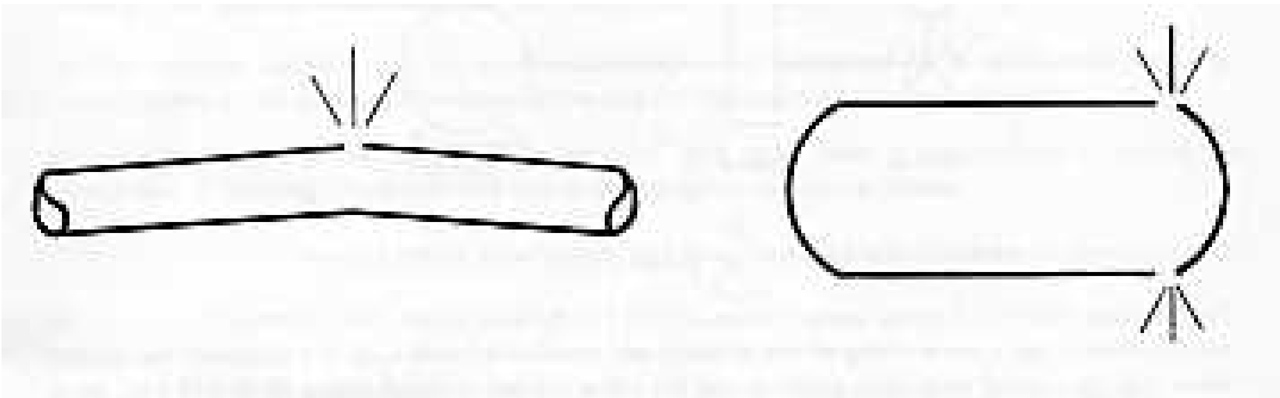
SAFETY NEWSLETTER

No. 112

IN THIS ISSUE

SOME PIPE AND VESSEL FAILURES



IMPERIAL CHEMICAL INDUSTRIES LIMITED

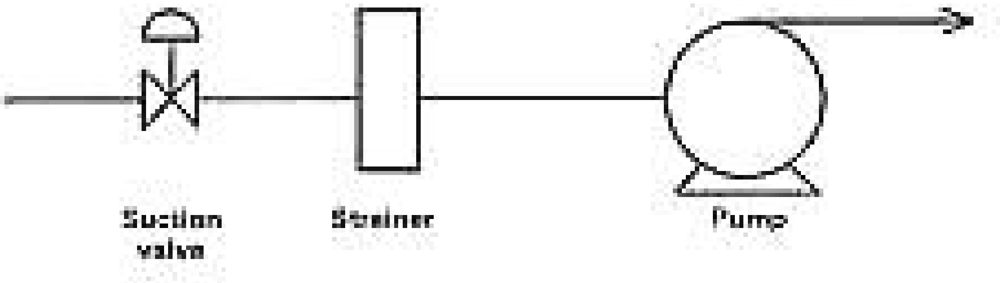
PETROCHEMICALS DIVISION

112/1 A PERMIT-TO-WORK SYSTEM IS IGNORED AND A PIPELINE EXPLODES

The US National Transportation Safety Board have published a detailed account of the July 1977 fire and explosion on the Alaska crude oil pipeline. It was due to a complete disregard of the permit-to-work system which, in turn, was due to inadequate training and a lack of proper management control — no-one was sure who was in charge.

The incident occurred while the pipeline was being brought on line. Soon after start-up the suction strainer on No 1 pump seemed to be choked and the maintenance crew were asked to clean it.

The control room operator switched No 1 pump suction valve into the manual position so that the maintenance crew could close the valve in the pump room. **He did not put any lock or warning on the switch.** He started up No 2 pump in place of No. 1.



The maintenance crew closed the suction valve and started work on the strainer.

Ten minutes later No 2 pump gave trouble and had to be shut down. The operator forgot that the maintenance crew were working on No 1 pump and decided to start it up. He switched the suction valve into the normal automatic position and the valve started to open. Crude oil at 235 psig came out of the open top of the strainer, hit the ceiling and deluged the entire pump room. An explosion blew off the roof and blew down the walls. One man was killed and five injured. The source of ignition may have been the lights which were damaged by the oil jet.

As repairs would take some time, the pump station was by-passed. Incredible though it seems, a similar incident occurred at another station during the next attempt at commissioning the pipeline. A pump was started up with a drain valve open; oil overfilled the drain tank and formed a pool 2 inches deep on the pump house floor. Fortunately, it did not ignite.

The full report can be obtained from the NTSB, Washington, DC 20594.

Other explosions in pumphouses were described in Newsletter 12/4a.

112/2 AN EARLIER FLIXBOROUGH

A vapour cloud explosion, similar to that at Flixborough, occurred at the City Services Refinery in Lake Charles in 1967. A 10 inch pipeline ran from two isobutylene tanks to a plant. A valve in the line was in an open pit which was full of rainwater. A sulphuric acid line nearby had leaked into the ground; some of the acid had run into the pit and corroded the butylene valve. Bubbles of butylene were seen coming out of the water in the pit.

It was decided to empty the line for repair and this was done by flushing the line back to the tank with water at a pressure of 110 psig. The pipeline would normally have withstood this pressure but because the valve was corroded the extra pressure blew off the bonnet of the valve and a jet of water shot into the air. When he saw this, the operator promptly isolated the water and this allowed the butylene to flow back out of the tank and out of the broken valve. About 100 tons escaped and after about 20 minutes it exploded, killing 7 men and starting a fire that burned for two weeks. The source of ignition was another plant, some distance away.

The mistakes made were:-

1 Allowing the valve pit to stand full of water.

2 Sweeping a corroded line with water at a higher pressure than that normally used. It would have been better to have isolated the butylene tank and then swept the line out with nitrogen or low pressure water.

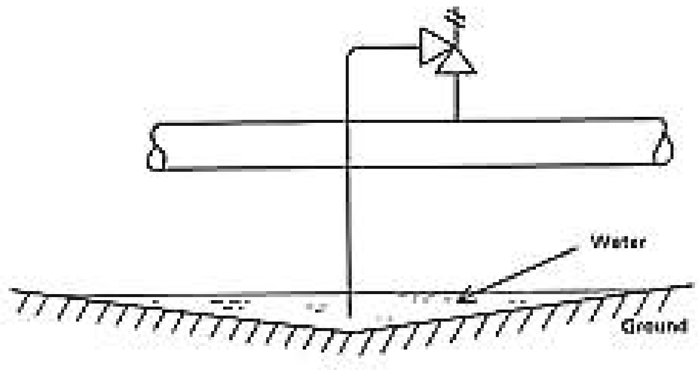
We can hardly blame the man who closed the water valve. His instinctive reaction when the line burst would be to close the valve which he had just opened.

For more information see “Fire Protection Manual for Hydrocarbon Processing Plants”, edited by C H Vervalin, Gulf Publishing Co., 2nd edition, 1 973.

112/3 A PIPE IS OVERPRESSURED ALTHOUGH FITTED WITH A RELIEF VALVE

A line carrying liquefied gas (in another Company) was protected by a small relief valve, but nevertheless a high pressure developed in the line and damaged a pressure transmitter.

It was then found that the tail pipe from the relief valve came down to ground level in an area that was prone to flooding. The water rose above the end of the tail pipe and froze.



112/4 A LOOK BACK AT NEWSLETTER 12 (August 1969)

A man was severely injured in another Division when a plant vessel burst and sprayed him with a corrosive chemical. The vessel was leaking and the material in it was therefore being blown into another vessel with compressed air. The leaking vessel was protected by a bursting disc designed to burst at 5 psig and the process man was told to watch the pressure in the vessel and not let it reach 5 psig. Nevertheless, he opened the air valve too far and the vessel burst. A valve below the bursting disc was closed.

A number of things were wrong:

1. *It is bad practice (and sometimes illegal) to fit a valve between a vessel and its bursting disc. This valve had probably been closed for some time. The valve had been fitted to stop escapes of gas into the plant after the disc blows and while it is being changed. The correct way is to fit two bursting discs, each with its own isolation valve, the valves being interlocked so that one is always open.*

2 *The process operator, who was a lone-worker, had worked on the plant for only 7 months, and during this time had received five warnings for lack of attention to safety or plant operation. Clearly a most unsuitable man (or inadequately trained man) for a lone-worker job.*

3. *When air or nitrogen has to be blown into a vessel which cannot stand the full pressure of the air or nitrogen supply, then it is good practice to fit a reducing valve and relief valve on the gas*

supply, set below the safe working pressure of the vessel This is not always possible — sometimes air or nitrogen has to be used to blow liquids into a vessel and if their pressure was reduced ft would not be sufficient to move the liquid — and in these cases the relief device on the vessel must be sized to take the full rate of air or nitrogen (as described in Engineering Specification PR 0301).

The installation of an isolation valve beneath a single relief valve is permitted in Petrochemicals Division in a few cases when leaving the valve closed cannot have serious consequences, for example, on long pipelines carrying oils of high-flash point (See "Loss Prevention and Safety Promotion in the Process Industries", Elsevier, 1974, p 314).

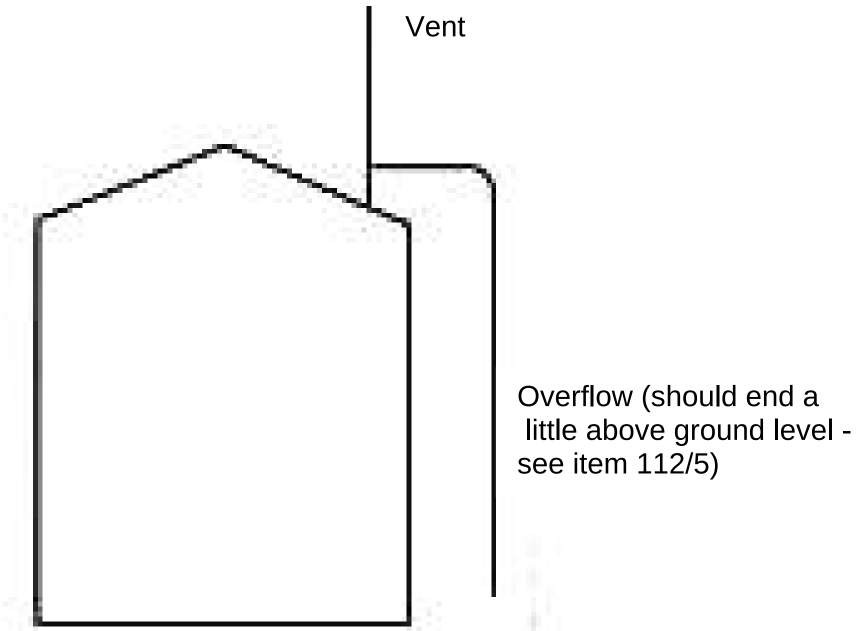
112/5 ANOTHER EXPLOSION IN AN ACID TANK

Newsletters 59/6 and "Ammonia Plant Safety", Volume 17, p 132, described explosions in tanks containing phosphoric acid and ammonia liquor — substances normally regarded as non-explosive. A similar incident is described in the Chemical Safety Summary (published by the Chemical Industry Safety and Health Council of the Chemical Industries Association) for October/December 1977, No 192.

An explosion occurred in a tank containing sulphuric acid. The vertical tank split round the bottom weld, rose 50 feet into the air, went through the roof of the building and fell into a clear space close by, just missing other tanks. Fortunately, nobody was seriously injured but if the tank had fallen on the other side of the building it would have descended into a busy street.

Slight corrosion of the tank had produced hydrogen. As the tank was provided with an overflow pipe leading down to ground level rather than a vent, the hydrogen could not escape and accumulated at the top of the tank (as in the incident described in Newsletter 59/6). The tank had not been made with a weak seam roof, presumably because the possibility of an explosion had not been foreseen. The hydrogen was ignited by welders working nearby.

The report recommends that acid tanks should have a vertical vent pipe as well as an overflow pipe, as shown below, so that hydrogen can escape, or an explosion vent in the roof or a weak seam roof.



Note: Many suppliers of sulphuric acid recommend that it is stored in pressure vessels designed for 30 psig as the acid is usually off-loaded with compressed air and if the vent is choked the vessel could be subjected to the full compressed air pressure.

112/6 AN EXPLOSION IN A SECONDHAND TANK

An explosion in the US draws attention to the risks involved in handling second-hand equipment.

A company bought an old tank for re-use. A quick inspection showed that it seemed to be clean and men were allowed to go inside to remove a sparger and steam coil which were no longer needed. An explosion occurred killing three men and injuring eleven.

The tank originally came from an Army arsenal and had contained explosives. It had been removed by a demolition firm, sold to an equipment re-seller who in turn sold it to the company where the explosion occurred.

From Chemical Engineering, 15 August 1977, page 89.

112/7 WHAT THE LAWS SAYS No 18

…in contrast to earlier legislation The Health and Safety at Work etc. Act 1974 creates a different dimension for the enforcing body. The inspector has to look beyond the physical conditions and deficiencies and consider the organ/sat/on itself. The ability of the organisation to cope adequately with the situation it controls has to be assessed. In basic terms, when a physical defect or a shortcoming is seen, the inspector will not only recognise the omission or defect but will go further and determine not only why the organisation has allowed such a development, but also what is the weakness that has failed to monitor the situation. The onus is now on top management to create and monitor a system which effectively controls and regulates the whole of the working environment. These considerations apply not only to established companies, professional and other business men, but also to activities controlled by voluntary committees, elected members and even ad hoc *bodies that have got together to organise and run a single activity. They range from the multiple activities of the local authority, the fairground operators and the many one-man businesses who provide services to the whole of the community, to the committees running village halls, golf clubs, preservation and rehabilitation schemes and archaeological digs.*

From “Heath and Safety— Manufacturing and Service Industries, 1976”, HMSO, 1978, p 11.

“What the Law Says”, Nos 1-17 appeared in Newsletters 40-66.

112/8 UNUSUAL ACCIDENTS No 78

One of our overseas companies reports that someone drove a metal spike into the ground to assist in winching a motor up an incline. He went through an electric cable and short-circuited the power supply to all the office and laboratory buildings.

112/9 RECENT PUBLICATIONS

(a) The Institute of Petroleum Model Codes of Safe Practice are now over ten years old. The Marketing Safety Code has now been completely revised and brought up-to-date. It covers the design and operation of service stations, installations and depots and vehicles for transport by road and rail. A feature of the new Code is that high-boiling liquids such as gas oil, handled above their flash points, have to be treated like petrol. The Code can be obtained from Heyden & Son Ltd, Spectrum House, Hillview Gardens, London NW4 2JQ (or 247 South 41st Street, Philadelphia, PA 19104, USA) price £9.00.

(b) Report No A,128,839 (available from Division Reports Centres within ICI only) describes all the ammonia releases known to have occurred from manufacturing plants, storage areas, user plants and transport containers.

(c) Loss Prevention Bulletin No 020, published by the Institution of Chemical Engineers, contains a 10-page review of incidents involving gas cylinders. It should be read by all who handle gas cylinders.

(d) Process Safety Guide No 5, “How to Establish Priorities Between Existing Plants for Detailed Hazard Studies” (Report No HO/SD/74001O/5) is available from Division Reports Centres (within ICI only).

(e) Process Safety Report No 10, “Seminar — Process Safety in the Next Five Years” (Report No HO/SD/740009/1OB) reports on the papers and discussions at this seminar and is also available from Division Reports Centres (within ICI only).

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.

June 1978

An Engineer's Casebook No 12

EXAMINATION OF STATUTORY VESSELS - HYDROTEST?

Some engineers are still of the opinion that Statutory equipment (steam boilers, steam receivers and air receivers) requires a hydraulic test as part of its Statutory Examination. This is evidenced by a recent incident involving a steam receiver in this Division which was damaged whilst on test and an enquiry from another Division suggesting that perhaps hydrotesting was not necessary.

The note on the back of Form 58, Note B, and on form 59, Note C, merely require the occupier to provide facilities for a thorough examination to take place. The mention of hydraulic test, steam trial, or other means of testing are indicative of the sort of work which the competent person conducting the thorough examination may deem to be necessary. What is necessary will be partly determined by the construction of the receiver, access for inspection, service conditions etc.

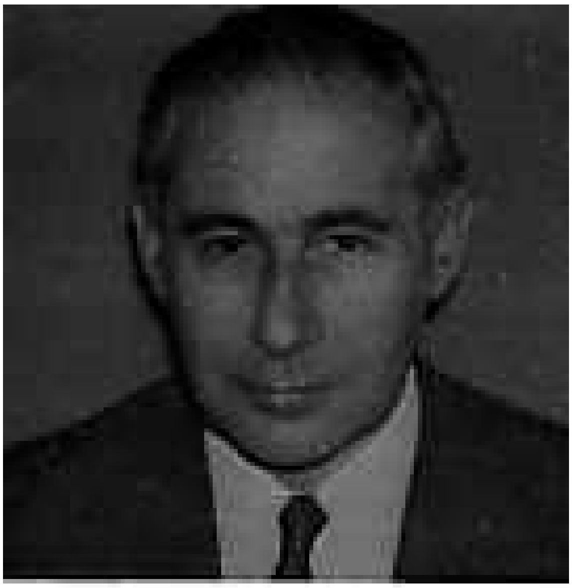
Section 35 of the Factories Act 1961 does not call for a hydraulic test every 26 months; it says "every steam receiver and its fittings shall be thoroughly examined by a competent person, so far as the construction of the receiver permits, at least once in every 26 months". The decision as to what constitutes a thorough examination is in the hands of the competent person. He has to examine the receiver in such a way as to satisfy himself that no part is weakened in any way such that it is no longer capable of safe operation at the working pressure.

In past years, with rivetted receivers, before the use of radiography to determine the state of welded structures, no crack detection methods, ultrasonic thickness testing etc., competent persons had little alternative, where thorough visual examination and calliper thickness measuring was not possible, but to determine adequacy through a proof hydraulic test. Today this is not so; inspection aids are readily available for use both on and off line. As a result, in most cases, continued fitness for purpose can be determined by means other than by pressure testing. Indeed information obtained via thickness testing is much more meaningful in determining whether metal is being lost, so that future life can be forecast, than is the successful passing of a pressure test which says only that, at the time of the test, there was sufficient metal.

Hydraulic proof testing to levels of 1.5 or 1.3 times the design pressure, depending on the design code used, can result in the material yielding at certain places where stresses are concentrated or there are residual stresses from piping, weld contraction etc. Proof testing also raises the level of stress at defects such as weld undercuts, slag inclusions, blow holes, cracks, and may spread these, but not to the point of ultimate failure, so that after test the vessel is less adequate than it was beforehand. Unnecessary proof testing is to be discouraged. Testing up to the set pressure of the safety valve, usually the design pressure, is, of course, quite acceptable and often useful to check for tube and flange leaks.

EHFrank

OBITUARY



Dr A D MEADS

Arnold Meads' many friends and colleagues were shocked by the news of his sudden death on 20th May, at the age of 51.

After studying chemistry at Imperial College, he joined the Nobel Division of ICI in 1950 and Plastics Division in 1959; in 1974 he was transferred to Central Safety Department. Since then, in his quiet way, he did a great deal to improve communication on safety between Divisions, particularly through the Process Safety Interest Group and its subordinate panels and by arranging seminars and editing the written reports.

As Secretary of the Process Safety Interest Group he provided continuity, the right amount of chivvy-ing and first-rate minutes. But it was in the ICI seminars that he excelled. The written records of the discussions on operability studies, hazard analysis, modifications, intrinsic safety and process safety in the next five years make excellent reading. Each speaker expresses his ideas concisely and lucidly, in faultless English. From the tape recordings Arnold was able to cut out all the repetition, verbosity, unfinished sentences and bad grammar and yet, somehow, retain the styles of the original speakers. At future seminars, and in many other ways, he will be sadly missed.

Our sympathy goes to his wife and family in their sudden loss.

The following seminar reports, edited by Dr A D Meads. are available through Division Reports Centres:

Hazard and Operability Studies	Report No HO/SD/740009/2A
Evolution of Risk	Report No HO/SD/740009/5A
Control over minor plant modifications	Report No HO/SD/740009/7A
Development of intrinsically safer plants and processes	Report No HO/SD/740009/8B
Process safety in the next five years	Report No HO/SD1740009/1OB