SAFETY NEWSLETTER

No. 139
HOW TO POUR PRODUCTS ON THE FLOOR OR DOWN THE DRAIN

139/1 We put our trust in an alarm in the drain line — but it went out-of-order.

139/2 As the result of modifications, an overflow line went to a full tank.

139/3 We thought it impossible to open the drain valve when the pressure was high, but ways were found.

139/4 Removing the wrong bolts caused a spillage of liquefied flammable gas which caught fire.

139/5 Oil spilt on a river caught fire 2½ miles away.

139/6 When does HSE prosecute?

139/7 How not to run a regulatory authority.

An Engineer's Casebook — Plugging boiler tubes.

What is wrong with the fire triangle?

ICI
IMPERIAL CHEMICAL INDUSTRIES LIMITED
PETROCHEMICALS DIVISION

139/1 THE STORY OF A LOSS TO DRAIN

On one of the Division's plants a series of filters are washed with hot water and the wash liquid run to drain. As a result of errors in valve settings, at various times filtrate liquor has also been run to drain, at a cost of about £10,000 per hour.

To try to prevent this happening again, a conductivity meter was installed in the drain line. The wash water has a low conductivity, the filtrate has a high conductivity, so the meter was set to sound an alarm when the conductivity was high. It was tested regularly. Nevertheless, when a wrong valve operation was made the meter failed to detect the flow to drain.

Why?

1 The conductivity probe was coated with carbon. This had little effect at low readings, at which the meter was test calibrated, but caused a big error at high readings.

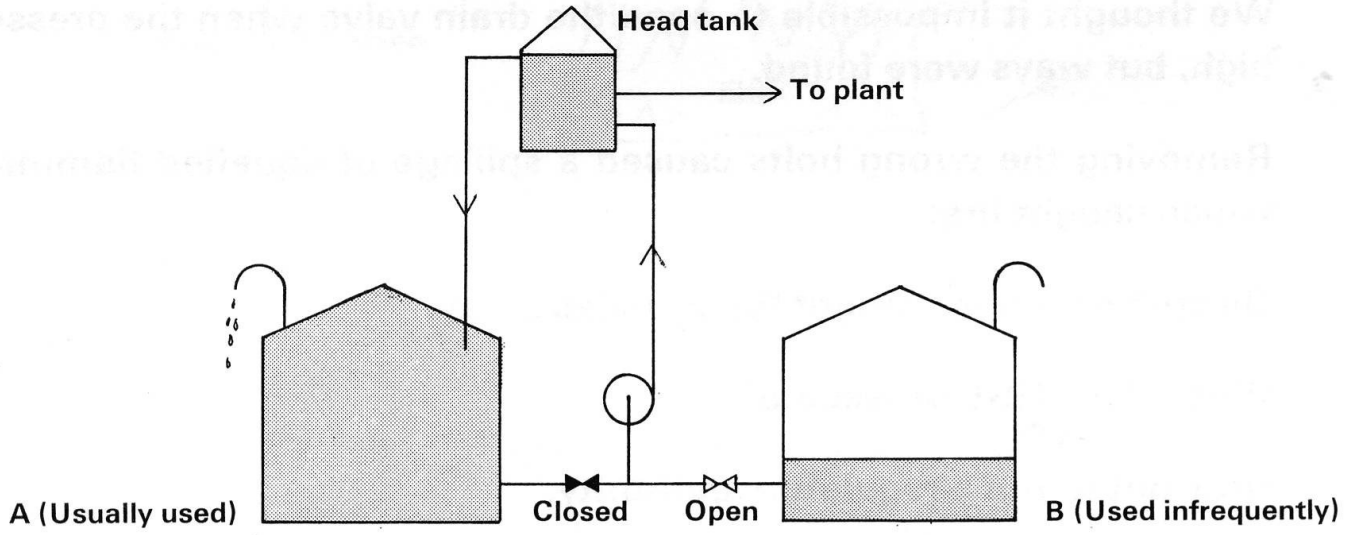
The meter should have been tested over its whole range. *Always test instruments as near as possible to real life conditions*. Newsletter 58/1 described other incidents which occurred because tests were not like real life.

2 The operators relied on the conductivity alarm and did not query the high reading on the drain line flowmeter. They did not realise that *all alarms fall sometimes*.

3 If the drain valve on a filter is opened when the feed pump is running, the filtrate goes straight to drain at a high rate. An interlock is therefore being fitted so that the pump cannot run when the drain valve is open.

139/2 AN ACCIDENT WAITING TO HAPPEN

Raw material is fed to a plant from two stock tanks. The raw material is pumped to a head tank from which excess flows back to the stock tank. The lines are arranged as shown below.



The system was used for several years before the inevitable happened. Tank B was in use, tank A was full and the flow from the head tank caused it to overflow. It was then discovered that the line from the head tank went only to tank A, the one normally used, and not to tank B.

The system grew up as the result of a series of modifications. Several years went by before a spillage occurred but it was inevitable that one would occur sooner or later.

All modifications should be examined systematically. See Newsletters 135/5, 131/1, 127/3 & 5, 126/12, 118/2, 111, 100/2, 99/1, 97/6, 83, 71/7, 67/7d and 63/7. The Newsletters underlined were devoted mainly to incidents caused by modifications.

139/3 AN INTERLOCK WAS MADE USELESS - AND A SPILLAGE OCCURRED

Experience shows that when autoclaves or other batch reactors are fitted with drain valves, they may be opened at the wrong time and the contents of the autoclave tipped onto the floor — often inside a building.

To prevent this happening, the autoclave drain valves on one plant — in another Division — were fitted with interlocks so that they cannot be opened when the pressure in the autoclave is above a pre-set value. The valves normally used for transferring the contents of the autoclaves to the next vessel are fitted with similar interlocks.

Nevertheless, the drain valve on an autoclave was opened when the autoclave was up to pressure and part of a batch was emptied onto the floor.

The enquiry disclosed that the pressure measuring devices were not very reliable and the operators had got into the habit of by-passing them. They did this by altering the indicated pressure with the zero adjustment screw or by turning off the instrument air supply.

One day the inevitable happened. Having defeated the interlocks the operator opened the drain valve by mistake instead of the transfer valve.

As a general rule operators should not be allowed to disarm protective equipment or alter the set points. Disarming or alteration of set points should take place only when authorised in writing.

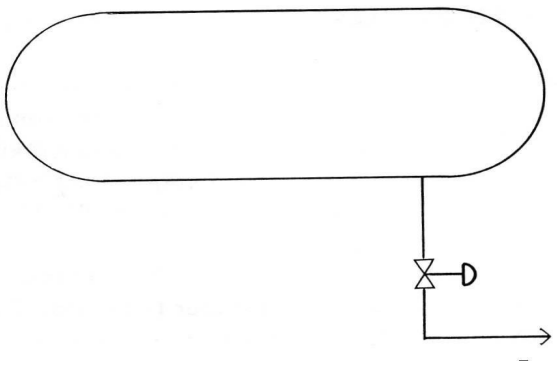
Reminder: Newsletter 136/2 described a fatal accident which occurred because protective equipment was by-passed.

139/4 ANOTHER FEYZIN

At Feyzin in France in 1966 a pressure vessel containing propane leaked and caught fire and the heat of the fire burst the tank, killing 18 people. The incident has often been described, for example in Newsletter 73/4, and led to many improvements in the design of other installations for handling liquefied flammable gases (LFG).

Now another Company has described a similar incident which occurred over 3 years ago, on an installation containing 12 horizontal cylindrical tanks, each 200— 300 m^3 in size.

A fitter, a man with 10 years experience, was asked to maintain the actuator on the first valve on one tank.



Instead of removing the actuator, he unbolted the bonnet bolts and the valve plug blew out. The escaping liquid vaporised and formed a cloud 1100 feet long, 800 feet wide and 5 feet deep. It caught fire at a neighbouring plant, flashing back to the tank, and, as at Feyzin, a fire burned underneath it

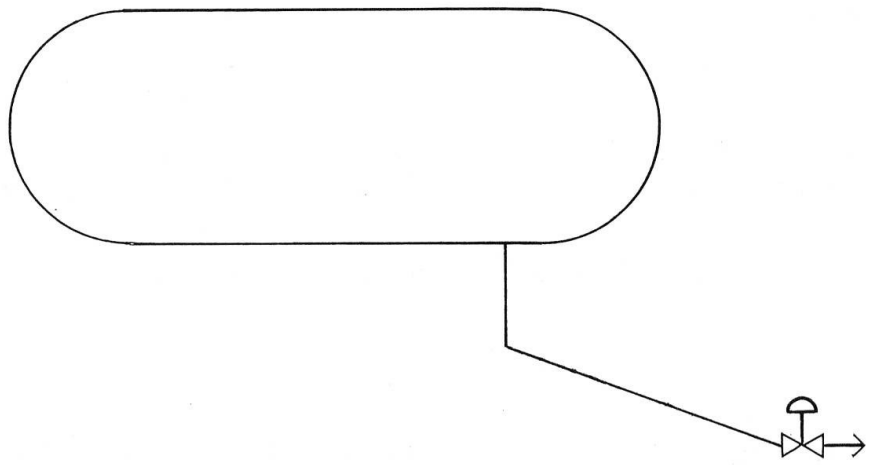
The tank burst, either because the relief valve was too small or, more likely, because the metal was softened by the heat. One half of the tank travelled 1000 feet in one direction and the other half travelled 1300 feet in the opposite direction, destroying other equipment on the way. Several of the other tanks were knocked or blown off their supports and two more burst.

Fortunately, before the leak ignited, most people had been evacuated from the area and only one man was killed and four injured.

Before the leak caught fire, attempts had been made to seal it with ice by hosing with water. A fairly good seal had been made but it melted as soon as the leak caught fire.

ICI's practice (see "Liquefied Flammable Gases— Storage and Handling", ICI Engineering Codes and Regulations Volume D 1.6, the supplements to Newsletters 26 and 64 and "Protect Pressure Vessels from Fire", Hydrocarbon Processing, August 1977, p 98) is:

1 To locate the first valve outside the shadow of the tank so that any leak is not underneath the tank.



2 To slope the ground so that any spillage runs aw~y from the tank to a containment area.

3 To provide fire insulation and water sprays.

4 To design relief valves for fire exposure and to provide means of reducing the pressure in a vessel in the event of fire.

Reminder: Safety Note 72/19 described a Feyzin-type incident which occurred in Brazil in 1972.

139/5 OIL WILL SPREAD A LONG WAY ON TOP OF WATER

Newsletters 110/2 and 53/6 described incidents in which oil spread across a water surface and caught fire some distance away. In one case a small spillage of oil, the result of removing a slip-plate in a flooded pipetrench, caught fire 65 feet away where a welder was working; the man removing the slip-plate was killed. In another case a leak onto a canal caught fire ½ mile away 2½ hours later; six men in a boat were killed.

Now the US National Transportation Safety Board has described another incident. A pipeline containing petrol at 300 psig (20 bars) was ruptured by a ripper (a bulldozer fitted with a heavy tooth) which was being used to break up a concrete valve anchor on a nearby water line. The petrol ran

downhill into a creek and then along a canal. It caught fire 2½ miles away and the fire ran back along 1 mile of open canal, ½ mile of underground canal and 1 mile of the creek. Vegetation, mostly gardens, was destroyed for 20 feet on each side. One man, who was trying to collect some petrol, was killed.

139/6 WHAT THE LAW SAYS No 21

"It is not HSE policy to prosecute for every breach of a requirement of health and safety legislation but rather to prosecute where employers or others concerned appear deliberately to have disregarded the relevant regulations or where they have been reckless in exposing people to hazard or where there is a record of repeated infringements."

From "The Leakage of Radioactive Liquor into the Ground, British Nuclear Fuels Limited, Windscale, 15 March 1979", Health and Safety Executive, 1980, paragraph 51.

This report is also interesting for another reason. The leakage occurred because the level in a sump was higher than indicated. The level was measured by a pneumercator and the pointer on the circular pressure gauge attached to the pneumercator was on its second circuit of the gauge (Paragraph 25).

Most of our pneumercators are designed so that this cannot occur, but a check might be worthwhile.

139/7 HOW NOT TO RUN A REGULATORY AUTHORITY

The story of the DC10 accident near Paris in 1974 has often been told. There was an earlier, similar, but less serious accident in 1972. After this accident the head of the US Federal Aviation Administration rang the Head of the Douglas Division of McDonnell Douglas.

"I rang him and said, 'What the hell is wrong with your Goddam plane?' And he replied; 'Jack, we'll have it fixed by Friday night',"

Agreements of this sort are better than regulations if they are followed by an agreement on precisely what is to be done and a check to see it is done. Unfortunately, neither occurred.

From "Destination Disaster" by P Eddy, E Potter and B Page, Hart-Davis and McGibbon, 1976, p 169.

139/8 COMMENTS FROM READERS

(a) Newsletter 136/2 described how a man was killed when the rope supporting a conveyor broke and the conveyor fell.

A reader points out that the conveyor, though it moves slowly, is moving machinery and should therefore be fenced. A good guide is the Agricultural Division Guide to "Machine Guarding for Materials Handling Equipment".

(b) Newsletter 136/8 described how a drum came to be overfilled. A reader suggests that it would swell by 5% before it would burst. Most small vessels swell before bursting; some cylinders can increase in volume by as much as 15%. Pipelines swell very little though the flanges may stretch.

139/9 A LOOK BACK AT NEWSLETTER 39 (April 1972)

An article in the "Oil and Gas Journal", 7 February 1972, page 83, describes nine incidents in which compressors have been damaged by sucking in loose objects.

139/10 UNUSUAL ACCIDENTS No 99

Another company report that two drums of green dye on a lorry started to leak. By the time they were empty the lorry had travelled 30 km.

It was winter and the road was covered with slush. Cars following the lorry splashed the dye around. The snow alongside the road and many of the cars were coloured green; people carried the dye into their houses on their shoes.

139/11 RECENT PUBLICATIONS

(a) An article by A G Johnson, J McQuaid and G A C Games in The Mining Engineer, March 1980, p 723 describes how hazard and operability studies and hazard analysis have been applied to coal mining.

(b) An Engineer's Casebook No 31 in Newsletter 131 discussed compensation plates around vessel nozzles and pointed out that a small hole should be drilled through the compensating plate to vent the space between the pad and the vessel wall. An article in "Ammonia Plant Safety", Vol 21, 1979, p 95 describes an incident which occurred because a leak of gas through one of these holes was ignored. Ten days later the vessel ruptured, causing extensive damage to neighbouring equipment.

(c) The Health and Safety Executive have published a Guidance Note (No GS11) on "Whisky Cask Racking". Presumably this is the result of the unfortunate accident in which George, Duke of Clarence, brother of Edward IV (1461 — 1483) was drowned in a butt of Malmsey. There is usually some delay before accidents are followed by official guidance.

(d) "Guide for the Location and Design of Control Buildings and other Occupied Buildings near to Hazardous Plant", Process Safety Guide No 6, Report No HO/SD/740010/6, available from Division Report Centres (within ICI only). The Chemical Industries Association report on the same subject (see Newsletter 131/12b) is included as an Appendix.

(e) "Stress Corrosion Cracking in Ammonia Storage", a paper by A Cracknell presented at the last AIChE Symposium on Ammonia Plant Safety.

For a copy of (d) or for more information on any item in this Newsletter please 'phone P.2845 or write to us at Wilton. 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.

September 1980

[**Transcribers Note:** Some corrections to Newsletter 138 were included here and have been incorporated into the transcription made by me]

An Engineer's Casebook No. 39
PLUGGING BOILER TUBES

Safety Newsletter 135/2 drew attention to some dangers arising from plugging tubes in heat exchangers and how to avoid them. A similar problem exists in fired boilers when it may be necessary to plug off leaking, burned or split tubes.

In the case of a boiler any tube which is taken out of service and plugged off will suffer from rapid oxidation and soon collapse since it is not being kept cool by the evaporation of water. It is usual therefore when plugging a tube to remove the ends from the header(s) even if the whole tube itself cannot be withdrawn.

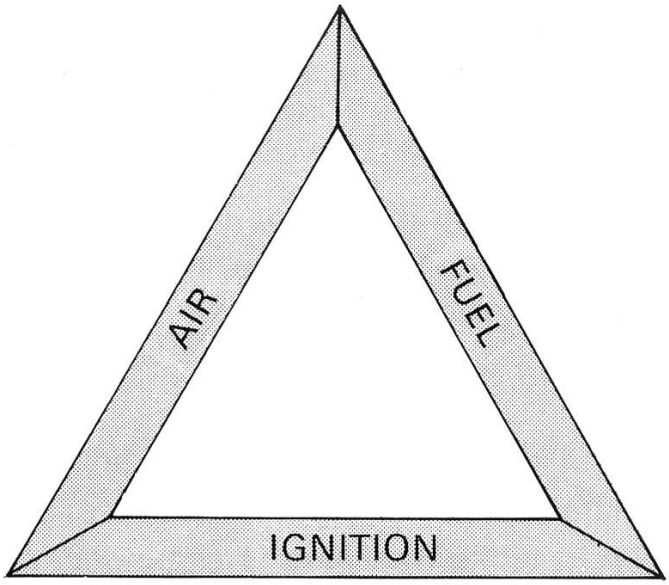
A hollow taper plug or thimble is then expanded into the steam and water drums from the inside to seal off the hole. The plug or thimble has to be a minimum of several inches long so that the mandrel of the roller expander may be driven in whilst the plug is expanded. Once in position the pressure acting on the cross-sectional area of the plug tends to seal it more tightly when the boiler is under pressure.

There is a tendency for hollow plugs to overheat when the boiler is in service and to become fouled on their inside if the water chemistry is not too good. These factors promote leaks and there is some incentive to put the hollow plug or thimble in from the outside if the tube hole is accessible to allow this. In this case the boiler pressure is trying to blow the plug out and if the pressure end load on it exceeds the load which the expansion can carry the plug will be blown out. A case is on record where this happened whilst a boiler was under hydrostatic test after repairs which included tube plugging using plugs pointing into the drum. An insurance inspector who was in the boiler at the time was, fortunately, not injured.

Plugs or thimbles should always be inserted and expanded from the inside and it is desirable, after raising the full hydrotest pressure, to drop it to 90% before entering any part of the boiler which is exposed to tubes and headers under pressure.

E H Frank

WHAT IS WRONG WITH THIS DIAGRAM?



This fire triangle is familiar. For a fire or explosion we need AIR, FUEL and a SOURCE OF IGNITION. Take one away and the fire cannot occur.

Though true in theory, this is not true in an industrial situation. Once fuel and air are mixed in the right proportions, a source of ignition is liable to turn up. So we should never allow fuel and air to mix in flammable concentrations, except in a few cases where the risk is accepted.

Instead of the fire triangle, I suggest