ICI in the last 18 years, including one in Petrochemicals Division this year. This note, based on a memorandum by D. Summers-Smith, summarises the way in which they occur and the action that should be taken to prevent them happening in the future.

Above 140°C lubricating oil oxidises and forms a black deposit on the walls of air compressor delivery lines. If the deposit is thin it is kept cool by conduction through the pipework but if the deposit is allowed to get thick it may catch fire. The fire may overheat the delivery pipe or aftercooler so that they burst, or, in a few cases, it may set up a shock wave that causes more serious damage. In a recent case the fire melted the tubes in the aftercooler and set up a shock wave in the cooling water line which caused serious damage.

To prevent fires or explosions in air compressors:-

- 1 If possible, do not let the delivery temperature exceed 140°C. It is easier to do this if the inlet air filters are kept clean and the suction line is never throttled.
- 2 Keep the pipework between the compressor and the aftercooler as short and simple as possible, avoiding any features in which oil might collect.
- 3 Use the thinnest practicable grade of oil, if possible one of the special air compressor lubricants.
- 4 Have a preventative maintenance programme for cleaning the delivery pipework regularly so that deposits do not get more than 1/8 inch thick. Check the design of discharge snubbers to make sure they can be cleaned properly. If cleaning is difficult or impossible they may have to be replaced.

At temperatures above 140°C, deposits build up more quickly and delivery lines must be inspected more often.

- 5 New machines should be designed so that the discharge temperature is below 140°C. If this cannot be achieved then machines of the non-lubricated type should be considered.

45/2 A NEW TANK BLOWS UP WHILE FILLING WITH WATER

Another company reports that a new tank was being filled with water for hydrostatic test when an explosion occurred. Two welders who were working on the roof, finishing off the handrails, were injured, fortunately not seriously.

How could an explosion occur in a new tank that apparently contained nothing but water? The answer is on a later page. It was nothing to do with the pressure of the water. The tank was only half full when the explosion occurred, and the man-hole was open.

The same report from the other company describes several other incidents that happened about the

same time.

- (a) The drain valve on a level glass was choked with solid. When it thawed, an oil leak occurred which caught fire. Nobody was hurt but £15,000 worth of damage was caused and production was lost for several days. -
- (b) A man was carrying out some repairs at a road tanker loading bay when a vehicle moved off over his foot, injuring it so badly that it had to be amputated. The report states:
"The accident resulted from working under unsafe conditions, i.e., while a vehicle was being filled in the same bay and in close proximity to the two men; they, in their turn, did not appreciate the risk involved and the sad comment to this accident is that there was little safety awareness by the several people directly involved in it."
- (c) A man used some petrol to clean the floor. It caught fire.
- (d) A rail tank car full of a very poisonous chemical was derailed during shunting. Fortunately it did not leak. The accident occurred because the shunter was not walking ahead of the tank car to make sure that the railway line was clear.
- (e) While excavating a hole in the ground a contractor cut through a live 3,300 volt electric cable. The contractor had been given a Permit-to-Work stating that there were no cables underneath the area to be excavated. The Permit did not tell him that there was a live cable about a foot to one side and the contractor did not excavate his hole very accurately (who does?). What is the procedure on your works before men are allowed to excavate holes in the ground?
- (f) Because somebody opened the wrong valve liquid nitrogen entered a mild steel pipeline. The pipeline jumped six feet into the air and disintegrated. A trip has now been installed to prevent cold nitrogen coming into contact with mild steel pipelines.

45/3 NITROGEN IS USED INSTEAD OF COMPRESSED AIR

A control room operator noticed a peculiar smell. On investigation it was found that a hose, connected to a nitrogen line, had been attached to the ventilation intake, It is believed that this had been done to improve the ventilation of the control room which was rather hot. The man who did it thought he was using compressed air.

Nitrogen does not usually smell and it is fortunate that on this occasion the plant nitrogen was not very pure and the operators noticed the smell.

All service points should be identified so that nitrogen and compressed air cannot be confused. As stated in Safety Newsletter No. 13, Item 10, different couplings have been accepted as standard for steam, air, nitrogen and water lines. For details see Engineering Standards Nos.

TDB 0605 for water
TDB 0615 for services steam
1DB 0625 for compressed air
TDB 0635 for nitrogen
TDB 0648 for fire steam

Copies are available from Standards Section, Engineering Department, Ext. B.3373/3393.

Needless to say, no hose should be connected to a ventilation system (or anything else) without a Permit-to-Work.

In addition, an open-ended hose should never be connected to compressed air. Compressed air is dangerous and can cause injury if it is directed at the body. A RoSPA leaflet giving more details is available on request.

45/4 DAMAGE TO EXPANSION BELLOWS BEFORE DELIVERY

Expansion bellows are made from thin material and are, therefore, easily damaged. A number ordered for a new plant were found to be damaged when they were received on site. In one case there had been a deliberate attempt to mask the damage by filling in the indentations with resin. It is recommended that in future a design for the protection of the bellows is included in the design drawings, and that all bellows are examined carefully before installation.

For further details see Agricultural Division Engineering Technical Services Progress Report for July 1972, available from Division Reports Centres, Ref. No. A17,880/72/7.

45/5 PLUGGING HEAT EXCHANGER TUBES

“Inserting taper plugs in the ends of leaking tubes is simple, quick and effective, so far as sealing is concerned, but it may have highly dangerous consequences.

In a recent incident an end plug was being drifted out prior to re-tubing when the plug weighing some 250 grams shot out at very high speed, travelled a distance of some 300 to 400 metres, ricocheting off structures and machines and miraculously missing people.

The source of high energy in this case was hydrogen pressure generated by the action of water on an aluminium tube, well sealed at both ends. Steel tubes containing water or moisture may generate some pressure, but not as high as that of aluminium and water. There may well be other combinations of tube metal, residual products, water etc., that react together and produce an equally dangerous situation .

It should therefore be mandatory to vent tubes to the shell side before plugging. The plug should not have too large a taper, and in addition, when removing plugs it is advisable to take adequate precautions to trap the plug should it have a tendency to fly out.” [See 47/5(e).]

From Agricultural Division Engineering Technical Services Report for June 1972.

45/6 THREE YEARS AGO—AND TODAY

“In these Newsletters I have frequently stressed the need for regular checks of the oxygen content of tanks, stacks, centrifuges and any other equipment which is blanketed with inert gas. Many explosions have occurred because the flow of inert gas was stopped”.

From Safety Newsletter No. 14, November 1969

Most of the items in these Newsletters tell us about something that went wrong. Here, for a change is a success story.

Earlier this year the reading on the oxygen analyser on one of the flare stacks in the Division rose to 3%. On looking round the operators found that a motor valve in a cross-over line to another flare stack had failed in the open position, the result of a broken air impulse line. Air was being sucked down one stack and through the cross-over into the other. The cross-over was isolated before the oxygen content got high enough for an explosion to occur. (Incidentally, the motor valve should have been designed to shut on air failure.)

Do you measure oxygen content on stacks, tanks and centrifuges and do your operators know what to do if the oxygen content rises? (See Newsletter 40, Items 6, 7 and 8 and 47/5 (e)).

45/7 36 YEARS AGO

I met my first such accident in a very small brickworks in Uddingston. During inspection I noticed a

small boy who was taking bricks from the press and had a bandage round the stump of his right fore-finger. I looked closer and saw half the third finger was missing but the stump healed. I asked him about them. "Och", he said, "I got ten bob for that one, but I got a pun for this!" And that is perhaps a fair comment on much of the industry of Glasgow of that day, only just climbing out of the depression of the early 'thirties."

From the reminiscences of Mr. W.J.C. Plumbe, former Chief Inspector of Factories, "Occupational Safety and Health", May 1972, page 32, June 1972, page 20, July 1972, page 24 and August 1972, page 20 a most interesting series of articles.

45/8 GOOD-BYE TO THE ALARM BELL?

"Alarm systems can also be obtained which incorporate the use of pre-recorded messages on tapes to indicate the nature of the problem for the operator."

From a paper by J.K.Kern presented to a Conference on the Control of Hazardous Material Spills held in Houston, Texas in March 1972

45/9 UNUSAL ACCIDENT NO. 15

Rumour has it that a certain Works Fire Brigade was about to brew up when the fire alarm sounded. They dashed out to answer the call and dealt very successfully with a major fire. Their next fire call was to the Fire Station. They had left the electric water heater on and it had boiled dry and caught fire!

45/10 WHAT THE LAW SAYS NO. 6

In Statute and Common Law and in satisfaction of other transport regulations, it is the responsibility of the filler of the dangerous goods to ensure that the cylinders or other containers are designed to satisfy the Regulations/recommendations for the product to be filled, that they are in a fit condition to be filled and have been inspected within the period prescribed.

From the draft revision of the IC! Pressure Vessel Code, IC! Engineering Codes and Regulations, Group B, Vol 1, 4.

If you fill any cylinders or other containers, how do you discharge this responsibility?

45/2 A NEW TANK BLOWS UP WHILE FILLING WITH WATER (cont'd)

The tank was filled with water through a pipeline that had previously contained petrol. A few gallons of petrol had been left in the line and were flushed into the tank by the water. They floated on top of the water and the vapour was ignited by the welders.

Men should not be allowed to weld on top of a tank when it is being filled with water for the first time. One of the reasons for filling it with water is to make sure that the tank and its foundations are strong enough. So everybody should be kept out of the way while it is being filled.

Tanks are usually designed with a weak seam roof so that if the tank is overpressured it fails at this seam. In this case the tank failed elsewhere. The contractor had strengthened the roof to wall weld thinking he was doing a good job!

On several occasions in the Division, welding inspectors have thought that the roof to wall weld looked undersized and have suggested strengthening it! Fortunately they were stopped in time.

45/11 RECENT PUBLICATIONS

- (a) A & D Paper No. S72/12, mentioned in Safety Newsletter 41, Item 13d has been followed by Paper No. S72/22 which describes a computer programme for predicting the final temperature and pressure obtained from the explosion of a mixture of substances containing carbon,

hydrogen, oxygen and nitrogen. Copies are available from Dr. H.W.W. Ehrlich, R & D. (Ext. 3700).

(b) "An example of Human Failing — Railway Signals Passed at Danger".

For a copy of (b) or for more information on any item in this Newsletter please write to Miss M.N. Organic House, Billingham or ring B.3927. If you do not see this Newsletter regularly and would like your own copy please ask Miss N to add your name to the circulation list.

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