IMPERIAL CHEMICAL INDUSTRIES LIMITED
PETROCHEMICALS DIVISION

SAFETY NEWSLETTER No 67

67/1 SHOULD WE DESIGN SAFE PROCESSES OR SHOULD WE TRY TO MAKE PROCESSES SAFE?

When we are designing a new plant, we try to find out all the hazards and then we try to control them. For example, if the temperature can get dangerously high, we may use a high temperature trip to isolate the feed. Sometimes we have to add a lot of safety hardware on to the plant.

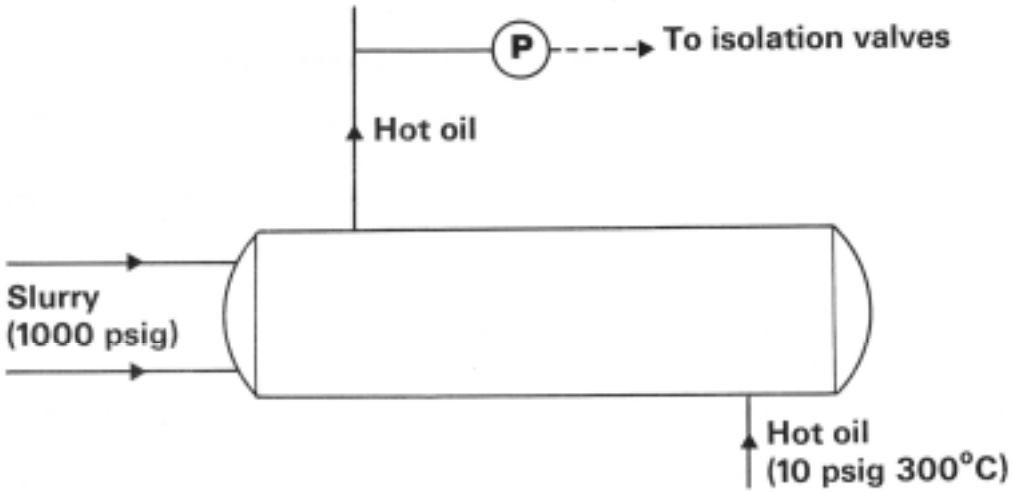
Only very occasionally do we go back to the beginning and ask ourselves if there is a safer process.

We keep a lion and build a strong cage to keep it in. But before we do so we should ask if a cat might do, instead of a lion.

On one of our plants a slurry of water and a salt at 1000 psig has to be heated to nearly 3000°C. The temperature of the site steam supply is only 200°C so hot oil, heated in a furnace, is used to heat the slurry, using a shell and tube heat exchanger. (The slurry cannot be heated directly in the furnace as salt might be deposited in the tubes causing overheating).

If a tube bursts, the hot oil will contact the water and steam will form so fast that a relief valve could not cope with the rise in pressure. An elaborate trip system was therefore designed.

A pressure switch detects a rise in pressure and closes four automatic valves, two in the oil lines and two in the water lines.



This system needs a lot of looking after, and, as described in Newsletter 53/4, one day it failed to work when required. The steam blew the oil out of the oil buffer tank and the oil caught fire.

When another plant was designed a special boiler was built and steam at 300°C used for heating the water. For the next plant, direct injection of steam is being considered.

Another example of redesigning a process to make it safe is the manufacture of nitroglycerine.

An article by N A R Bell in IChemE Symposium Series No. 34, “Major Loss Prevention in the Process Industries”, page 50 describes the modern process in which the risk of explosion has been greatly reduced by keeping the quantity of material in the plant down to the minimum.

There must be other processes which have been made safer (or could be made safer) by redesign instead of by adding protective equipment. If you know of any examples, please tell me.

67/2 DIFFERENT SORTS OF COMPRESSED AIR MASKS.

Recent incidents have shown that many people are not clear about the difference between the two types of compressed air masks that are used in the Company demand masks and full-flow masks.

The demand mask is intended to be used with a compressed air cylinder and delivers just the amount of air required.

Three sorts of cylinders are used:

Ten minute cylinders which are just for escape.

Half-hour cylinders which are intended for rescue and emergency isolation.

Large cylinders which are intended for maintenance work.

The ten minute and half-hour cylinders are carried on the back but the large cylinders are on wheels.

Full-flow masks are intended for use with compressed air pipe lines. They deliver a full rate of air, much more than is really needed and therefore would empty a cylinder very quickly. Some people like them because the excess air helps to keep their faces cool.

In one recent incident a full-flow mask was used with an air cylinder and rapidly emptied it.

In another incident a demand mask was used on a compressed air pipeline using a long lead. The man wearing it felt the effects of insufficient air.

Please make sure that everyone you work with understands the difference between the two sorts of face masks.

67/3 USE OF THE WRONG HOSE IS FOLLOWED BY AN ACID LEAK AND AN "ACTION REPLAY"

Earlier Newsletters (50/3, 38/2 and 20/5) have described spillages which occurred because the wrong hose was used. Now another incident has occurred in another Division. A road tank wagon arrived with a load of 65% oleum. The Fluoroflex hose on the tank wagon could not be used because the vent cock on it had been removed. Instead the operators used a different type of hose which was normally used for 20% oleum. After 45 minutes the hose leaked and a large spillage occurred. The operators assumed that the hose must have been in bad condition and replaced it with a new hose of the same type. After 15 minutes this hose also leaked and a further serious spillage occurred.

As mentioned in earlier newsletters we can let you have a list of suitable hose materials for the various materials used in Petrochemicals Division.

From the ICI "Materials Handling Review" May/June 1974, available from Mr. A. P, Organics Division, Manchester.

67/4 SOME QUESTIONS I AM OFTEN ASKED

2 WOULD TWO SMALL PLANTS BE SAFER THAN ONE BIG ONE?

If we build two small plants twice as many leaks will occur. If these leaks are half as big as the leaks from a large plant, then one might expect the chance of injury or damage to be halved. If this is the case two small plants are no safer, or no less safe than one big one.

But it is not as simple as this.

First, it is true that two small plants will produce twice as many leaks as one big plant but, many of the leaks will be more than half the size. If one large plant uses 4 inch pipes, two small ones will use 3 inch pipes. A leaking joint on a 3 inch pipe produces almost as big a leak as a leaking joint on a 4 inch pipe. In addition, both plants will probably use the same size sample and drain lines.

Even if the leaks from the small plant are smaller, one gallon of petrol, if it catches fire, can cause almost as much damage as two gallons; one ton of ethylene can cause nearly as much damage as two tons. The number of leaks is more important than the size.

Suppose one big plant costs £10,000,000. Then two small ones might cost about £6,500,000 each or £13,000,000 total. By building one big plant we save £3,000,000. Some of this money can be put back in extra safety precautions; we get a safer plant and still save money. So big plants are safer.

This is supported by ICI's experience. We have had more serious accidents and fires on our small plants than on our large ones.

Once one Company builds large plants, then other companies have to do the same or give up the business. To quote from a paper by Jack Lofthouse (originally quoted in Newsletter 24/11), "There are great dangers in putting all the eggs in one basket but in a competitive world, if a number of people take that risk and get away with it, the remainder will be forced to follow this lead. At least it is a wise precaution to ensure that it is a good, stout, well-made basket and not a flimsy paper bag and that a reliable and trust-worthy human being is employed to carry it."

67/5 UNUSUAL ACCIDENTS No 37 BALLS CAUGHT IN HEAT EXCHANGER.

A plant shutdown was caused recently when some of the ceramic balls which support a catalyst bed found their way through a screen into an exchanger. The mean diameter of the balls was about 20 mm and the bores of the exchanger tubes were 19 mm. Result: about 75% of the tubes became plugged off with a ball stuck in the end like an egg in an egg-cup. If the balls had been a few millimetres smaller they would have passed through harmlessly, if they had been a few millimetres larger they would not have stuck in the ends of the tubes.

When specifying balls for a catalyst support bed process designers should try to avoid a size which matches the bores of the downstream exchangers. The size of the ceramic balls is rarely critical and often irregular lumps can be used instead (they are cheaper). Even if there is a grid to stop the balls getting downstream, it may be modified at a shutdown as in the present case, or it may fail.

It is not practical to expect the vessels designer to change his tube size to fit your balls.

From ICI Engineering News, June 1974.

67/6 SIMPLIFYING THE JOB

We are always on the lookout for ways of making our jobs easier and rightly so. But before we make a change, we must make sure that we are not introducing unforeseen hazards.

Some years ago an operator used to empty tank wagons by gravity. His instructions said

1 Open the vent valve on the top of the wagon.

2 Open the drain valve.

3 When the tanker is empty, close the vent valve.

This meant climbing up to the top of the wagon twice.

The operator therefore decided to do Step 3 before Step 2.

Result: The wagon was sucked in.

The operator had not understood that when liquid flows out of a tank it leaves an empty space (a vacuum) behind, and unless air can get in, the pressure of the air on the outside will squash the wagon.

67/7 NOTES FROM READERS

(a) Self-sealing couplings are sometimes used so that hoses can be disconnected while full of liquid. With some types of coupling, such as the Snaptite series H, liquid can escape during the making or breaking of the coupling.

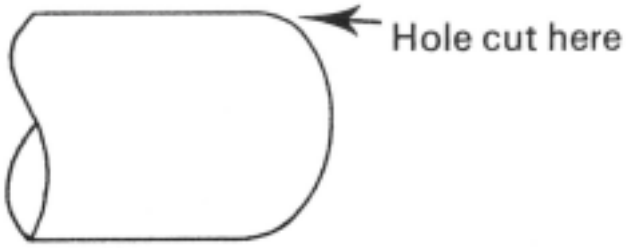
If leakage of liquid is hazardous then other types of self-sealing coupling should be used, for example, Snaptite series E, with an additional 0 ring.

(b) Some cans and bottles, some with metal caps and some with plastic caps, were exposed to fire. The containers with metal caps burst but the containers with plastic caps were intact and still contained some liquid. The plastic caps had melted and relieved the pressure.

Clearly plastic caps are better for bottles and cans which may be exposed to fire. (The plastic must not, of course, be affected by the contents).

(c) The handle of a Stillson wrench fractured. The break started at a point where identification marks had been welded onto the handle. Identification marks should be engraved onto tools, not welded.

(d) A reader in another Division reports that a hole was cut in a pressure vessel at the worst possible place the corner of the dished end.



Pressure vessels are highly stressed items and extra holes should never be cut in them or extra branches welded on, without expert advice.

67/8 ENGINEERING FAULTS ON NEW PLANTS

HOC Division sprang from the old Billingham Division, which in turn started as a branch of Brunner Mond & Co. Nearly 100 years ago the founders put their little capital into the construction of a plant for the manufacture of soda ash by a new method. An account of some of their early difficulties with their equipment will evoke sympathy in the minds of the engineers who have had to start up some new plants.

'Their early years were dogged by failures of the mechanical plant which they bought. They had, of course, many chemical problems, but these were comparatively easily solved. On the mechanical side, however, it was touch and go whether they would be able to continue. The following extracts from their correspondence give an indication of their troubles;

January 1874 - to the engine builders.

We very much regret to have to tell you that the wrought iron hoop round the slide valves in one of the engines is broken and the other shows signs of giving way. The iron is bad, and we dare not leave the as yet unbroken one in. Please get two stronger ones made at once. The broken one we return by your man. We are most bitterly disappointed by these often repeated failures of one part after another and have to tell you frankly that we do not mean to bear all the loss ourselves.

May 1874 - to the engine builders.

Yours of yesterday asking for payment duly to hand. We regret to have to in form you that after working a very few days, the fly-wheel has given way. We have ordered a new one to be made with all possible dispatch, and shall hold you responsible for its cost.

June 1874 - to the boilermakers.

Another disaster, which might have been very serious, occurred late last night. One of the tubes of one of our Howard's boilers burst, fortunately without hurting anyone, and without doing any serious damage.

This evening at seven o'clock, a tube in the other boiler has given way, after being tested yesterday to 280 lb. The safety valve was set to blow off at 102, and the boiler was full of water. The boiler-man was severely scalded and is in danger of his life. Under these circumstances your reputation and our very existence is at stake. We request that you will send your foreman and your inspector here at once. We dare not put fire under your boilers again except with your guarantee that care on our part is all that is required."

From an article by G.A.J.Begg in "The Chartered Mechanical Engineer", March 1969, page 9, originally quoted in Newsletter 11, July 1969.

67/9 RECENT PUBLICATIONS

(a) On 27 September 1973 the re-inforced concrete natural draft cooling tower at Nylon Works, Ardeer collapsed during a 70 mph wind. No-one was hurt.

The Committee of Enquiry into the incident have now published their report and it can be obtained from Engineering Services Department, ICI House, Millbank, London SW1P 3JF (price £10 outside ICI).

The Committee concluded that the collapse was probably due to imperfections in the shape of the tower which led to unacceptably high stresses and caused a bending collapse. The stresses were made worse by cracks and by the relatively small amount of re-inforcement.

(b) Terylene Works, Wilton have produced an excellent booklet on ‘Warehousing with Care” which consists entirely of pictures of the right and wrong ways to do things. Copies can be obtained from Tom Nosworthy, Terylene Works, Wilton.

(c) Newsletter 59/1 described a serious fire which occurred in a stack of drums. The liquid burnt far more quickly than the same quantity of liquid in a tank would have burnt and buildings up to 75 metres away were set on fire. There is a photograph of the damage and a short report of the fire in “Fire Prevention”, May 1974, page 40.

As a result of this fire a detailed survey has been made of the drum storage areas in Petrochemicals Division. The results are reported in Safety Note 74/10 which also includes, as an Appendix, a draft Code of Practice for the storage of drums.

For a copy of (c) or for more information on other items in this Newsletter please ring B3927. 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.

August 1974