SAFETY NEWSLETTER

No. 110

IN THIS ISSUE

IMPERIAL CHEMICAL INDUSTRIES LIMITED

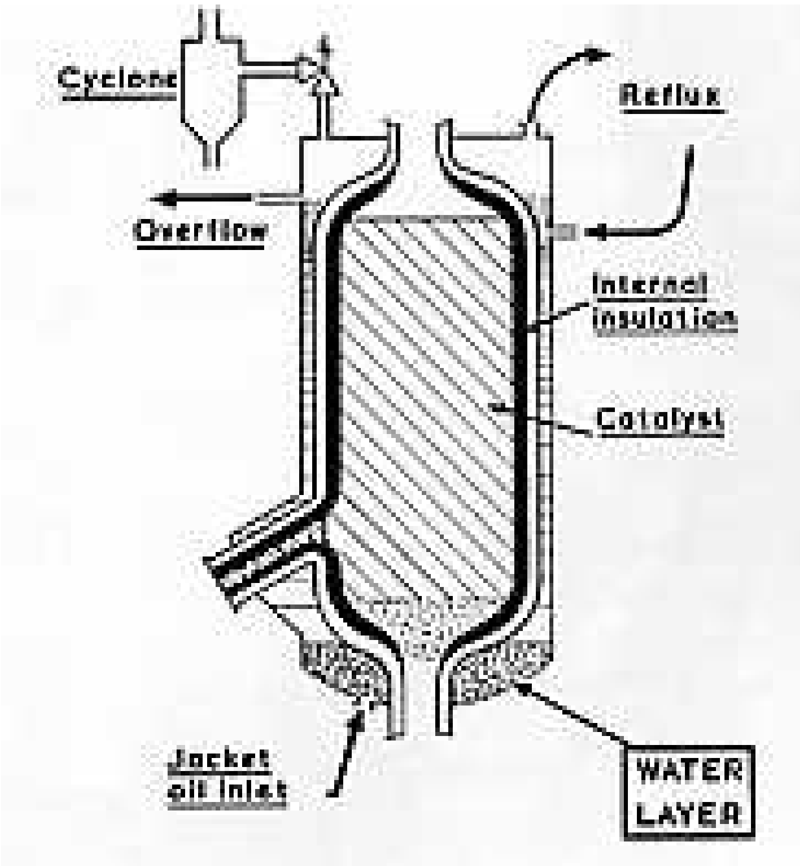
PETROCHEMICALS DIVISION

110/1 ANOTHER FIRE CAUSED BY MIXING WATER AND HOT OIL

Newsletter 107/1 described how water got into a hot heat transfer oil system and vaporised so rapidly that the oil buffer tank blew up.

Now another similar incident has occurred, this time in the Division.

A carbon steel reactor is insulated internally. Cracks in the insulation and channelling in the catalyst could cause hot spots to develop on the steel shell and these might exceed the safe working temperature. The reactor is therefore surrounded by a jacket containing a heat transfer liquid.



NOT TO SCALE

Originally water was used but it was found that temperatures above 100°C were needed. Water under pressure could not be used as the jacket was not strong enough, so oil was used instead. A by-product of the process, boiling point 170°C, was found to be suitable and was used. To avoid degradation, there is a continuous make-up at the bottom of the jacket and overflow from the top. The oil enters at about 120^{o}C and oil vapour from the top of the jacket is condensed and returned.

As the result of an upset in the plant the by-product oil became contaminated with water which settled out in the base of the reactor. The water did not boil immediately as the hydrostatic pressure in the jacket raised its boiling point to about 120° C, the temperature of the incoming oil. However, when a minor disturbance caused some mixing of the oil and the water, some of it flashed and blew some of the oil out of the jacket relief valve. A cyclone had been provided after the relief valve but it was not designed for such a high flow and some oil escaped to atmosphere. It was ignited by a neighbouring furnace and, although all the oil that came out burnt in five minutes, damage to instruments and electric cables was extensive.

All hot oil systems should be critically examined in order to identify ways in which water might enter. Precautions should then be taken to prevent water entering and to detect and remove any that does enter.

Replacing water by oil had disadvantages that were not foreseen. The process is a gas-phase one and any process leaks will be gas. By introducing 200 tons of oil as the heat transfer medium, we introduced a new hazard: The possibility of a liquid fire.

The liquid jacket was itself the result of an earlier change. In an earlier plant there was a stainless steel liner inside the reactor insulation. It was difficult to seal so, when a new plant was built, a liquid jacket was installed to avoid the need for a liner.

After the fire it came to light that unexplained increases in the pressure in the reactor jacket had occurred before, but no-one had attached any importance to them.

Reminder: Newsletter 83 described other changes that had unforeseen and unwanted effects.

110/2 OIL WILL SPREAD ALONG WAY ON TOP OF WATER

CONSTRUCTION JOBS ON RUNNING PLANT NEED EXTRA SUPERVISION

A fatal accident which occurred 12 years ago taught us several very different lessons. It was described briefly in Newsletters 11/1 0 and 62/4.

A welder was constructing a new pipeline in a pipe trench, while 65 feet away a slip-plate was being removed from another pipe which had contained light oil. Although the pipe had been blown with nitrogen, it was realised that a small amount of the oil would probably be spilt when the joint was broken but it was believed that the vapour would not spread as far as the welders. Unfortunately, the pipe trench was flooded after heavy rain and the oil which was spilt spread across the surface of the water and was ignited by the welder’s torch. One of the men working on the slip-plate was badly burnt and died later.

The first lesson from the incident is that **welding should not be allowed over large pools of water** as spillages some distance away might be ignited. Newsletter 53/6 described how 35 tons of petrol were spilt on the Manchester Ship Canal. Half-a-mile away, 2½ hours later, the petrol caught fire, killing six men.

The second lesson is that when large joints have to be broken regularly, a proper means of draining the line should be provided. The contents should not be allowed to spill onto the ground when the joint is broken.

Why was a clearance certificate issued to remove a slip-plate 65 feet away from a welding job? Although vapour should not normally spread this far, the two jobs were a bit close together.

The supervisors who issued the two clearance certificates were primarily responsible for operating a plant some distance away. As they were busy with the running plant they did not visit the pipe trench as often as they might. Had they visited it immediately before allowing the de-slip-plating job to start they would have realised that the two jobs were rather close together and might have realised that oil would spread across the water in the trench.

After the incident special day process supervisors were appointed to supervise construction jobs and liaise with the construction teams. The construction teams like this system as they deal with only one process supervisor instead of four shift men.

The following are some other points to consider where construction has to take place in a plant area where flammable gases or liquids are handled:-

1 Minimise the amount of on-site welding by fabricating as much pipework as possible off-site, by using flanged joints for service lines and by using bolting for structural work.

2 Minimise the amount of high-level welding, which spreads sparks, by constructing the upper sections of tanks first and then jacking them up.

3 Build little huts to contain sparks, particularly when welding has to take place at a height.

4 Build fences round areas in which ground level welding is permitted.

5 Use portable gas detector alarms to give early warning of leaks. (See Newsletter 51/1).

6 Make sure vapours cannot come out of the drains. (See Newsletter 90, pages 11 and 12).

110/3 LPG COMES OUT OF AN OPEN END ON A DISUSED LINE

A rather unusual movement of liquefied petroleum gas (LPG) had to be made from one storage tank to another. The arrangement of lines and valves was very complicated and as a result two experienced men made an error in setting up the route, and pumped some LPG down a disused line. The LPG came out of an open end in another plant operated by another Division. It was not immediately apparent where the LPG was coming from and 7 tons came out before the leak was stopped.

The Fire Service set up water monitors round the leak and no gas was detected in flammable concentrations outside the water curtain.

The disused line was last used in 1971 and it is believed that when it was taken out of use it was slip-plated at the receiving plant end. It is believed that a year or so later the slip-plate was removed when changes were made in the receiving plant area.

Disused lines and equipment should be isolated by removing a section of line and blanking the open-ends. Inserting a slip-plate or removing a valve is not sufficient — it is too easy to remove the slip-plate or put the valve back.

110/4 A LOOK BACK AT NEWSLETTER 10 (May1969).

Oil Spillages

When petrol or oil are spilt they can soak into the ground and come up years later when the water level rises.

In 1966 there were several petrol spillages at Thurrock in Essex. Some of the petrol soaked into the ground and in September 1968 was brought back to the surface by heavy rain. The vapour accumulated on the ground floor of a house, ignited and blew a hole in the staircase. Two people were injured. A 22 feet deep trench has now been dug to try to recover the rest of the petrol (“The Times”, 9.4.69 and “Petroleum Times”, 11 .4.69).

A Hydraulic Oil System is isolated

The emergency blow-down valves on a plant are kept shut by a hydraulic oil supply. One day the plant started to blow itself down and it was then discovered that, unknown to the managers, the supervisors had developed the practice, contrary to instructions, of isolating the oil supply valve “in case the pressure in the oil supply system failed” — a most unlikely occurrence and less likely than the oil pressure leaking away from an isolated system.

An escape of Liquefied Petroleum Gas (LPG)

Two tons of propylene escaped to atmosphere when a valve spindle blew out. Fortunately it did not fire.

The valve was not the type recommended in the Division for LPG duty and in other ways the installation was below standard. There was only a single valve on the sample line; it was not fixed directly onto the tank and the diameter of the line was too great; the tank was too near a road, it was not lagged. Almost everything possible was wrong with it.

Since the Feyzin disaster three years ago (1966) much has been written on LPG storage and a lot of money spent on improving our old installations.

Are there any out-of-the-way corners in your area where LPG tanks have been overlooked?

110/5 TRAINING — AN OFFICIAL VIEW

The following is taken from a Health and Safety Bulletin summarising a new report on “Safety in the Operation of Ceramic Kilns”. We do not operate ceramic kilns but the advice given could be applied to other furnaces.

“Only an authorised person should operate a kiln after having been trained fully according to the manufacturer’s instructions. Before authorisation an operator should have been tested by a responsible member of management who should be satisfied that the operator has a full practical understanding of operating instructions, including shut-down procedures. Regular re-examination at least once in every six months should be arranged”

110/6 OTHER MEN’S VIEW No 7

“On the 26th September (1850) we were able to fix the first column into its place. From this time I took the general management of the building under my charge, and spent a/I my time on the works — feeling that, unless the same person who made the drawings was always present to assign each part to its proper p/ace in the structure, it would have been impossible to finish the building in time for the opening on the 1st of May.”

Charles Fox, builder of the Crystal Place, quoted by L T C Rolt in “Victorian Engineering”, Penguin Books, 1970, p 153.

110/7 UNUSUAL ACCIDENTS No 76

Welders have been known to put welding rods inside scaffold poles, and then forget that they were there.

While a man was dismantling a scaffolding, a welding rod slid out and hit him on the nose. Fortunately his injuries were not serious but they might have been if he had been hit in the eye.

110/8 COMMENTS FROM READERS

Newsletter 105/7 told the story of a manager who collected some beetles in a vacuum cleaner, tried to poison them with town gas and blew up the vacuum cleaner bag.

A reader has provided a little more detail. The manager filled the vacuum cleaner bag with town gas using a gas poker and then left it standing overnight in order to make sure that the beetles were killed.

The next morning he forgot about it and went off to work.

When his wife switched on the vacuum cleaner the bag exploded.

The moral seems to be:-

Before handing over the plant to another shift make sure they know about any unusual circumstances.

Newsletter 105/3 described another accident caused by poor handover.

110/9 RECENT PUBLICATIONS

(a) Safety Note 77/4A, a revision of Safety Note 77/4, describes the method recommended for use in the Division for calculating the peak incident pressure from a vapour cloud explosion, assuming that the TNT equivalent is known.

Safety Note 77/13A describes a method for estimating the TNT equivalent.

(b) A note dated 7th March 1978 summarises the papers presented at the 1978 Loss Prevention Symposium organised by the American Institute of Chemical Engineers. (The 1977 papers and discussion have now been published in “Loss Prevention, Volume 11 “).

For copies of (a) or (b) or for more information on any item in this Newsletter please ‘phone Eileen Turner (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 Turner to add your name to the circulation list.

April 1978

An Engineer’s Casebook No. 9— Nuts and Bolts

The frustration which we have experienced for years with finding the right size of spanner to fit a particular hexagon nut is becoming increasingly apparent in finding a nut to fit a particular bolt. In the case of spanner sizes it is readily apparent that if the spanner is a slack fit you need to ring the changes between the three main types, namely, Whitworth, A/F and metric, to find one which does fit properly or, as alas many do, resort to mole grips or a Stillson wrench. Ultimately one is usually successful in getting the nut tightened down by one means or another. But what has been achieved if the nut and bolt are mismatched?

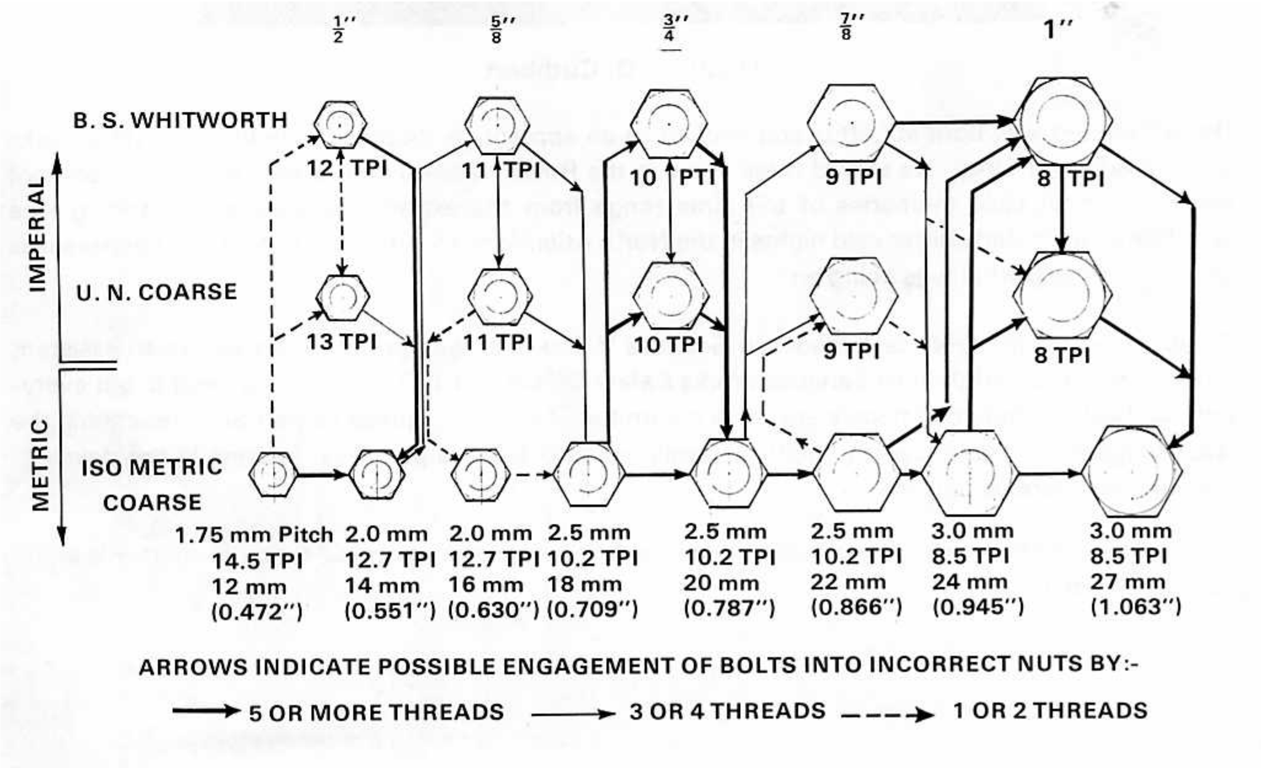
Most of the nuts and bolts in use on our plants are required to produce a minimum bolt load, for example, to yield a gasket in a pipe joint, to carry pressure and dynamic loads in reciprocating machinery, high strength friction grip bolts in structural connections etc. A few nuts serve merely to hold the bolt in place where the bolt is in shear. It is therefore important that not only is the nut tight on the bolt but also that the nut and bolt are properly matched, each of correct diameter, pitch of thread and thread form so that when correctly tightened the design bolt load is produced.

Three screw thread systems cover most of the nuts and bolts used on our plants from the ¼ inch size upwards and considerable error potential exists for them to become interchanged. The three thread systems are the Whitworth system (BS 84), traditionally used in the U.K. and based on the round topped 55^o Whitworth thread form, the Unified ISO (inch) system (BS 1580) based on the American 60^o flat top thread form and the ISO Metric system (BS 4190) which also uses a 60 thread form. ICI took a lead in this Country in the late 1940’s in pioneering the introduction of the Unified thread series into what at that time was an almost exclusively Whitworth field. The widespread introduction and adoption of the Petroleum Equipment Engineering standards for petrochemical plant based on the American ASA series, notably for piping, accelerated the investment in Unified bolting in the late 1950’s and 1 960’s, largely through the use of stud bolts to BS 1750. More recently the move towards metrication, now well established in the electrical and civil and building industries, and importation of more goods from within the EEC is increasing the number of nuts and bolts made to the ISO Metric system. This will ultimately become the only system to be used.

Interchangeability between the three main thread systems is illustrated on the accompanying chart (BSF and UNF ignored) which shows that thread engagement can vary from full engagement of a loose nature of incorrect nuts from another thread system, through misleading apparently correct engagement, to a tight fit of perhaps only two or three threads which could tempt the user to apply force suspecting a burr, dirt or other cause of tightness.

Proper segregation in stores helps keep the problem under control together with an awareness of error potential on the part of all users. Marking systems can help where manufacturers and/or users have applied these. Whitworth nuts and bolts carry no identification, Unified bolts have a shallow circular recess on the head with nuts stamped on one flat with circles (000) or a circular groove of semi-circular section in the non-bearing face, ISO Metric bolts have the symbols ISOM or M stamped or embossed on the head with nuts stamped with an M on one flat. ICI Standard Sheet 08-0200 gives all the details.

E H Frank 1978



WHO'S WHO IN SAFETY

No 25— D. Cuthbert

Denis Cuthbert was born at Loftus and worked as an apprentice cobbler and in the local steel works until called up in 1943. He served three years in the Royal Navy on defensively equipped merchant ships. His most vivid memories of this time range from the extreme loneliness of standing lone watches on pitch dark, bitterly cold nights in the North Atlantic to the utter frustration and helplessness of never knowing what was going on.

Denis joined ICI in 1956 as a lagger in Services Works and was promoted in stages to assistant foreman in 1963 and then to Services Works Safety Officer in 1969. His aim has been to get everyone involved; he finds that people are more committed if they have played a part and understand the reasoning behind the measures adopted. Denis has also taken a particular interest in the development of safe systems of work.

He is married with a married daughter and is interested in gardening and all forms of sport. His ambition is to write a book.