IMPERIAL CHEMICAL INDUSTRIES LIMITED
PETROCHEMICALS DIVISION

SAFETY NEWSLETTER NO. 72

72/1 A CORRODED VESSEL IS REMOVED AND REPLACED BY A TEMPORARY BY-PASS PIPE

Most of the items in these Newsletters describe something that went wrong. For a change here is an account of an incident that was handled well.

One Sunday morning in 1972 vapour was seen coming through the lagging on a large cyclone which separates catalyst dust from a stream of flammable vapour. The plant was immediately shut down and the lagging removed from the area. A small hole, about 3/8“long and 1/8”wide, was found in the vessel. A full internal and external examination of the vessel and associated pipe-work was carried out. It was found that severe erosion had occurred in the vessel but the pipework was OK. At a meeting held on the following Wednesday it was decided to remove the vessel for repair and replace it with a temporary by-pass pipe.

The Engineering Department worked late that day designing the temporary pipe and supports. It was 10. p.m. when they finished.

By the following Sunday morning the workshops had fabricated the pipe and supports and installed them on the plant. Feed was started on the following day and by Tuesday the plant was fully back on line and on specification.

The temporary pipe was 36 inches diameter, 15 feet long and contained two bends.

The following should be noted:

1. The by-pass pipe and supports were properly designed in the drawing office.
2. All the associated equipment which might have eroded was examined.

72/2 AN ERROR DURING CONSTRUCTION IS COVERED UP - THE NEXT YEAR SOMEONE IS GASSED

The following occurred in one of our overseas companies.

During the construction of a plant, one of the construction team misread a drawing and thought a pipe-support was a branch pipe. He therefore cut a hole for the branch.

When he discovered his mistake he decided to patch the pipe, which was made from stainless steel. A repair was made but insufficient care was paid to the quality of the weld; no radiography or pressure testing was done. The support was then fitted and the pipe lagged. The mistake was covered up - in both senses.

Some weeks after the plant came on line the weld started to corrode and a poisonous liquid came out, soaking the lagging and vaporising into the atmosphere. Several men were gassed one seriously.

It is easy to blame the constructor and to talk of criminal neglect; but had anyone ever explained to the construction team what might happen if a leak in the piping did occur?

Reminder: Newsletter 62/1 described another incident — the collapse of a bridge — which occurred because the construction team did not realise that a new design required greater accuracy in construction than traditional designs.

72/3 VENT STACKS WHICH CATCH FIRE

Most large discharges of flammable gas or vapour to atmosphere are flared. Sometimes flammable gas or vapour is vented to atmosphere without flaring either because the quantity is small or

because the discharge velocity is high enough to give good mixing with the air by jet action. Hydrogen can usually be vented to atmosphere as it is so light that it goes straight up. Report No. PC 200,801/A and an article in “The Chemical Engineer”, October 1974, p.629 both by A L Cude, show how to calculate the minimum velocity necessary for good jet mixing.

Every year one or two vent stacks are set alight by lightning or by a discharge of static electricity from hail or snow. People often ask how this can be prevented and how we can stop the flame travelling back into the plant. In particular, they ask if flame traps should be fitted.

If the vent stack is discharging a mixture of flammable gas and air, then a flame trap may stop the flame travelling back down the vent stack; it will not prevent the mixture igniting in the vent stack in other ways. Many vent stacks have ignited in other ways. We should therefore never allow mixtures of flammable gas and air to exist in vent stacks and connecting pipes. There should always be a continuous flow of gas through the pipe to sweep away any small leaks of air that occur, and to prevent air from diffusing down. If the flow of process gas is not continuous, then inert gas is usually used. The flow should be checked regularly and the vent stack should be analysed regularly for oxygen. If the mixture in the vent pipe is not flammable, then the flame cannot travel back down the vent pipe and there is no need for a flame trap.

It is difficult to prevent these vent stacks catching fire occasionally and it does not matter very much if they do. The vent stack must, of course, discharge clear of the structure so that the flame will not impinge on any equipment, and it must be possible to put out the flame either by isolating the flow of flammable gas or by putting an excess of nitrogen or steam up the stack. On some plants extra nitrogen or steam is put up the vent stack when there is a lightning warning. A lot of extra nitrogen or steam is needed, about twenty times the volume of the flammable gas, so it is usually impossible to use this rate all the time.

Some publications suggest fitting insulated tips to the ends of stacks. They are unlikely to be effective. Other people suggest fitting a hollow ring of metal near the top of the stack. This may work but is hardly necessary, except possibly on very large stacks.

Storage tanks containing flammable non-hydrocarbons are an exception to these rules. We do allow flammable mixtures to exist in the vapour space of the tank — provided there is no splash filling — and the vent may catch fire, so we fit a flame trap to prevent the flame travelling back into the tank. Experience shows that the chance of ignition in a storage tank containing non-hydrocarbons is very small; but the chance of ignition in a vent stack or vent collection system is significant.

So, to sum up, make sure there is never a flammable mixture in your vent stack and then it does not matter if it catches fire when it mixes with air at the tip of the stack. If there is a flammable mixture in your vent stack it will catch fire or explode sooner or later, whatever you do.

72/4 WHAT SORT OF GASKET SHOULD WE USE?

A number of flange leaks have occurred recently, both in the Division and other Companies, which could have been prevented by the use of spirally wound gaskets such as Metaflex instead of compressed asbestos fibre (CAF) gaskets. It may therefore be useful to quote from the Division specification No. P1/0101 which states when the two sorts of gaskets should be used.

“4.12.1 CAF gaskets to BS 1832 ‘Oil resistant compressed asbestos fibre jointing shall be used for all Class 150 steam, utility and process duties with the exception of Class 150 caustic, Thermex, high temperature gas, hydrogen duties, critical steam duties or other particularly hazardous duties which shall have spirally wound gaskets.

4.12.2 Spirally wound gaskets type SG/1R to 8S3381 ‘Metallic spiral wound gaskets for the petroleum anti petro-chemical industry shall be used for all class 300 and above steam, utility and process duties and also for the exceptions listed in 4.12.1.

4.12.3. The standard BS3381 gasket provides for 18/10/2 winding, CAF filler and carbon steel centring ring. Some process fluids may require alternative materials and if so these shall be shown in the Pipeline Material Specifications”

72/5 SOME QUESTIONS I AM OFTEN ASKED

7—HOW CAN WE KEEP ALIVE THE MEMORY OF INCIDENTS THAT HAVE HAPPENED ON THE PLANT WHEN THE STAFF CHANGE EVERY FEW YEARS?

One method which has been used successfully on at least one plant in the Division is the plant black book. On this plant there is a folder containing reports of every serious incident and near miss that has occurred on the plant, together with reports of incidents in similar plants in other companies. This is compulsory reading for all managers and engineers when they first join the plant, and the old hands dip into it from time to time to refresh their memory.

Why not start a similar folder on your plant? It may look a little thin at first, but nevertheless it may help your successor. I can probably help you fill it.

The incident described in the next item might have been prevented by a plant black book.

72/6 A RUNAWAY REACTION - BECAUSE PROCESS INFORMATION HAD BEEN LOST

A runaway reaction occurred in 1974 in the Division, the temperature of a reactor reaching about 600°C compared with a design temperature of 200°C.

The following are some extracts from the Report of the enquiry:

‘The reaction was believed by the present management, supervision and operating group, to be readily controlled by simple procedures. The technical in formation to contradict this was well known to the licensor and, if known originally to ICI, had been diluted in handover between managers.”

“Whilst the management, supervision and operators may once have been uniformly aware of the hazards of a temperature runaway, it is clear that successive changes of staff, coupled with familiarity, have led to this reactor being regarded as a docile unit, occasionally ‘lively’ in the initial stages but always controllable. It is essential that the process be better documented to permit more reliable technical handover between managers and that the methods by which the supervisors and operators are made and kept familiar with the process be reviewed ….. Reasons for instructions are not always given, critical processes are not highlighted from the routine …..”

72/7 SOME RECENT PAPERS ON LOSS PREVENTIONS

The proceedings of the International Conference on Loss Prevention and Safety Promotion in the Process Industries, held in Holland in May 1974, have now been published by Elsevier. Papers by ICI staff include two on emergency plans D J Bruce (Cleveland Fire Service) and W M Diggle describe the Teesside plan and G M S Duff and P Husband describe the Billingham Site plan.

J D Reed shows that if a liquefied gas is allowed to escape, some of the liquid vaporises and most of the rest disappears as spray. (If you have ever taken the radiator cap off your car while the engine is hot, or opened a pressure cooker while it is hot, you will know already that this is true).

G W Westbrook compares road and rail transport of liquefied gas and concludes that there is nothing to choose between them on safety grounds; accidents are less frequent on the railways but more serious when they occur.

J S Fitt describes the m9thods we use for fixing the size of a relief valve.

Finally, I describe some myths of the chemical industry - deeply ingrained beliefs that are not wholly true. A summary appears as the supplement to this Newsletter.

72/8 UNUSUAL ACCIDENTS No.42

The following account of a fire is taken from “The Times” for 11 September 1974.

‘Teams of police and fire experts, insurance investigators and Government officials have descended on the town of following the huge blaze which destroyed £7m worth of

The fire has come as an acute shock proving as it has the appalling dangers which storage of vast quantities can present. It is now expected that the authorities will insist on strict new regulations

The fire was a spectacular affair. It lasted six hours and workmen from many producer companies in the area helped to rescue other stock nearby.

The government will probably insist on storage centres being built away from urban areas and new methods of handling will have to be considered. [A Director] admits candidly that local people are "terrified" that the events of last week will be repeated."

This fire occurred in a warehouse in the town of Cognac in France. 800,000 gallons of brandy were burned.

72/9 RECENT PUBLICATIONS

(a) The Stationery Office have published a list of "Forms and Other Publications for Use in Premises Under the Factories Act", available free. When the new Health and Safety at Work Act comes into operation, many of the regulations in this list will be replaced by codes of practice. The process will be a gradual one, but in ten or twenty years time many of the regulations will be collector's pieces. Now is the time to order your copy of the "Baking and Sausage Making (Christmas and New Year) Order 1973" (price 3p), the "Felt Hat Manufacturing Regulations 1902" (1p), the "Gut Scraping, Tripe Dressing, etc., Welfare Order 1920" (1p), the "Herring Curing (Norfolk and Suffolk) Welfare Order 1920" (1p), and the "Ice Cream (Overtime) Regulations 1939" (1p). Also available is a placard on the effects of lemon and orange peeling on skin (price 2½ p) and a leaflet with the title "So You Want to Start a Factory" (free).

More seriously, the publication includes a complete list of the Health and Safety at Work booklets and the Technical Data Notes.

(b) Report No. PC 200,806/A by R P Hanage, available from Division Reports Centres, describes ways of dealing with the problems that arise when a plant has to be wholly or partly demolished to make way for a new plant or extensive modifications. It also covers problems arising during construction and handover. Based on experience gained in two recent projects, the report contains much that is applicable to other projects. I know of no other report on the subject.

(c) Report No. PC 200,807/A, by the same author describes the methods used for planning the commissioning of small plants.

(d) Report No. PC 200,808/A by B W Eddershaw and R P Hanage describes the training programmes used on two recent projects.

(e) An article by Dick Robertson in "Fire International", No. 45 describes the methods recommended by the Division for minimising the spread of fire and reducing the damage caused.

For a copy of (e) or for more information on any item on this Newsletter, please write to E T at Wilton or phone ext. P.2845. 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.

January 1975

SUPPLEMENT TO SAFETY NEWSLETTER No 72

Reprinted from “European Chemical News”, 20 Sept 1974.

OVER-PRESSURE AND OTHER RISKS—SOME MYTHS OF THE CHEMICAL INDUSTRY

The thoroughness with which the chemical industry protects equipment against over-pressure was contrasted with the almost casual way it-protects equipment against other risks, such as over-temperature, which can produce equally serious consequences, in a recent paper by T. A. Kletz of ICI’s Petrochemicals Division presented at the First International Symposium on Loss Prevention and Safety Promotion held at the end of May in the Hague, the paper discusses the standard of protection that is desirable for both over-pressure and other risks, and in particular the extent to which reliance may be placed on human intervention. Also discussed are other myths of the chemical industry—deeply ingrained beliefs that are not wholly true.

Vessels on process plant can burst if they are subject to a sufficiently high pressure, and they are usually protected by relief valves. Any other form of protection is usually considered inadequate. However, vessels can also burst if they are subjected to excessive temperatures, but as a rule very little protection against this is provided.

The paper endeavours to show that the attitude to over-pressure, over-temperature and some other problems is often not the result of a scientific assessment of the hazards and practicalities, but is in part due to traditional ways of thinking and a failure to understand the problem fully; in other words to a belief in myths.

A deliberate use of the word ~‘myths” is made in the paper, which notes that a myth is not completely untrue, and there is always a measure of truth in it. Yet a myth is not completely or literally true either, and it was usually more true in the past than it is now. Another feature of a myth is that it is deeply ingrained; intellectually we may no longer believe that it is true, but we may still continue to act as if it were true.

Belief in myths is a common feature of all cultures, primitive and advanced, and the chemical industry is no exception, the author added. Seven myths in the chemical industry were dealt with by the paper. These are:

- pressure vessels must be fitted with relief valves (or bursting discs).
- a relief valve, properly designed and maintained, will prevent a vessel bursting.
- if a vessel is exposed to a fire, it should be emptied as quickly as possible.
- it is bad practice (and illegal) to fit a block valve below a relief valve but operators must be free to disarm trips which protect vessels from the effects of high or low levels, high concentrations of dangerous materials, and so on.
- operators, properly trained and motivated, should not make mistakes. In designing plants we should assume that the operator will do what is required (providing it is within his physical and mental powers and he has time to do it).
- trips are unreliable; the more trips we install, the more spurious trips we get, so on the whole it is better to rely on operators.
- if a material has a high flashpoint it is safe and will not explode.

The discussion on “myth two” will be considered in detail. The rider on “myth two” is that special protection against over-temperature is unnecessary, Or at least a luxury.

However, a relief valve will prevent a vessel bursting if it is at its design temperature but not if the vessel gets too hot. Operating staff often fail to realise that if a vessel gets too hot it may burst at or below the design pressure of the relief valve and that the relief valve provides no protection.

The protection provided against over-temperature, if any, is usually primitive compared with the protection against over-pressure provided by a relief valve, the paper noted.

Vessels can become over-heated in several ways and the paper considered these separately, namely vessels heated by electricity, internally insulated vessels, furnace tubes and vessels exposed to fire.

Vessels which are heated by steam or hot oil usually cannot get too hot as they are normally designed to withstand the maximum

temperature attainable. Electric heaters, on the other hand, will over-heat if the flow through them stops or gets too low. Protection against high temperature is, therefore, as necessary as protection against high pressure, and in this case can be provided just as easily, the author maintained.

For internally insulated vessels, such as reactors, a similar situation obtains. The internal temperature is often higher than the shell will stand. Any deterioration of the insulation may overheat the vessel. Yet how often is a high temperature alarm or trip on the vessel wall provided, the author asked.

Vessels which are exposed to a fire can be protected by water cooling, fireproofing the vessel, or reducing the pressure. Water-cooling has been the main line of defence adopted in the petrochemicals industry and the fire services are usually fully aware of the need to apply cooling water as soon as possible.

Vessels which cannot be reached by mobile monitors should be provided with fixed sprays and/or fire-proofed, as should vessels in storage areas where the total demand for water is high, the paper asserts.

In addition, it should be possible to lower the pressure in vessels exposed to fire. Often this can be done through existing process lines. Sometimes a relief valve by-pass can be fitted and operated remotely. It is also possible to obtain a combined relief valve and motor valve which can be lifted by remote operation but which also functions as a normal relief valve.

A copy of the complete article is available on request