IMPERIAL CHEMICAL INDUSTRIES LIMITED

PETROCHEMICALS DIVISION

SAFETY NEWSLETTER No.89

CONTENTS

News from five companies and three countries.

89/1 ACCIDENTS CAUSED BY THE RAPID COOLING OF LIQUEFIED GASES

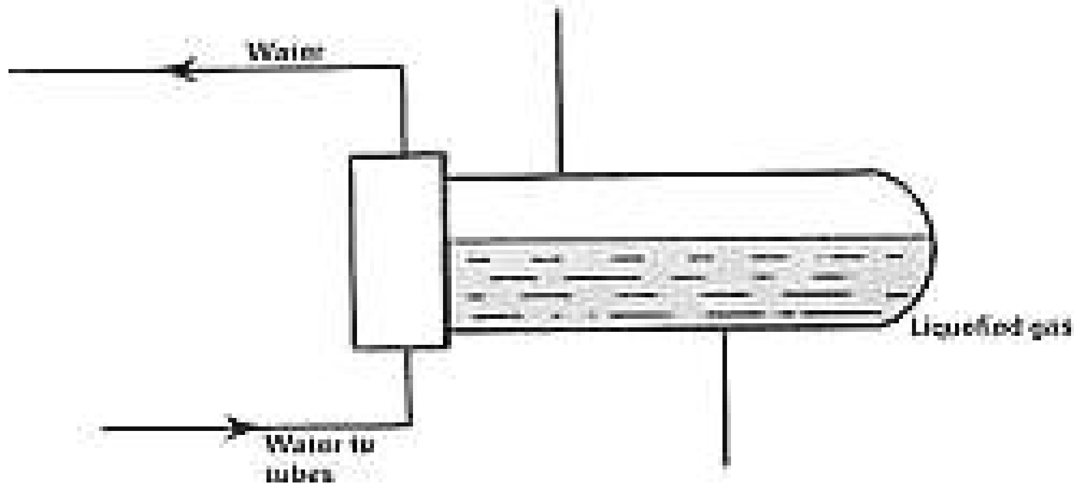
If the pressure on a liquefied gas is reduced, some of the liquid evaporates and the liquid that is left gets colder. All refrigeration plants, domestic and industrial, make use of this principal. For example, if we reduce the pressure on a vessel containing liquid propylene, some of it evaporates and the temperature of the remaining liquid falls and may reach -47°C, the atmospheric pressure boiling point.

This cooling can cause accidents in two ways:

(a) The vessel containing the liquefied gas can get so cold that the metal becomes brittle and cracks. This has caused some serious leaks and fires. On new plants we identify, through operability studies and in other ways, the lowest pressure that can be reached in both normal and abnormal operation. We then choose materials which remain ductile at the corresponding temperatures. However, many old plants contain grades of steel that become brittle at the lowest temperatures that can be reached. On these plants operators need to be on the lookout for any unusually low temperatures and low temperature alarms and trips should be provided.

(b) The second way in which evaporative cooling (as it is called) can cause trouble is in heat exchangers. If liquefied gas on one side of a heat exchanger is allowed to cool, then water, or even steam, on the other side of the heat exchanger can freeze and this can damage the exchanger and cause it to leak.

Reduction of pressure here will cause liquefied gas to evaporate and cool and may freeze the water in the tubes



One incident of this type was described in Newsletter 38/5. Another occurred last year in another company.

During the shutdown of a plant containing liquid propylene, the flow of cooling water to a cooler was isolated. As the pressure in the plant was reduced the propylene got colder and the water in the tubes froze, breaking seven bolts in the floating head. The operators saw ice forming on the outside of the cooler but did not realise that this was dangerous and did not do anything about it.

When the plant was started up again propylene entered the cooling water system and the pressure blew out a section of 16 inch line. The escaping gas was ignited at a furnace 130 feet away and the fire caused serious damage.

Cooling water should have been kept flowing through the cooler while the plant was depressured. If this had been done the water would not have frozen so long as depressuring took longer than 10 minutes.

Safety Note 76/11 describes how gas has got into steam lines as a result of similar incidents, and in other ways, and makes recommendations.

89/2 ISOLATION FOR MAINTENANCE — SHOULD RELIEF VALVES BE SLIP-PLATED OR DISCONNECTED?

A reader draws attention to a point that is not covered in many Works Instructions. Suppose a piece of equipment such as a heat exchanger or vessel has to be given to maintenance for cold work only - no entry or hot work. The equipment is fitted with a relief valve discharging into the blow-down system. All the entry and exit lines are isolated, locked off, and slip-plated and the drain valve is opened. Do we need to slip-plate the relief valve as well or can we rely on it to prevent back flow?

It is generally agreed that the relief valve should be slip-plated or physically disconnected. Whenever possible it is better to disconnect or turn the relief valve rather than slip-plate it as there is then no danger of someone forgetting to remove the slip-plate. If a slip-plate is used the relief valve line should be slip-plated last and de-slip-plated first. See Safety Newsletters 35/1, 37/5c and 48/5.

A few relief valves are fitted with easing levers. If the maintenance job is a quick one and is being done under valve isolations without slip-plating or physical disconnection, then the easing lever should be locked in the closed position.

All this, of course, applies only to relief valves which discharge into a flare system, not to relief valves which discharge direct to atmosphere. Obviously they do not need to be slip-plated or disconnected. See item 92/8(b).

89/3 WHEN VISITING ANOTHER COMPANY (OR ALLOWING PEOPLE FROM ANOTHER COMPANY ON OUR SITES) DO NOT ASSUME THAT THEIR STANDARDS ARE THE SAME AS OURS.

Some ICI employees visited a company in another country to help them repair a plant which was in trouble. They had to supervise some welding. While this was taking place a small explosion occurred because the plant had not been properly freed from gas.

The ICI men were used to working in a factory where there is a rigid clearance procedure. Whenever they received a fire permit from their process colleagues they felt confident that the plant really had been freed from flammable gas or vapour. Unfortunately, in the overseas company the system was not so good.

If you ever have to visit another company remember that their safety standards may not be as good as ours. If they tell you there is no oil in the plant, try to check the state of the plant. If you are asked to enter a vessel, ask to see the entry certificate and satisfy yourself that the vessel is slip-plated or physically disconnected; make sure there is a standby man and there are some rescue arrangements.

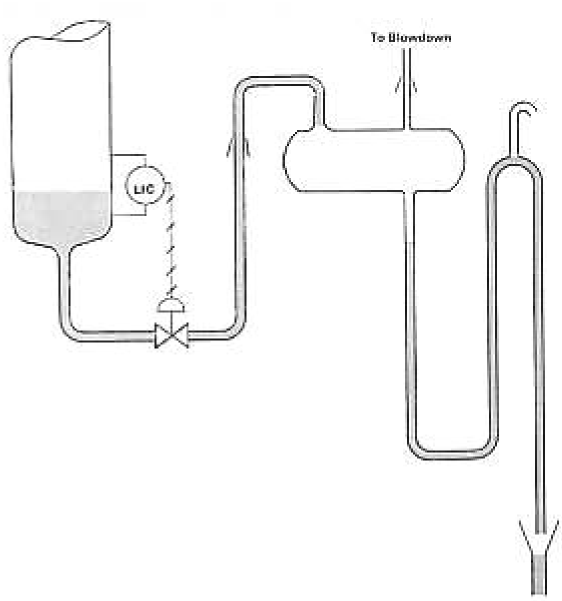
Just as we have to be very careful when we visit other factories, so we have to be very careful when contractors and other outsiders come into our Works. They may not know our standards. This is illustrated by a recent incident in one of our overseas companies. An outside contractor was hired to clean some pipelines with acid. He was shown which lines to clean, but, without waiting for a clearance certificate, he connected up his equipment and started to pump acid through the pipelines. As they had not been freed from process material a violent reaction occurred and a bolted lid was blown off a vessel.

Other incidents in which contractors acted without authorisation are described in Newsletters 56/4 and 63/3.

89/4 PRESSURE EXPECTED 0 PSIG, ACTUAL PRESSURE 2 PSIG. DOES SUCH A SMALL DIFFERENCE MATTER?

The diagram below, taken from *Loss Prevention Bulletin* No 009, published by the Institution of Chemical Engineers, shows how a small change in pressure can make a big difference to the performance of a piece of equipment.

Water from the base of the tower enters the disengaging drum. Any dissolved gases pass to blowdown and the water goes to drain. The drum was designed to run half full of water at atmospheric pressure. In practice, the pressure in the blowdown system frequently reached 2 psig and the water/vapour interface was then in the exit pipe from the drum. The water had only a small surface area, little disengagement took place and gas came out of the drain point.



Would an operability study have shown up the error?

The article in the *Loss Prevention Bulletin* also describes what happened when the level control valve at the bottom of the tower failed in the open position.

89/5 ZINC EMBRITTLEMENT

Zinc embrittlement of stainless steel received a lot of publicity during the Flixborough enquiry.

A new Technical Data Note (No 53/1, available free from any Factory Inspectorate office) describes the circumstances under which zinc embrittlement may occur when molten zinc comes in contact with stainless steel under stress and at elevated temperature. It points out that “at temperatures where zinc embrittlement becomes possible, stainless steel equipment is also liable to failure by creep, or some other mechanism, whether or not zinc embrittlement occurs”. Therefore, “the complete elimination of zinc from structural materials is neither practical or advocated. . . . judgement is necessary to balance the risk of zinc attack. . . . against the risk of other failures from the use of less than adequate corrosion protection systems”.

89/6 A QUESTION I AM *NOT* ASKED —ISN’T A CONCERN WITH SAFETY RATHER CISSY?

I have never been asked this question, but sometimes I feel that someone would like to ask it, but is too polite to do so.

“Safety First” seems to imply a cowardly attitude to life. To most people phrases like “taking a risk”, “having a go”, “nothing ventured, nothing gained”, seem more acceptable, (See Newsletter 9/12). For example, in *Personnel Management*, February 1976, page 25, two sociologists describe interviews with employees and managers in two factories. Operatives who wore all the protective clothing they were supposed to wear were seen as good, responsible and often elderly men, conscientious plodders who were rather out of touch, rather fastidious and compulsive, slow but reliable men who could safely be left alone.

Are safety conscious people really like this? Do successful men of action get there by taking chances?

Taking chances is fine if the risk is worth the gain. We go rock-climbing or sailing because we think the pleasure is worth the risk. We take jobs as air-line pilots or soldiers or become missionaries among cannibals because we think the pay or the interest of the job or the benefit it brings to others make the risks worthwhile. We weigh the risk in the balance and find it is worth the gain.

Many of the risks taken in industry are not worth the gain. A few moments saved by not putting on goggles does not balance the risk of getting chemicals in our eyes. A few moments saved by short-cutting the permit-to-work procedure does not balance the risk of injury to the maintenance man.

In fact, successful men of action never take unnecessary risks, only those risks that are worthwhile. The explorer, Admiral Byrd (originally quoted in Newsletter 52/1) wrote:

> *In all my travels and adventures in the interests of science and discovery I have never taken an unnecessary risk. Only the best and safest equipment was selected for planes and ships. Everything was safe that could be made safe.*
>
> *"By careful planning and by taking no unnecessary chances my men and I have lived to enjoy the hazards and thrills of adventure and discovery. We found adventure only by planning for safety as far as possible."*

The same attitude is seen in John Hunt's book *The Ascent of Everes*". Everything possible was planned; so much so that the book is more like an ICI report than an adventure story. But his methods got Hillary and Tenzing to the top and down again without injury.

UNUSUAL ACCIDENTS No. 58 - AN ATTEMPT TO ENCASE A LEAK

Ten years ago there was a leak on a large fuel gas system operating at gasholder pressure. To avoid a shutdown a wooden box was built round the leak and filled with concrete. It was intended as a temporary job but was so successful that it lasted for many years.

On other occasions leaks have been successfully boxed in or encased in concrete, but the operation can only be done at low pressures and expert advice is needed, as shown by the following story from another company.

One Friday evening there was a bad steam leak from the bonnet gasket of a 3 inch, 300 psig steam valve. An attempt to clamp the bonnet was unsuccessful so the shift crew decided to encase the valve in a box. They made one 3 feet long, 2 feet wide and 14 inches deep out of ¼ inch steel plate. Plate of this thickness is quite strong but the shape of the box was quite unsuitable for pressure and could hardly have held more than 50 psig, even if the welds had been full penetration, which they were not.

The box was fitted with a vent and valve. When the valve was closed the box started to swell and the valve was quickly opened.

A piece of 2 inch by 2 inch angle iron was then welded round the box to strengthen it. The vent valve was closed. A few minutes later the box exploded. Fortunately the mechanic — if he deserves the title — had moved away.

This did not happen in a back-street concern but in a branch of a major international company.

89/8 MORE ABOUT HUMAN ERROR

The following are a few of the comments received on Newsletter 86:

(a) The **Engineer's Socks**

Newsletter 86/7 described how a reliability engineer, on going to bed, threw his dirty socks into the toilet bowl instead of the dirty clothes basket alongside. Everyone is liable to make silly mistakes of this sort occasionally and the Newsletter suggested that we accept an occasional mistake or re-design the work situation. It is no use telling people not to be stupid.

A group of operators have carried out a detailed study of the incident and suggest the following alternative ways of re-designing the work situation:

1 Keep the dirty clothes basket in a different room (or a different part of the bathroom).

2 Stop wearing socks.

3 Keep socks on in bed.

4 Use disposable paper socks.

5 Paint or tattoo sock design on feet and ankles.

6 Fit a wire mesh sock guard over the toilet bowl.

This shows once again that once we have recognised a problem we are very good at finding solutions. We are not always so good at recognising problems.

Another reader, a Works Engineer, reports that when making the early morning tea, twice in six years he has emptied a whole packet of tea into the pot. Perhaps the job should be left to Process.

(b) Human Error and Road Accidents

An "Accident Spotlight" issued jointly by our local Police Force and Radio Station gives a diagram of a road junction where seven injury accidents occurred last year. It then says, "Principal cause — road user error".

Of course, it is easier to blame road users than make expensive changes to the junction which was re-designed only a few years ago. However, there is not much chance that road users will change their ways and no evidence that they behave any worse at this junction than at any other junction in the county. The only way of stopping accidents therefore is to undertake some re-design.

89/9 RECENT PUBLICATION

Safety Note 76/15 summarises a survey of 1 3 unconfined vapour cloud explosions.

For a copy or for more information on any item in this Newsletter please 'phone ET (Ext. P.2845) or write to her at Wilton. If you do not see this Newsletter regularly and would like your own copy, please ask Mrs. T. to add your name to the circulation list.

July 1976

Who's Who in Safety?

No. 6—W M DIGGLE

Mike Diggle was born in Essex, 39 miles from Bow Bell, and studied physics and mathematics at Nottingham University, returning after his National Service to study chemistry and biology.

During his service in the Navy he was a combined operations navigator on various types of landing craft, at one time piloting a flotilla of small craft from Gibraltar to Norfolk, Virginia via Bermuda.

In 1944 he commissioned a tank landing craft on the River Tees. It was protected from air attack by an overhead bomb, which was sent up by a rocket, held by a wire and kept up by a parachute. There was a short circuit in the firing button, so that when the signalman made the circuit live, the rocket went off, taking the bomb and the signalman's trousers with it. The only casualty was Mike, who fell into the Tees. He thinks this destined him for a career as a safety officer in Teesside.

Mike joined ICI in 1950 and worked in the Industrial Hygiene Research Laboratory until 1957 when he joined Central Safety Department. In 1959 he was seconded to the International Labour Office as the resident expert in Istanbul. He came back to the scene of his first real accident in 1966 to work on fire prevention with Agricultural Division and later became the Deputy Division Safety Manager. In 1968 he came to Wilton as Site Safety Officer; he is still enjoying it and says he intends to go on doing so.

As Site Safety Officer Mike is responsible for security, fire fighting, fire prevention and all safety matters of common concern for the Divisions operating on the Wilton Site.

His hobbies are exercising an Old English Sheep Dog, who, in return, has dug up his garden, and keeping pace with his family. He is married and has three grown-up sons.