IMPERIAL CHEMICAL INDUSTRIES LIMITED
PETROCHEMICALS DIVISION

SAFETY NEWSLETTER No 65

65/1 OXYGEN DEFICIENCY METERS

Newsletter 36/1 described a new instrument which sounds an alarm when the amount of oxygen in the air gets too low. It was suggested that these should be used on all vessel entry jobs. Difficulties were experienced with manufacture of the instrument but it is now available from Draeger Normalair, price £75.

Several readers have said that if a vessel is isolated from all sources of danger and if the atmosphere is analysed and shown to be OK before the entry permit is issued, then it is impossible for the oxygen concentration to get too low. Why then do we need oxygen deficiency meters?

Earlier Newsletters have described incidents in which the impossible happened and the oxygen content was found to be low.

In the first incident (Newsletter 4/2) the atmosphere was tested by aspirating a sample through an analysis instrument. There was a blockage in the instrument so no sample passed through it. A bubbler should have been fitted.

In the second incident, also described in Newsletter 4/2, a sample was taken near a man-hole instead of in the middle of the vessel.

In the third incident (Newsletter 18/6), two men working inside a tank complained of fumes. Their supervisor told them to connect up a compressed air hose but they connected up a nitrogen hose by mistake.

In the fourth incident (Newsletter 28/5), an “air”-driven light was used to illuminate a vessel. As a man was about to enter the vessel he noticed that the light was connected to the nitrogen supply.

Another incident is described in the supplement to Occupational Safety and Health Bulletin for May 1973. A pit was dug in an old factory where acid is handled. The atmosphere was sweetened with compressed air and tests carried out. Soon afterwards a man went into the pit but felt unwell and came out. It was found that there was 12% carbon dioxide in the pit. Acid had soaked out of the ground and had reacted with limestone in the soil to produce carbon dioxide.

In all these cases somebody was wide-awake and spotted the mistake before anyone was seriously hurt, but can we be sure that the impossible will not happen again and if it does, will we spot it in time?

I therefore urge that each Works should obtain a number of portable oxygen alarms and that it should become the normal practice to carry one when entering a vessel or similar confined space.

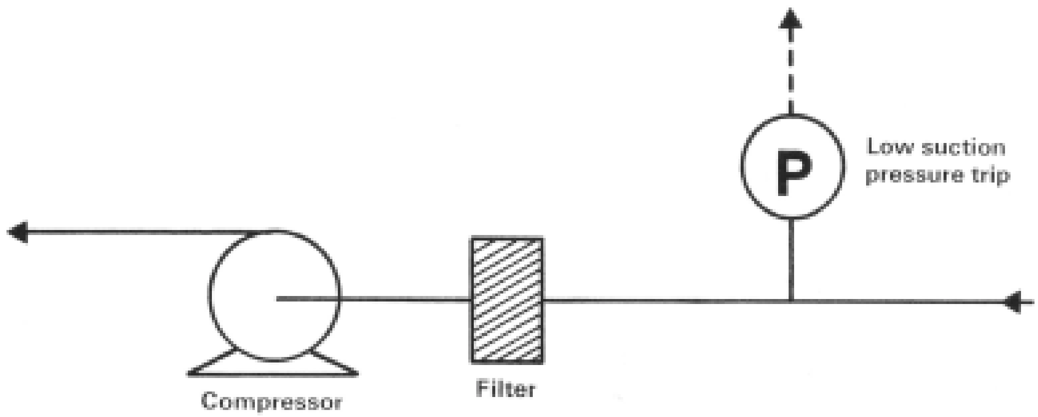
The detector is the size of a packet of cigarettes and makes a noise if the oxygen content falls. To test it, just breathe on it.

65/2 HOW CAN WE MAKE SURE THAT START-UP MODIFICATIONS DO NOT INTRODUCE UNFORESEEN HAZARDS?

Newsletter 63/2 described a leak that occurred because a plant modification had not been checked for its effect on the safety of the plant. All modifications should be checked for their effects on relief and blowdown, trip systems, area classification and other safety aspects and to make sure that the right materials of construction are being used.

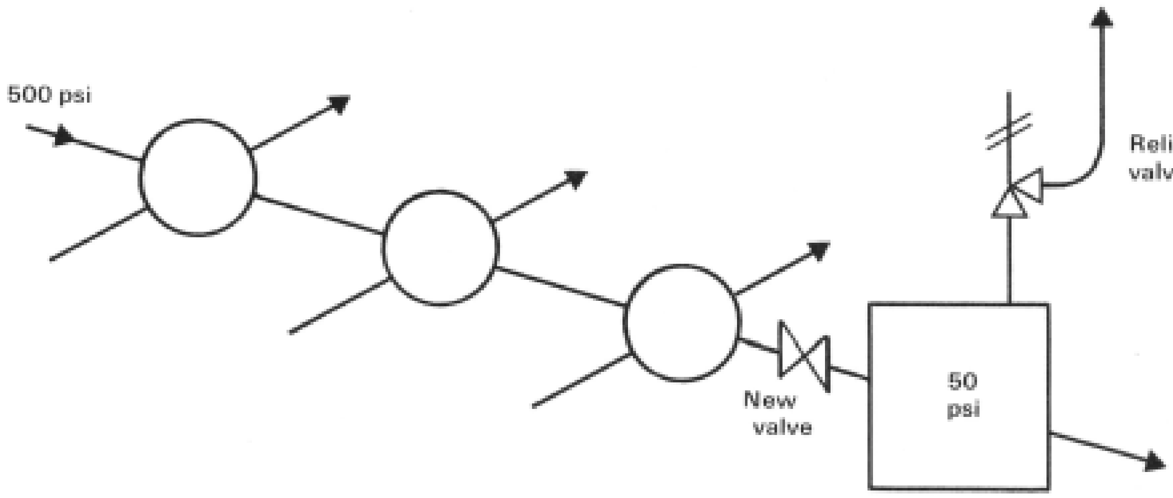
A special problem arises during the start-up of new plants when many modifications may have to be made, sometimes at short notice. Failure to think out the consequences of start-up modifications has caused some serious incidents.

One was described in Newsletter 55/2. 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 and you can guess the rest.

Another incident occurred in another company. A process stream passed through a series of heat exchangers into a vessel. The relief valve on the vessel protected the whole series of exchangers.



The start-up team had an extra valve fitted during construction; they decided it might be useful in preventing back-flow.

During start-up this valve was closed and the whole train of exchangers was subjected to the full upstream pressure. One of them burst. Result: a major fire and a big delay in start-up.

How can we make sure that modifications made during or just before start-up are thoroughly probed? At times like this everyone wants the job to go forward and they are tempted to say, ‘What can possibly go wrong?”

It helps if everyone is aware of the sort of things that have gone wrong in the past. But this alone is not sufficient.

On some projects we have appointed a special “modifications man” and insisted that he checks all modifications for their effects on

Relief and blow-down
Trip systems
Area classifications
and Safety

Normally the check is done before the modification is made but if it has to be made during the night the “modifications man” does a thorough check the next day. On a big project there may be enough work for several “modifications men”.

This system has been used successfully on many projects. It should be standard.

65/3 DIESEL ENGINES

Earlier Newsletters (23/1, 32/2 and 51/4) have pointed out the hazards of diesel engines. They can ignite a leak of flammable gas or vapour in several ways. The exhaust pipe may be hot enough to ignite it, the electrical equipment may ignite it, or the vapour may be sucked in through the air inlet and a flashback occur.

Another hazardous feature of some diesel engines is not widely known. Turbo-charged engines are coming into increasing use. In these, the air is not sucked into the engine but is blown in by a turbine driven by the exhaust gases. These turbines can get very hot and some types can actually glow cherry red when the vehicle is operating on a fairly heavy load.

Turbo-charged engines are now fitted to many road vehicles and some have been fitted to cranes. *These cranes are quite unsuitable for use in areas where leaks of flammable gas or vapour may occur and they should not be allowed into Petrochemicals Division plants.*

It is impossible to tell if a road vehicle is turbo-charged without examining the engine. It is now more important than in the past that diesel-engined vehicles are not allowed into areas where leaks of flammable gas or liquid may occur without the permission of the process supervisor, who must first make sure that the area is safe.

There is no longer any justification for considering diesel-engined road vehicles as safer than petrol engined ones, the same regulations should apply to each.

65/4 WILL A RELIEF VALVE, PROPERLY DESIGNED AND MAINTAINED,ALWAYS PREVENT A VESSEL BURSTING?

Here is the answer to the question in our last issue.

“No”. If a vessel gets too hot the metal will be weakened and the vessel will burst even though the pressure is below that of the relief valve. For example, at 1300°F (700°C) many of the vessels we use would burst after 2½ minutes.

Vessels can get hot in several ways. One way is by exposure to a fire. It is, therefore, most important that when a pressure vessel is exposed to a fire it is kept cool with water sprays. The first thing to do in a fire is to cool the plant vessels. Failure to do this led to a burst vessel at Feyzin in 1966. The fire fighters used the available water to cool the neighbouring vessels and assumed that the relief valve would look after the vessel that was on fire. As a result this vessel burst, killing 18 people and injuring 81.

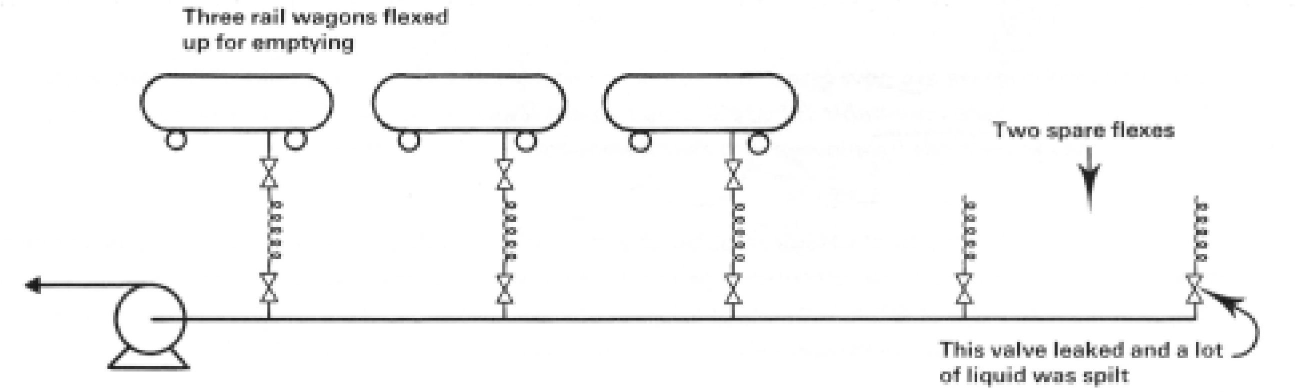
If there is a layer of liquid in a vessel the liquid will boil and absorb the heat and this will prevent the metal in contact with the liquid getting too hot. Above the liquid surface, however, the metal may over-heat and burst. In addition to cooling a vessel which is exposed to fire, the pressure inside should be reduced to 20% of design pressure.

Fire proofing is another way of protecting vessels which may be exposed to fire.

Vessels can also get too hot if they are heated by electricity. If the flow stops, heat continues to pour in and the vessel may over-heat. Electrically heated vessels should, therefore, always be fitted with high temperature trips unless we are certain that the maximum possible heat input will not make the metal too hot.

Furnace tubes can get too hot if the flow through them stops or is reduced or if the flames impinge on them. We should try and measure the metal temperature and we should know the maximum temperature that the tubes can withstand. For further information see Safety Newsletter 55/3.

65/5 OPEN ENDS SHOULD BE BLANKED



On the plant concerned screwed plugs have now been provided for the ends of the hoses. The plugs must be fitted with vent cocks so that any pressure can be released before they are removed

65/6 A TANK IS OVERFILLED BECAUSE THE DUTY WAS CHANGED

A pentane tank was overfilled and a ton of pentane was spilt. The high level alarm did not sound.

The level indicator was a DP cell which actually measures the *weight* of liquid in the tank. The tank had previously contained petrol (specific gravity 0.81). Pentane is much lighter (specific gravity 0.69). When the tank was full of pentane the level indicator said it was only 85% full. The high level alarm was fixed to the level indicator.

Some level indicators measure volume and some measure weight. If a level indicator measures weight and a lighter liquid is put into the tank, then remember it will not hold so much.

High-level alarms should be independent of level indicators as the high level alarm is needed when the indicator fails. An instrument that measures volume is better than one which measures weight.

65/7 CONFUSION BETWEEN DIFFERENT THREADS

Several accidents have occurred because of confusion between metric, unified and Whitworth threads, particularly on equipment that is threaded to take eye-bolts for lifting. There is usually no indication on the equipment to show the type of thread. If the eye-bolt is of the wrong type it can often be fitted into the hole but may give way when the equipment is lifted. A poster is available from your safety officer.

65/8 ANTI-DERAILMENT BRACKETS

A vehicle recently caught the hanging chain of a 5-ton hoist and pulled the hoist carriage off its beam.

We now recommend that anti-derailment brackets should be fitted to all hoists. A sketch is available if you wish to see one.

65/9 UNUSUAL ACCIDENTS NO. 35 - ALARMS ARE NOT ALWAYS FALSE

When a plant alarm operates, people sometimes assume the alarm is faulty and take no action. Newsletter 5, Item 1 described how a vessel was burst as a result.

Another incident is described in “Total Loss Control” by J.A. Fletcher and H.M. Douglas. A night watchman on his rounds in a warehouse found that the sprinklers were operating. He promptly closed the main valve on the water line. Result: the warehouse was destroyed.

65/10 COMMENTS FROM READERS

Newsletter 63/7 described an incident which occurred because containers of acid and caustic soda were interchanged while an operator was on his days off. Nobody told him about the change when he returned, The Newsletter made the point that we must tell people about changes made while they were away.

Readers have suggested that if acid and caustic soda, or other incompatible chemicals, are handled on the same plant, then, whenever possible, the containers should differ in size, shape or colour. It is then harder for them to be confused.

In many instances, of course, we have to accept the containers in which suppliers pack their goods but we can always change their colour.

65/11 RECENT PUBLICATIONS

(a) A note by H F dated 7 May 1974 describes the precautions to be taken when isolating pipelines by freezing using a mixture of isopropanol and DRIKOLD.

The note points out that the use of liquid nitrogen for freezing can be dangerous as brittle failure may result. Liquid nitrogen should be used only after the most thorough, expert examination of stress levels and material properties.

(b) The ICI steam curtain vapour barrier is described in an article in “Power and Works Engineering”, 8 May 1974.

For copies of (a) or (b) or for more information on other items in this Newsletter please ring B.3927. If you do not see this Newsletter regularly and would like your own copy, please ask us to add your name to the circulation list.

June 1974

QUESTION

Will a combustible gas detector such as a Sieger or MSA always detect flammable gas or vapours?

Answer in the next issue.

STOP PRESS

WHAT HAPPENED AT FLIXBOROUGH?

It is too early to comment on the explosion at the Nypro factory at Flixborough on 1 June or to make any recommendations. At the time of writing (9 June) it seems that a pipe broke, causing a big leak of cyclohexane and that the vapour exploded with exceptional violence. (See Newsletter 60/6 for a note on explosions).

Two things can be said at this stage.

First, there is nothing special about cyclohexane that makes it more likely to leak or explode. So far as fire and explosion are concerned, it is very similar to petrol and naphtha and many of the other materials we handle.

Second, we should continue with the measures described in the supplement to Newsletter 53, namely:

- Minimise the chance of a leak by good design, construction and maintenance and by following the rules when preparing equipment for maintenance.

- If experience shows that equipment is liable to leak, then we should install gas detectors so that the leak is detected at once and we should install remotely operated emergency isolation valves so that the leaking equipment can be isolated.

- We should make our plants as open as possible so that leaks can be dispersed by natural ventilation. In some cases a steam curtain may be needed to prevent leaks reaching sources of ignition.

Trevor A. Kletz
10.6.1974