IMPERIAL CHEMICAL INDUSTRIES LIMITED

PETROCHEMICALS DIVISION

SAFETY NEWSLETTER No.85

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85/1 A SCREWED PLUG CAN BLOW OUT

Another company has described a serious fire which occurred because a screwed plug blew out of a pump body. The plug was 1 inch diameter and the pump was handling a hydrocarbon stream at 250 psig and over 370°C. The oil which came out caught fire and the damage amounted to £3M. It is believed that the plug was held by only one or two threads and that it was in use for 18 years before the failure occurred.

A survey on another works belonging to the same company brought to light many other plugs held by only a few threads; some of the plugs were made from the wrong grade of steel.

An incident in Petrochemicals Division was described in Newsletter 16/3. A ½ inch plug blew out of a heat exchanger, producing a jet of oil 30 feet long.

Another incident occurred recently when a hinge-pin retaining plug on a standard swing non-return valve worked loose and blew out. The non-return valve was on the delivery line from an ethylene compressor and the gas leaked out at a rate of about 2 tonnes/hour until the compressor was shut down. Fortunately the compressor was located in an open-sided compressor house and a strong wind was blowing at the time.

A similar incident was described in the Mond Division Safety Report for January 1976.

Petrochemicals Division policy is to avoid the use of screwed plugs whenever possible; see Engineering Specification Pl 0101, Section 4.11. If the use of screwed plugs is unavoidable, they should be locked in some way so that they cannot vibrate loose.

I suggest you have a look for screwed plugs on existing equipment, particularly on non-return valves. The plugs should be welded or locked; we can let you have details of locking methods.

As pointed out in Newsletter 17/3, we should not seal weld over an existing screwed plug, as if the thread is corroded, the seal weld will have to carry the full pressure in the vessel; a specially designed plug should be used. Note that if the vessel has had any post-weld heat treatment, this may have to be repeated after the plug has been welded. (See also page 7, bottom.)

85/2 THREE MEN ARE AFFECTED BY FUMES WHILE REPAIRING A HEAT EXCHANGER IN A CONTRACTOR'S WORKSHOP

When a piece of equipment is sent to a workshop or to another company for repair or modification we should, whenever possible, make sure that it is spotlessly clean before it leaves our works. Contractors are not familiar with chemicals and do not know how to handle them.

Occasionally, however, it may be impossible to be certain that a piece of equipment is spotlessly clean. If it has contained a residual oil or a material which polymerises, it may be impossible to remove all traces of residue or polymer from behind rust or out of crevices. Fires and explosions have occurred in equipment which contained such oils when welding or burning was allowed on them (see Newsletters 82/5, 56/1, 51/2, 24/6 and 18/7e).

If, therefore, a piece of equipment cannot be made spotlessly clean or there is some doubt about its cleanliness before it leaves the works, then the hazards and necessary precautions must be made known to the workshop or the other company. This is usually done by attaching a certificate to the equipment. This certificate is not a clearance or permit-to-work; it does not authorise any work, but it should describe the state of the equipment and give the other company sufficient information to enable them to carry out the repair or modification safely. Before issuing the certificate the engineer in charge should discuss with the other company the methods they propose to use. If the problems are complex a member of the works staff may have to visit the other company.

An incident last year shows the need to clean equipment thoroughly, or, if this is not possible, to carry out the procedure just described.

A large heat exchanger, 8 feet long by 8½ feet diameter, was sent to another company for retubing. It contained about 800 2½ inch diameter tubes, of which about 80 had been plugged. The tubes had contained a process material which tends to form chokes, and the shell had contained steam.

Before the exchanger left the works the free tubes were cleaned with high pressure water jets. The plugged tubes were opened up by drilling 3/8 inch holes through the plugs to relieve any trapped pressure, but these holes were not big enough to allow the tubes to be cleaned.

A certificate was attached to the exchanger stating that welding and burning were allowed, but only to the shell.

The contractor, having removed most of the tubes, decided to put men into the shell to grind out the plugged tubes. He telephoned the works and asked if it would be safe to let men enter the shell. He did not say why he wanted them to do so.

The engineer on the works who took the telephone call said that the shell side was clean and therefore it would be safe to enter it. He was not told that the men were going into it to grind out some of the tubes.

Two men went into the shell and started grinding. They were affected by fumes and the job was left to the next day. Another three men then restarted the job and were affected so badly that they ended up in hospital. Fortunately they soon recovered.

The certificate attached to the exchanger when it left the works should have contained much more detail. It should have said that the plugged tubes had not been cleaned and that they contained a chemical which gave off fumes when heated. Better still, the plugged tubes should have been opened up and cleaned. The contractor would have to remove the plugs, so why not remove them before they left the works?

Do your instructions cover the points mentioned in this item? We can let you have a copy of a model instruction.

Reminder: Newsletters 56/4 and 44/1 described other dangerous incidents which occurred because contractors did not fully understand what they could and could not do.

85/3 METHODS FOR PLUGGING TUBES

The last item has a sequel.

A few months after the incident described another heat exchanger had to be sent to a workshop for repair. Many of the tubes were plugged and this time it was decided to remove the plugs on the works. They were removed by tapping them with a hammer to loosen them and then turning them with a Stilson wrench. One of the plugs flew out while it was being removed and struck the fitter just above his left eye.

When plugging tubes it is as well to remember that one day the plugs may have to be removed. A type of plug which is easy to remove is illustrated in the drawing overleaf.

85/4 AN EXPLOSION IN AN UNDERGROUND STORAGE TANK

The 1974 Annual Report of the Chief Inspector of Factories describes (on page 19) an explosion which occurred in a 4000 m^3 underground storage tank at Sheffield Gas Works in October 1973.

Six people were killed, 29 injured and the tank was wrecked. The complete tank top was thrown into the air, turned over and deposited upside-down on the bottom of the tank.

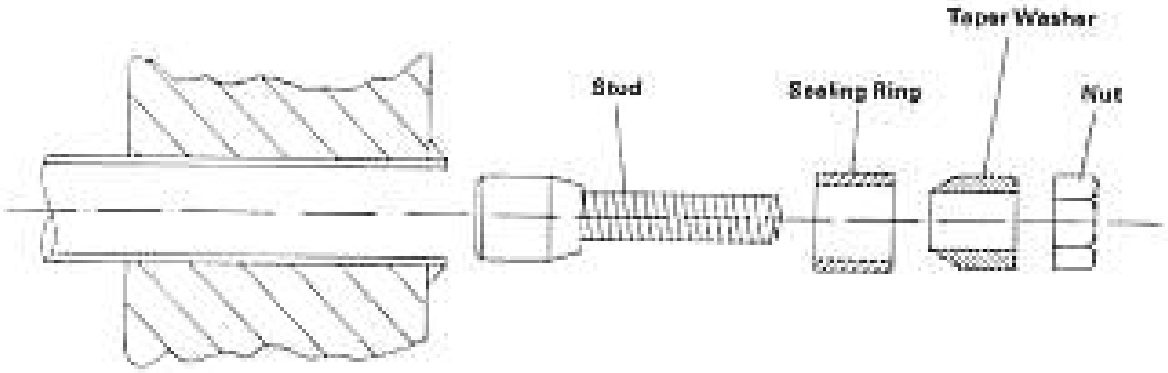
The tank had contained a light naphtha and had not been thoroughly cleaned before repairs started. It had been filled with water and then emptied but some naphtha remained in various nooks and crannies. (It might, for example, have got into the hollow roof supports through pin-holes or cracks, and then drained out when the tank was emptied, as in the incident described in Newsletter 40/1). No tests were carried out with combustible gas detectors.

It is believed that the vapour was ignited by welding near an open vent. The body of the welder was found 100 feet up on the top of a neighbouring gasholder still holding a welding torch.

According to the Report there was no clear division of responsibilities between the Gas Board and the contractor who was carrying out the repairs.

“Where, as in this case, a special risk is liable to arise due to the nature of the work performed on the premises, and the owner of the premises has special knowledge of it, it is essential that the owner retains sufficient control of the operation to ensure that contractor’s employees are properly protected against the risk”

The Annual Report also points out (on pages 7 and 8) that polyurethane insulation can be set alight by hot metal from welding. Care is needed if welding takes place near this material. If you are thinking of installing polyurethane insulation on storage tanks or other equipment make sure that a low flammability grade is specified. Advice can be obtained from Dick Robertson. We are carrying out some experiments on the protection of polyurethane with a thin layer of vermiculite cement; it is hoped that this will increase its fire resistance without losing its effectiveness or greatly increasing its cost.



NOTE

1. The tube is sealed by assembling the plug and tightening the nut until the sealing ring is crimped onto the tube.

2. The tube is vented by slackening the nut and tapping the stud forward into the tube.

85/5 FLIXBOROUGH AND THE TAY BRIDGE

The Tay Bridge disaster was not the worst railway accident in British history, but is certainly the best remembered. New books on the subject still appear. In 1879 the bridge collapsed six months after it was opened, and a train fell into the river. All the passengers and crew — 75 people — were drowned. The failure of a major engineering work so soon after opening caused considerable public

and professional disquiet.

Will the Flixborough explosion be forgotten in a few years time or will it be remembered, like theTay Bridge, 100 years afterwards?

I have been reading “The Tay Bridge Disaster”, by John Thomas (published by David and Charles) and have been struck by a number of similarities between the two incidents, though of course there are also differences. These are the similarities:

1 The failure of the Tay Bridge was due to a change in the original design. It was originally intended to construct the piers entirely of brick and concrete, and fourteen out of fifty were, in fact, made this way. During construction, however, it was found that the river bed was not as strong as expected, and in order to reduce the pressure on the river bed and also to save cost, it was decided to build the piers of brick and concrete up to the high water mark and then construct the upper portions from cast iron pipes with cross bracing. The brick piers still stand. Many of the original girders which went across the top of the piers were re-used and are in use today, but the cast iron piers collapsed in six months (and they did not turn out to be cheaper).

2 The main lessons from the Tay Bridge disaster are concerned with management. The casting of the iron pipes and their erection was not properly supervised, with the result that the quality of the iron was poor, the thickness was unequal and many of the lugs to which the cross-bracing was attached were not secure. The subsequent inspection of the bridge was entrusted to a man who was very competent in his own field, but lacked relevant experience. He was a good bricklayer but had little knowledge of ironwork. To quote from the Book:

> “The most embarrassing of all the NB (North British Railway) witnesses to the company was Henry Noble, the most honest and competent of men in his own limited sphere, but a bricklayer and not a man many railway companies would have chosen to take charge of the bridge.”

To quote from a letter by one of the lawyers concerned:

> “Mr Noble, as you know, is not a man of skill as regards iron work. He is a good bricklayer. That is all. Yet he, and men much more ignorant than he, were apparently left to look after the iron work of the bridge. No man of skill apparently went over it from week to week, or month to month. This point I think might be pressed home against the company very much.”

3 Sir Thomas Bouch, the designer of the bridge, and the North British Railway had their own theory for the cause of the collapse they suggested that an excessively high gust of wind had blown a carriage against the side of one of the girders and that this had caused the girder to collapse. They stuck to this theory even though, to most people, the evidence against it seemed overwhelming.

4 At the official enquiry, carried out by Col. Yolland of the Board of Trade, the expert witnesses were putty in the hands of the lawyers. Sir Thomas Bouch was tricked into admitting that, if only two struts were fractured, the whole of the centre would collapse.

5 The publication of the official report was followed by a public debate on the extent to which reliance should be placed on official approval and inspection. As today, there were many people who thought that Government Inspectors should have supervised the project so closely at all stages that they could guarantee its safety. The President of The Board of Trade, Joseph Chamberlain, in a minute presented to both Houses of Parliament, wrote:

> “If any public department were entrusted with the power and duty of correcting and guaranteeing the designs of the engineers who are responsible for railway structures, the result would be to check and control the enterprise which has done so much for the Country, and to substitute for the real responsibility which rests on the railway engineer the unreal

and delusive responsibility of a public office."

One of the differences between the Tay Bridge and Flixborough reports is that the Chairman of the Tay Bridge enquiry placed the blame mainly on one person, Sir Thomas Bouch. (The two other members of the enquiry agreed that the bridge was badly designed, badly constructed and badly maintained, but did not think that they were obliged to place blame on any particular person or group of persons). There is no doubt that Sir Thomas had a large share of the blame, but many people feel that he was unfairly censured and that the Company as a whole and various people involved in the construction carried a large share of responsibility.

After the enquiry Sir Thomas Bouch's reputation was finished; his health deteriorated and he died soon afterwards. He had made his name by building cheaper bridges than anyone had built before, but in the Tay Bridge perhaps he went too far. In particular, in his desire to save construction and operating costs, he went too far in economising on the inspection of the ironwork during both construction and operation.

85/6 SOME QUESTIONS I AM OFTEN ASKED

19—HOW DOES OUR SAFETY RECORD COMPARE WITH OTHER COMPANIES?

A lot depends on the method we use for measuring the safety record. If we use the lost time accident frequency rate, then ICI is a lot better than the rest of the chemical industry in this country, but a lot worse than the best American Companies. For 1974 the figures were:-

Petrochemicals Division	0.62	(all staff)	0.92 (weekly paid staff)
ICI	0.63	(all staff)	0.94 (weekly paid staff)
The rest of the British chemical industry	2.42	(all staff)	3.69 (weekly paid staff)
Du Pont	0.021	(all staff)	
US chemical industry	0.43	(all staff)	

If we take insured fire and explosion losses as a measure of our safety instead of the lost time accident rate, then ICI seems to be as good or better than most of the other large chemical companies in this country and the USA. Within ICI, Petrochemicals Division has had a particularly good record within recent years, but do not use this as a reason for complacency; our plants are so big that one single incident could wipe out all the profit that the insurance companies have made from us in recent years. Continuing vigilance is needed to stay where we are.

Fire and explosion losses are a better measure of safety than the lost-time accident frequency rate, not because fire damage is more important than injury, but because fire and explosion cause by far the worst sorts of injuries. Numerically, most of our injuries are associated with simple mechanical accidents that could happen in any sort of factory, but when fires and explosions do occur, the injuries are much more severe.

85/7 UNUSUAL ACCIDENTS No.54

A member of Petrochemicals Division staff got a cup of coffee from a beverage vending machine and found a box of matches floating in it!

85/8 RECENT PUBLICATIONS

(a) We can let you have a copy of “Some Fires and Explosions in Liquids of High Flash Point”, an article which appeared in the second issue of the new “Journal of Hazardous Materials”.

The first issue contained two interesting articles on new methods that are being developed for dealing with spillages of hazardous materials from road tankers; a universal gelling agent that will turn any liquid into a solid; a foam gun that can be used to lay a barrier of quick-setting foam; and a plug of plastic foam that can be used to seal a hole in a leaking tanker (see pages 3 and 21).

(b) Research Department Paper 76/21, available from Division Reports Centres, summarises the information available on the hazards of butadiene.

(c) Safety Note 76/6 summarises the reports which Les Cude has written during the last few years on methods of calculating the dispersion of gases from vents, flares and accidental leaks.

For a copy of (c) or for more information on any item in this Newsletter please ‘phone E.T. (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.

March 1976

STOP-PRESS See Item 85/1

A survey of one plant in the Division has disclosed several 2 inch plugs held by only one thread.

They had been in use for nearly ten years and were supplied as part of a compressor package.

This again emphasises the need to check all screwed plugs.

Who's Who in Safety?

No.2—MR E S HUNT

Eric Hunt was born in London but was brought to the North-East as a boy. He joined ICI in 1935 as a messenger boy and was transferred two years later to Research Department where he remained until called up into the RAF in 1939. He spent the War in North Africa, Sicily and Italy and was demobilised in 1946.

After studying chemistry at Constantine Technical College (now Teesside Polytechnic), Eric returned to Research Department in 1950 and worked on general exploratory and oxidation chemistry until 1968 when he joined Safety and Loss Prevention Group.

Eric spends a lot of his time on the Works carrying out safety surveys — he has witnessed the testing of several hundred protective systems and has examined many hundred items of electrical equipment, looked at all our LPG handling equipment, most of our sample points and much else besides. He is also our expert on static and other electrical problems.

Eric is married with two children, a son practising veterinary surgery in Plymouth and a daughter who has recently qualified as a doctor.

His hobbies are music, gardening and 'doing-it-himself.'