SAFETY NEWSLETTER

No. 165
ALL CHANGE — BUT DO SO WITH CARE

IMPERIAL CHEMICAL INDUSTRIES LIMITED

PETROCHEMICALS DIVISION

165/1 MATERIAL OF CONSTRUCTION

Manufacturers of equipment now have a very wide range of materials available from which to make equipment suitable for handling chemicals. For any particular duty some material can usually be found which is resistant to damage by the chemical and has suitable other properties. When equipment needs repair it is important to use replacement parts of the same material. A recent incident illustrates the problems that can arise when modifications are made unwittingly.

In a typical tanker loading installation the flow of liquid is measured by a turbine meter which gives an electrical signal to the totaliser on which the required volume has been set by the operator. A solenoid valve should automatically shut when the meter has registered the required amount or when the flow falls to zero.

In one such installation a road tanker overflowed when the meter indicated only 9,500 litres had been loaded although the cut-off had been set at 11,000 litres and the tanker was capable of holding that volume. The meter had been in service for some time and as some parts were found to be worn they were replaced by new ones. Within a few days a similar incident occurred. When the meter was again examined it was found that the new bearings, which had been fitted after the first incident, had already worn badly and allowed the turbine to touch the casing. The turbine was therefore restrained and gave a low reading.

It was found that the new bearings were of the wrong material, Stainless steel bearings had been used whereas a 'Stellite' bearing sleeve should have been used with a tungsten carbide shaft.

One of the constantly recurring problems with modifications is that even comparatively minor changes can have serious consequences.

165/2 CLOSE CONTACT OF A SIMILAR KIND

An operator had just finished loading a ship when he noticed flames coming from the area of the inboard and outboard glands of a transfer pump. The fire was put out and the cause remained something of a mystery. The pump was carefully dismantled and there was no obvious mechanical defect that might have caused the fire. It was decided, therefore, to reassemble the pump and to test it under close supervision.

During the test run, five minutes after start-up, smoke was seen coming from the area of the inboard bearing. It was found that when the pump was assembled for test a gasket of the wrong material had been used. This had caused an oil thrower to come into contact with the housing of the inboard bearing. Following repairs the pump was again re-installed and used without further problems.

The cause of the original fire is still uncertain. The failure of the pump during the test again illustrates the need to use parts of the correct specification.

165/3 TOO HOT TO HOLD

We have said before that, following Flixborough, great attention has been paid to modifications to equipment but the possible effects of changes in process conditions are often not foreseen. Here is an unusual case.

In a multi-product plant a restriction orifice plate (ROP) was bolted between two flanges in a lagged pipeline. After a campaign of manufacturing one product a new campaign was started and the temperature of the pipeline was increased by about 40°C. Soon afterwards there was a severe lagging fire which was soon extinguished by alert plant personnel.

The investigation revealed that at some time the flange bolts had been overtightened and weakened. The ROP joints had leaked and product had soaked unobserved into the lagging. It is surmised that the increase in temperature associated with the change in product had been sufficient to initiate the fire.

I don't think anyone would have foreseen this incident. But it illustrates that changes from a steady state often reveal unsuspected weaknesses. There is a need for greater care and alertness at the times such changes are made.

165/4 RAW MATERIAL: COMPLICATED BY-PRODUCT

In a chemical process the proportion of phosphorus in a raw material was known to be critical. After extensive investigation it was concluded that another source of supply could be used and that a consequential small increase in the phosphorus content could be accepted.

The proportion of sulphur in the raw material was not critical to the main process. The raw material from the new source, as well as containing more phosphorus, also contained rather more sulphur compounds. In the main process hydrogen sulphide was formed from the sulphur compounds and was removed from the gaseous product stream by washing it with lime slurry. The hydrogen sulphide was converted to calcium hydrogen sulphide $Ca(SH)_2$.

There would probably not have been any difficulty if the waste lime slurry containing the calcium hydrogen sulphide could have been disposed of without further treatment. However, local regulations required that the slurry be neutralised before disposal.

The slurry was neutralised in batches in an agitated vessel. Operators needed to climb to the top of the vessel from time to time to switch on the agitator, to take samples or check the level of slurry in the tank. One day an operator was poisoned by hydrogen sulphide emerging from a vent at the top of the vessel. It is thought that because of the change in the sulphur content of the raw material more hydrogen sulphide was generated from each neutralisation batch. Also, on that particular batch, the acid concentration was higher than usual and the hydrogen sulphide could have been released at a greater rate. The vent exit was too near the working area on the tank top.

I hope my summary of this very complex sequence is clear. The incident report is a model of its kind and records a painstaking investigation. It is a sad illustration of another aspect of change or modification.

165/5 TAIL-PIECE: THE WRONG PROCEDURE

In a recent incident an operator was injured as a result of failing to adopt the correct procedure in purging a system with nitrogen.

A nitrogen flex was connected by a snap-connection coupling to a valved branch on the line to the suction of a pump. This isolation valve was then opened and the operator was sprayed with hot product coming out under pressure from the coupling which was subsequently shown to have a defective rubber seal. The branch was provided with a blow-off cock and the installation conformed to the standard design. Flexes on the plant are pressure tested and colour coded but there is no routine examination of connections on the plant.

The correct procedure, of course, would have been to have *opened up the nitrogen service line valve first* to pressure up the branch. The defective seal may then have become apparent by the noise of escaping nitrogen before any attempt to open the process isolation valve. In the incident, process material under pressure flowed back into the flex and sprayed out through the bad coupling.

It was also noted in the incident report that the access to the blowing-in point was obstructed by redundant pipework and that the lighting in the area was poor.

Do your operators use the correct blowing or line purging procedures?

Have you checked your p/ant recently for access to equipment?

165/6 ANOTHER TAIL-PIECE: A CORRECT PROCEDURE DESCRIBED

It had become the practice on a tank farm to drain water from a large tank using one valve only. A large valve on the tank base was cracked open and water flowed via a 4” line to a drain pit. There was a second valve on the end of the line leading to the pit and this valve was habitually left open.

Tanks having a floating roof can collect a very large volume of water following a few days of heavy rain. There may also be a considerable quantity of dirt and scale in the tank base. It is possible for scale etc. to become jammed in the valve and prevent its closure. The second valve, if left open, may already have become affected by rust or become frozen and inoperable. A 50 foot level of naphtha or petrol above the water would give a pressure at the base of about 15 psi and considerable flow rate of liquid even through a partly open valve. With both valves seized it would be impossible to stop the flow.

Draining water from hydrocarbon storage tanks can thus be highly dangerous if the correct procedure is not adopted. (*Remember Feyzin*—see Safety Newsletter 73/4). Starting with both drain valves shut, THE CORRECT PROCEDURE in all cases is first to open up the isolation valve nearest the tank. Then crack open the final drain valve. The intervening pipe remains under pressure and if the draining valve cannot for some reason be fully shut, then usually the first valve can be used to isolate the flow.

At the end of the operation the valve nearest the tank should be closed first. The liquid in the line should then be allowed to drain out before the final drain valve is closed.

165/7 OXYGEN

Recent Newsletters have drawn attention to the hazards of nitrogen which is about 80% of the air we breath (Items 158/2, 164/3). Too much nitrogen implies too little oxygen, but TOO MUCH oxygen can also result in some alarming hazards!

Material such as clothing can burn readily in oxygen-enriched atmospheres (see Safety Newsletter 7/7 — a leak of oxygen from the flexible connections on an oxygen cylinder enriched the atmosphere within a tank and a welder’s clothes caught fire). A number of metals will burn in high oxygen concentrations, in fact oxygen will assist almost anything to burn.

How does the body react when the concentration of oxygen in the atmosphere breathed differs from the normal 20.8%? The following table gives a guide:

Oxygen Concentration	*Effect*
Enriched (>21%)	Pulmonary inflammation, lung collapse, bleeding.
17%	Judgement can be impaired.

16%	Oxygen starvation of tissue commences.
12%	Breathing rate increases and pulse quickens. Muscular co-ordination affected.
10%	Breathing difficulties, abnormal fatigue.
6%	Vomiting, nausea, possible physical collapse while still mentally aware, loss of consciousness.
Below 6%	Extreme breathing difficulties, breathing stops, heart action ceases in a few minutes.

Some Points to Watch

1 Don’t allow oxygen to come into contact with oil or grease — they could explode.

2 Too much or too little can injure your health.

3 Never attempt to artificially sweeten the atmosphere in a confined area using oxygen.

4 Report any leaks immediately.

5 Keep cylinders away from heat and electrical equipment.

6 Never attempt to cross-connect air and oxygen flexible hoses.

7 Don’t use damaged equipment or attempt any temporary repair of hoses.

For more information on any item in this newsletter please phone P2845 or write to us at Wilton. 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.

January 1983

Engineer’s Casebook No 65
ELECTRIC RESISTANCE WELDED CARBON STEEL PIPE

Traditionally up to 18 inches in diameter NS seamless pipe has been used by ICI in the UK for most carbon steel process and utility systems. Although pipe to various British and American specifications has been used, over the last ten years pipe to API specification 5L, Grade B, has been adopted as standard through the Company in the UK.

In the mid 1970’s consideration was given to using Electric Resistance Welded Pipe (ERW) and large quantities were used successfully on one of the Company’s major projects. Until recently there has never been any commercial benefit in using ERW pipe and so far it has not been used for maintenance and minor capital work. The situation has changed during the last year or two and now significant economies can be made by using ERW pipe.

Carbon steel pipe for maintenance and major capital work is purchased through a Company contract. In common with most major petrochemical and chemical companies, we place restrictions on the carbon content and tensile strength of API 5L, Grade B seamless pipe bought to this contract. The contract has now been extended to cover API 5L Grade B ERW pipe and certain additional requirements are called for with this material. Approved suppliers of ERW pipe normalise the whole of the pipe and also use on-line ultrasonic inspection. At present there are limitations on the size of pipe that can be fully normalised and therefore API 5L Grade B ERW pipe is restricted by ICI to the size range ½” NS to 10” NS.

The code, ASNI/ASME B31.3, to which most of the Company’s carbon steel pipe systems are designed permits the use of both types of pipe. However, due to a weld joint quality factor the allowable hoop stress of ERW pipe, is restricted to 85% of that for seamless pipe.

The 1977 revision of the Company Standard Sheets for carbon steel pipe systems was based upon the allowable stress for API 5L Grade B ERW pipe, thus permitting ERW and seamless pipe to be regarded as interchangeable. Generally, in the smaller sizes and lower class ratings, standard schedule wall thicknesses are selected, rather than calculating the thicknesses for each system. These thicknesses are much greater than is required to contain pressure alone. These standard schedules are covered by the contract.

For temperature range 0°C to 400°C ERW pipe covered by the Company Standard, and the purchase contract, is suitable for the following applications:

a) ANSI Class 150, in size range ½” NS to 10” NS;

b) ANSI Class 300, in size range ½” NS to 6” NS.

Above 6” NS in ANSI Class 300 and in all sizes in higher class ratings the weld joint quality factor may become significant and the design of each system, particularly the branch compensation, should be checked before using ERW pipe.

The wall thickness of ERW pipe should not be increased to compensate for the weld joint quality factor without due consideration as this will increase the stiffness of the system and may produce unacceptable longitudinal stresses.

In the past concern has been expressed about the corrosion resistance of welded pipe. In ERW pipe manufacture filler metal is not used in the welding process and the normalising stage that has been specified restores the metallurgical structure of the weld to that of the parent pipe. The net result is that the corrosion resistance of the weld is unimpaired.

In future considerable economies can be made in carbon steel piping systems through the use of API 5L Grade B ERW pipe, purchased to the Company contract. This applies to both maintenance work and new design work. For systems designed to the 1977 revision of the Company Standard sheets ERW pipe may be regarded as being interchangeable with seamless pipe. In systems where the wall thickness has been designed for a specific duty it is necessary to check that the design hoop stress does not exceed the allowable hoop stress and that the branch compensation is adequate, before ERW pipe is used. Similar checks should also be made before using ERW pipe on other plants where Standard Wire Gauge wall thickness pipe was used. Where doubts arise regarding ERW pipe your regional office of the Piping Section of Engineering Department should be consulted.

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