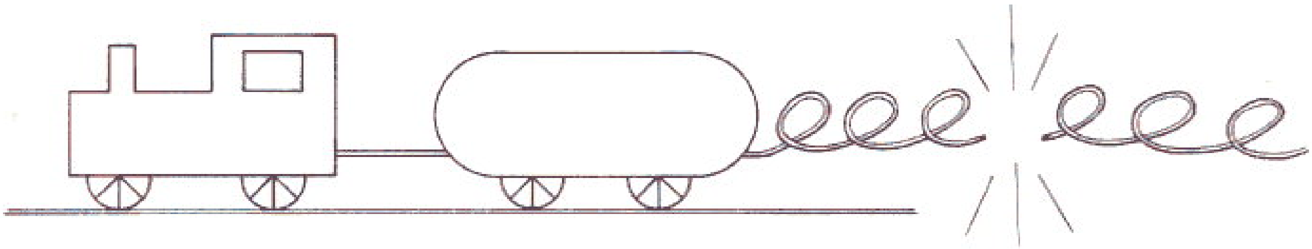
SAFETY NEWSLETTER

No. 124

MOVEMENTS OF TANKERS AND LIQUIDS ATTHE WRONG TIME OR INTOTHE WRONG PLACE



124/1 A rail tanker was moved before disconnection.

124/2 Back flow could not occur — except when the plant was shut down.

124/3 A high-level alarm was ignored because the tank could not be full. It was.

124/4 Dead-ends fail again.

124/5 Some valves were ordered correctly but were supplied with screwed plugs.

124/6 Has all the money and effort put into technical safety produced any results?

124/7 Let's use hazard and operability studies more *at the early stages.*

An Engineer's Casebook— Gasket contact surfaces.

IMPERIAL CHEMICAL INDUSTRIES LIMITED

PETROCHEMICALS DIVISION

124/1 ANOTHER TANKER IS MOVED BEFORE DISCONNECTION

An empty rail tanker that had contained ammonia was moved before it was disconnected breaking the articulated arm and causing a leak of ammonia vapour. Fortunately no-one was injured.

Two tankers are connected up at a time and discharged in turn. Usually, tankers are disconnected as soon as they are empty. However, on the day of the leak the emptying was finished 15 minutes before the end of a shift. The new shift were told that the first tanker was empty and still had to be disconnected, but the message did not register. There was no handover in writing.

After the new shift had emptied the second tanker, two operators disconnected its off-loading arm, coupled up the railway engine and moved both tankers. There was a loud bang and the escaping gas could be seen and smelt. Neither operator had noticed that the first tanker was still connected though both had walked past it.

An interlock is now being installed to prevent tankers being moved while off-loading arms are connected.

Newsletters 68/8 and 50/2, “Fire”, November 1973 and Safety Note 74/5, Appendix described other occasions on which road or rail tankers were moved before disconnection and Newsletter 83/9 (and an article in Loss Prevention, Vol 10, 1976, p 151) described a simple device which prevents road tankers being driven away while connected.

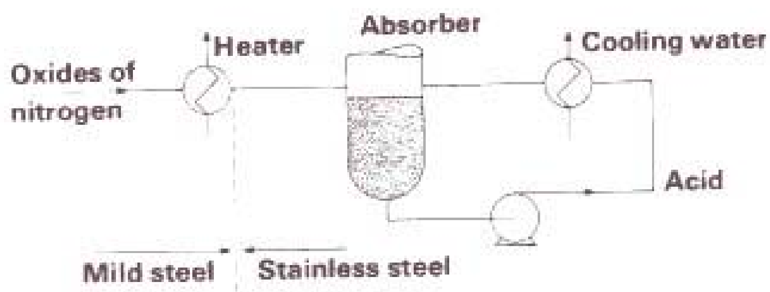
The operators used breathing apparatus but did not seem fully familiar with it. One man carried the compressed air bottle in his hands.

The water spray over the tankers was not used. It was not tested regularly and there was some uncertainty as to the correct way to use it.

Newsletter 60/1 described another example of emergency equipment which was not used because people forgot why it was there. All emergency equipment should be tried out regularly.

124/2 ANOTHER CASE OF REVERSE FLOW

Newsletter 79/2 (reprinted in an expanded form in Hydrocarbon Processing, March 1976, p 187) and Newsletters 98/2 & 3, 96/4, 9/8 and 8/8 described accidents caused by reverse flow. Now another incident has occurred.



Oxides of nitrogen are absorbed in water and the liquid from the base of the absorber is circulated through a cooler. If a tube leaks, cooling water enters the acid and dilutes it slightly.

However, nobody considered what would happen if a tube leaked while the plant was shut down with a level in the absorber, and the leak caused the level to rise.

The acidic liquor filled up the inlet line and corroded the mild steel heater.

124/3 HOW A TANK WAS OVERFILLED

A product is moved in batches of about 400 tonnes from a producing plant to a storage tank about a mile away. The transfer line is normally left open to the tank to provide relief protection.

The producing plant operators are supposed to tell the storage operators before they move any product.

The storage operators are supposed to measure the level in the tank before and after every movement. As the level indicator was out-of-order this had to be done by dipping.

One day the producing plant operators moved 400 tonnes into the tank without telling the storage area operators.

Next time some product had to be moved into the storage tank the storage area operators did not dip the tank first. They assumed that the level was the same as at the end of the last movement they had recorded.

During the movement the high level alarm on the tank sounded. The storage area supervisor checked the record sheet and decided that the alarm must be faulty. He did nothing. An hour later the tank overflowed.

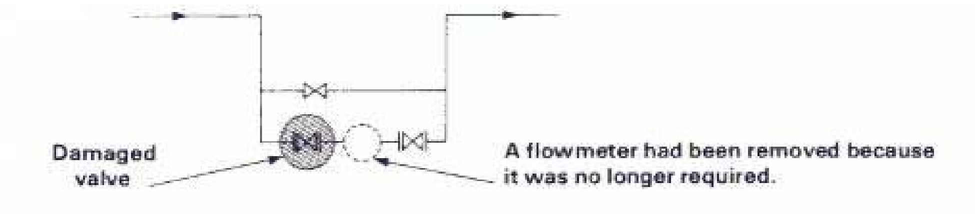
Never **disregard an alarm without checking the job. The alarm might be right.**

Tanks should be isolated between movements (There was a relief valve on the line at the producing plant end, so there was no need to keep it open to the tank).

124/4 THE DANGERS OF DEAD-ENDS

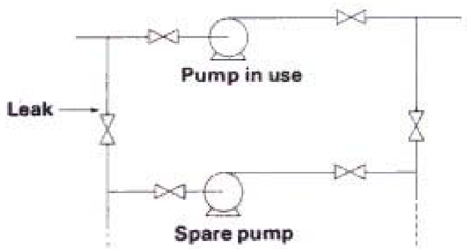
Newsletters 99/5 and 84/2 and Engineers Casebook No 17 described incidents which occurred because water collected in dead-end pipes. Now two other companies have described similar incidents.

1 In the first incident, a flowmeter was no longer required and was removed. Flow continued through the by-pass.



Water collected in one of the dead-ends leading up to the flowmeter, froze during cold weather and damaged the valve, causing a leak.

2 In the second incident corrosion products collected in the branch leading to a spare pump which, in practice, was never used on this duty. The pipe corroded through and a serious fire resulted.



Look out for dead-ends on your plants where water or corrosive materials may collect.

124/5 SCREWED PLUGS IN VALVES

Although they were ordered correctly, in accordance with the British Standard, 700 valves supplied for a recent major project were supplied with unwanted screwed plugs in the gland space. The manufacturers supplied them, although they are not in the standard, because most customers want them. Experience on other plants shows that these plugs are liable to leak and those on critical duties are therefore being welded up.

124/6 SOME QUESTIONS I AM OFTEN ASKED No 38

HAS ALL THE MONEY AND EFFORT PUT INTO TECHNICAL SAFETY IN THE LAST 10 YEARS PRODUCED ANY RESULTS?

Yes, there have been far fewer serious fires and explosions in ICI in the 1970's than in the 1960's and the number of people killed by chemical accidents has fallen sharply. As the figures below show, the number of people killed by mechanical accidents, the sort that could happen in any factory, has also fallen, but not so sharply. Unfortunately, transport accidents have risen.

	No of ICI employees (excluding Nobel Explosives) killed during the period	
	1960-1969	**1970-1978**
Chemical accidents (fires, explosions, contact with toxic or corrosive chemicals or asphyxiation)	33	6
Mechanical accidents (falls of persons, falls of material, contact with machinery, electrocution, steam boilers)	24	13
Transport accidents	15 (including 2 air)	21 (including 11 air)
TOTAL	72	40

Travelling by air (especially air taxis) is now the most dangerous occupation in ICI!

To allow for the fact that there were 10 years in the 1960's but only 9 in the 1970's (so far) and that the number of employees was not the same in the two periods, the figures have been expressed below as Fatal Accident Frequency Rates (FAFR), the number of fatalities in a group of 1 000 men in a working lifetime (100 million hours).

	FAFR	
	1960-1969	**1970-1978**
Chemical accidents	1.65	0.38
Mechanical accidents	1.20	0.82
Transport accidents	0.75	1.32
TOTAL	3.60	2.52

So you see the chemical accidents have fallen. But do not use these figures as a reason to relax. A single incident on one of our large plants could change the whole picture. Constant vigilance is needed to maintain our record.

124/7 A STEP TOWARDS SIMPLER PLANTS

In Newsletter 117/1 and in an article in "The Chemical Engineer" for March 1979, p 161, I pointed out that our usual practice is:

To design a plant

To identify the hazards

To add on protective equipment to control the hazards.

We do not as a rule see if we can remove the hazard by modifying the design. And if we want to, it is often too late.

Increasingly, therefore, hazard and operability studies are being used to identify problems at an early stage in a 'Project when it is still easy to modify the design.

Hazard and operability studies have been described in earlier Newsletters (68/1, 71/8, 91/8 and 96/5). They are a systematic technique for examining a line diagram, line by line, in order to identify things that might go wrong. For example, we ask ourselves if there could be 'more temperature' in the line and what the causes could be; we list the consequences and if these are undesirable we suggest ways of preventing 'more temperature'. And similarly for less temperature, more and less flow, more and less pressure and so on.

It is possible to carry out an operability study on a flowsheet a year or more before the line diagrams are available when changes in design are still easy to make. The following are a few examples of some changes that have been suggested to a plant design as a result of doing so. The plant consists of a batch reactor, followed by a stripping section in which an excess of one reactant is removed under vacuum. The process has been purchased from a contractor.

1 If the reactor is overfilled it overflows into a pot which is fitted with a high level alarm. Why not fit the high level alarm on the reactor and dispense with the pot?

2 What would it cost to design the reactor to withstand the vacuum produced by the stripper, thus avoiding the need for a vacuum relief valve which would allow air to be sucked into the reactor, producing a flammable mixture?

3 Why do we need two filters per reactor? Will a change in type allow us to manage with one.

4 By suitable choice of bottoms pump, can we reduce the height of the stripper above grade and thus reduce the cost of the structure?

5 Can heat exchangers be designed to withstand the maximum pressures that can be developed under all but fire conditions, thus avoiding the need for relief valves?

6 A material proposed for removal of colours may be unsuitable on toxicological grounds.

These are just a selection from the 66 points that came up during three 3-hour meetings. Many of the points would have come up in any case but without a hazard and operability study many might have been missed or might not have come up until it was too late to change the design.

124/8 UNUSUAL ACCIDENTS No 87

An amateur wine-maker put a large cask of carrot wine under his bed and covered it with an electric blanket to keep it at a constant temperature. The blanket sagged, came into contact with the liquid and short-circuited, causing a fire.

The wine-maker, who was 89 years old, had to rescue his artificial leg from the bedroom before walking ¾ mile to the nearest telephone to call the Fire Brigade.

From “Fire ‘~ January 1979, page 384.

124/9 RECENT PUBLICATIONS

(a) The press give the impression that dangerous incidents in the oil and chemical industries are getting bigger and more frequent. To check this we have listed all the incidents we could find since 1970 which have killed 5 or more people. The results, in Safety Note 79/2A, show there has been no change (except that 1978 was a bad year for transport accidents), despite the growth of the oil and chemical industries since 1970.

(b) Newsletters 54/12d, 47/9b and 45/1 described some fires in reciprocating air compressors and the precautions necessary to prevent them. A recent note by 0 Summers-Smith of Agricultural Division describes some fires in oil-flooded rotary air compressors and recommends that they are not used

— as temporary replacements for reciprocating compressors

— in parallel with reciprocating compressors

— in fire hazard areas

(c) Safety Note 79/3 discusses how far we should go in bringing old plants up to modern standards. There is no easy answer but the action taken in a number of cases is described.

For copies of these publications or for more information on any item in this Newsletter please ‘phone Eileen Turner or Carole Johnson (Ext. P.2845) or write to them at Wilton. If you do not see this Newsletter regularly and would like your own copy, please ask them to add your name to the circulation list.

June 1978

An Engineer's Casebook No 24

GASKET CONTACT SURFACES

BS 1560 for steel pipe flanges specifies the machining details for the gasket contact surfaces of the raised flange facings between which the gasket is placed. For all flange ratings of 12 inch nominal size and smaller the gasket contact surfaces shall be finished with a continuous spiral groove generated by a 1/16 inch radius round-nosed tool at a feed of approximately 1/32 inch per revolution. When correctly executed this results in a surface roughness of about 400 µin CLA (centre line average) which is pretty rough. BS 1560 is, however, unsatisfactory in that it does not specify surface roughness in measurable terms and unacceptably wide variations in roughness have been experienced in practice. Specification of flanges to BS 1560 has now been discontinued.

The American Standard B 16.5 — 1977 calls for a finish by a 0.06 inch or larger radius tool at a feed of 24 to 40 grooves per inch. The resultant surface finish shall have a 500 µin (approximately) surface finish. However, to ensure a satisfactory finish for all jointing, Piping Design Section are making use of an exclusion in Clause 6.3.4 and specifying 300-500 µin for Class 1 50 and Class 300 and 125-250 µin for Class 600 and above. 125-250 µin is occasionally specified for Class 300 where the duty is known to be severe and spiral wound gaskets are being used. The above exclusions have been introduced as an interim measure pending issue of the International Standard ISO 2229 currently in its final draft form.

It is probable that the standard finish was originally specified with the almost exclusive use of sheet gasket material such as compressed asbestos fibre (CAF) in mind. Rough finishes dig into the sheet to give a seal and effectively carry the radial pressure load in compression and shear, thereby preventing ejection of part or all the gasket when the pressure is applied. The elasticity of CAF is minimal, perhaps a spring of 0.002 inch with 1/1 6 material.

Joint making with spirally wound gaskets, which are now in general use in Class 300 ratings and above, relies on the metal strip, in chevron form, being in intimate contact with the flange face on each turn so that a 'labrinth' is formed between the inside diameter and the outside diameter. A soft filler such as CAF fills in between the turns to act as a seal and to make the gasket 'springy' when compressed. A typical gasket is compressed from 0.176 inch to 0.125 inch by the bolt load and has a compliance (recovery) or 0.020 to 0.030 inch.

Manufacturers of spiral wound gaskets consider them adequate to seal when properly jointed between standard 'rough' 500 µin CLA flange faces. However, they will seal much better between smoother faces. A figure of four times better has been quoted for a 250 500 µin CLA finish by one manufacturer. The optimum surface finishes have been incorporated into ISO 2229 by the gasket manufacturers and apply to both CAF and spiral wound gaskets.

Where pressures or temperatures are close to the maximum allowed by pressure/temperature rating and/or the fluid is difficult to seal it may be beneficial to specify smoother flange faces than in B 16.5 if spiral wound gaskets are to be used.

The above remarks apply primarily to carbon and low alloy steel flanges. Austenitic steel (18/8) flanges usually have a smoother finish anyway since it is difficult to get a tear free finish at 1/32 inch feed with the specified radius tool.

E H Frank

WHO'S WHO IN SAFETY

No 32 Dr P Waterhouse

Peter Waterhouse was born in Dewsbury and graduated in chemistry from the University of Leeds in 1953. He was awarded a PhD in organic chemistry in 1956.

After working for two years with the Atomic Energy Authority on the synthesis of C^{14}, Peter joined Agricultural Division, spending six years on fertiliser research. He was a shift manager for a short time then spent three years as a plant manager, most of the time on the Oxygen Plant.

Peter joined Agricultural Division Safety Services Department in 1967 and was Safety Officer on various Works at Billingham before moving to Severnside as the Safety, Fire and Security Officer in 1974. In 1977 Peter was appointed Assistant to the Company Safety Adviser with special responsibility for the human side of safety.

He is a member of the Institution of Industrial Safety Officers, serving both on the Council and the Education and Examination Committee.

Peter's interests are varied and numerous and he prefers active pursuits to passive occupations. His wife teaches chemistry and they have three children.