SAFETY NEWSLETTER

No. 105

IN THIS ISSUE

IMPERIAL CHEMICAL INDUSTRIES LIMITED

PETROCHEMICALS DIVISION

105/1 RUPTURE OF A STEAM MAIN

A crack 12 feet long suddenly occurred in a 22 inch diameter, 250 psig steam main. One man was injured by the escaping steam, fortunately not seriously, and a number of consuming plants were shut down for ten days.

The pipe failure occurred near a desuperheater and was due to a combination of several unsatisfactory features:

(a) The desuperheater design was poor so that sometimes too much water and at other times too little water was injected into the steam. As a result the downstream piping was repeatedly wetted and then dried out by evaporation.

(b) The water, though demineralised, was cold and contained traces of oxygen and dissolved solids.

(c) The longitudinal seam weld in the pipe was in the 6 o'clock position so that water collected in any defects.

These features resulted in a combination of corrosion fatigue and caustic cracking. When the crack reached a critical size it spread suddenly.

The design of the desuperheater has now been changed and hot de-aerated water is used.

When liquid may settle at the bottom of a gas pipe, seam-welded pipe should not be installed with the welds at the bottom.

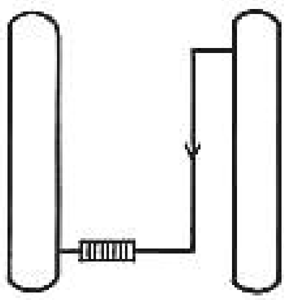
A number of similar cracks had occurred in earlier years but they developed slowly and were noticed when other work was in progress in the area or by the observation of a slight leak and were repaired without inconvenience. However, these earlier cracks had been *circumferential.* The people on the job did not realise that a similar *longitudinal* crack might spread rapidly. Perhaps the experts realised, but if so the information and its significance did not get across to the men on the job.

For further details see Report No PC.21,788/B.

Reminder Newsletters 43/4, 48/2 and 57/1 described failures of steam mains by water hammer.

105/2 A NEAR FAILURE OF A BELLOWS

A large distillation column is made in two halves. A 42 inch vapour line, containing a bellows, runs from the top of one half to the bottom of the other



During a shut-down this line was steamed out. Immediately afterwards it was noticed that one end of the bellows was 7 inches higher than the other although it was designed for a maximum deflection of ± 3 inches.

Investigation showed that during normal operation the end-to-end deflection is 1 inch. The design contractor had not calculated the deflection during other modes of operation and had supplied a bellows suitable for normal operation only. In fact the deflection reaches a maximum of 6.5 inches during start-up and 5 inches during a steam-out. The movement takes place very quickly, in 15-30 seconds, as the hot vapours or steam displace the cold nitrogen.

Neither the construction team nor the inspection team had picked up the fact that the bellows was not designed for these conditions.

The bellows has now been replaced by one with more tolerance. However, if the designer had recognised the need for so much deflection, he could have pre-set one end of the bellows down by 3 inches and this would have allowed 6 inches movement.

The report on the incident recommends:

1. All modes of plant operation, including transient conditions occurring during start-up and shut-down, should be identified and any bellows in the system designed for all conditions.

2. All bellows and their supports should be checked in detail at acceptance and commissioning and should be scheduled for regular inspection.

As stated in earlier Newsletters (71/2, 74/1 and 103, page 7) bellows have only limited tolerance for errors in design and installation and whenever possible their use should be avoided on new plants by building flexibility into the piping.

105/3 HOW A TANKER WAS OVERFILLED - THE NEED FOR A GOOD HANDOVER

A road tanker was filled during the night. A “filling certificate” — a very small piece of paper — was completed by the operator who slipped it into the set of despatch papers — the usual practice.

By the end of the shift the driver had not returned to collect the tanker. The morning shift operator was not sure whether or not the tanker had been filled as the record sheets had all been sent to the records office and he could not find a “filling certificate”. He shook the despatch papers but no certificate fell out. (It was caught up in the other papers). He therefore started to fill the tanker.

It overflowed.

This incident shows the need for a good handover between shifts.

What is it like on your plant?

105/4 IS IT SAFE TO STAND ON EQUIPMENT?

Many years ago I was one of a group involved in the development of analysis instruments, some of which were intended for use on the plant. We developed a simple rule of thumb. If the instrument had to go on the plant, then it had to be strong enough to withstand someone standing on it.

I was reminded of this when I read in a report that an electrical junction box was positioned so that it became a convenient foothold for access to other equipment. Finally it moved, a short circuit occurred and the man who was standing on it was thrown backwards with his overalls scorched.

The box has now been moved to a more protected position.

We should not, of course, assume that it is safe to stand on all equipment, but, at the same time, we should be on the look-out for pieces of equipment which are so located that there is a temptation to stand on them. If we find any we should either move them or protect them — unless, of course, we are sure they can be used as footholds.

105/5 A LOOK BACK AT NEWSLETTER 5

Relief valves are usually well maintained but some companies pay less attention to open vents, although they are a sort of relief valve.

Newsletter 5 (November 1968) described two incidents which occurred because open vents were not treated with the same care as a relief valve.

In the first incident a tank was sucked in because the flame arrestors in all three vents were choked with dirt. They were scheduled for yearly inspection but, because of pressure of work, had not been looked at for 2½ years.

The second incident was more serious. A tank contained a solid of melting point 97°C, kept liquid by a steam coil. The vent was choked with solid. When the inlet line was blown with compressed air to prove it was clear — the usual procedure before filling it — the end of the tank was blown off, killing two men who were working nearby. There is a fuller account of the incident in Newsletter 93.

Newsletter 5 also described an explosion in a centrifuge — in another company — which killed two men. The centrifuge handled flammable solvents and was blanketed with nitrogen to keep out the air. During maintenance a cover plate was removed and not replaced and the nitrogen supply was then not sufficient to prevent air entering the top of the centrifuge.

The incident shows that on tanks, stacks, centrifuges and any other equipment which is blanketed with nitrogen, it is necessary to carry out regular checks to make sure that the oxygen content is at a safe level.

Finally, Newsletter 5 suggested that items in the Safety Newsletters might be discussed at section meetings.

105/6 OTHER MEN'S VIEWS No 4

In Newsletter 71/9 I suggested that safety officers (and other advisers) should not merely supply information or display alternatives but should state clearly what they think should be done. In "The Contribution of the Expert to Disasters" J E Bannister puts forward a different view.

"… the tendency has grown in recent years for reliance to be placed on individual or small groups of experts, frequently from the same discipline, to provide us with guidance on what is essentially a multidisciplinary problem. It would be too facile to blame the experts for their situation; we also need to point a finger at those managements who are too ready to delegate their responsibility for effective decision taking. Instead of balancing all the factors on the best possible information available to them, such management relay on reports presented by experts, and see their own role as the relatively narrow one of accepting or rejecting such a report."

"It is my view that the development of such narrow thinking has directly contributed to a number of disastrous errors in various fields. One might illustrate the social failures of high-rise flats, the building failures associated with the use of high alumina cement, failures in individual makes of motor cars that have led to mass recall, or the series of events that have led to some of the world's most serious air disasters.

In each of these cases the expert has his way and catastrophe ensued. In each of these cases we see an arbitrary exercise of power by the expert and a reluctance of those who should properly be making the decisions to exercise balanced judgement."

From "Foresight — The Journal of Risk Management'~ September 1977, Vol III, No 3, p 15 and "Risk Analysis: Industry, Government and Society' TNO, The Hague, 1977, p 81.

Some accidents are due to a failure to ask for expert advice, Flixborough for example.

Reliance on experts is inevitable but they should not spend all their time in the back-room; they should spend some time mixing with the people they advise. The expert who designs instruments will then realise (see 105/4) that, on the plant, someone will stand on them; the expert who designs bridges (see Newsletter 62/1 on the collapse of the Yarra Bridge) will then realise that construction teams sometimes force together components that have been badly made and do not fit.

105/7 UNUSUAL ACCIDENTS No 72

Many years ago at Billingham there was a story about a manager who had a reputation for eccentricity. There were some beetles in his kitchen so he collected them in a vacuum cleaner. Realising that they were probably still alive in the bag of the cleaner, he decided to poison them with town gas — it was before the days of non-toxic natural gas. He put the end of the cleaner in the oven, turned on the gas without lighting it, and switched on the vacuum cleaner. The gas was sucked into the vacuum cleaner and exploded, covering the walls of the kitchen with the remains of the beetles except where the manager's shadow could be seen outlined.

I cannot vouch for the truth of this story, but I was reminded of it when I read the following.

An operator cleaned the inside of a cabinet with a rag soaked in acetone. He then placed the end of a non-flameproof vacuum cleaner in the cabinet and switched it on. Flames 4 feet long came out of the other end of the cleaner.

As stated before in these Newsletters, when possible, use a non-flammable solvent such as Genklene.

105/8 A COLD-WEATHER HAZARD

In one Works in the Division a low temperature alarm, set at -4° C, detects a flow of cold gas into a pipeline leading to a stack.

In the UK the temperature in a plant area does not often get as cold as this but one day last winter, during an unusually cold spell, the alarm came in and stayed in. When a leak occurred the operators had no warning and the leak continued until the gas was smelt coming out of the stack.

105/9 OUR RECENT PUBLICATIONS

(a) "What Risks Should we Run?", from the New Scientist, 12 May 1 977.

(b) "Evaluate Risk in Plant Design", from Hydrocarbon Processing, May 1 977.

(c) "Protect Pressure Vessels Against Fire", from Hydrocarbon Processing, August 1 977.

(d) "Accidents that Will Occur During the Coming Year", from Loss Prevention, Volume 1 0.

For copies of these 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.

November 1977

An Engineer's Casebook No 5- SPM

SPM - Safe Production Methods, or perhaps Scientific Principles of Maintenance, both equally commendable. However, in this case, SPM stands for Shock Pulse Measurement.

What is it? It is a simple means of determining, on line, the condition of a rolling element bearing. The principle of operation is based on the transmission of shock waves through the bearing housing, the waves emanating from minute damage on the contacting surfaces. Damage to the races, cages or rolling elements themselves arises from pitting or debris produced after a period of properly lubricated operation, by under-lubricated operation, infiltration of dirt particles etc.

A transducer attached to the machine by a special sensor stud screwed into a bearing housing, or clamped to a bearing housing using a modified pair of plier grips, is used to pick up the shock wave. The transducer is tuned mechanically and electrically to have a resonant frequency of 32 kHz. The shock waves set up a dampened oscillation in the transducer at the resonant frequency. The peak amplitude of this oscillation is related to the magnitude of the shock wave and is consequently a measure of the condition of the bearing.

The transducer signals are processed in a shock pulse meter which gives a scale reading of shock value. A nonogram is provided to relate this value to the bearing condition. Alternatively the range readings indicating good condition, damage likely and bearing damaged are well-established.

All rolling contact bearings contain minor imperfections which result in a background shock value reading at a low level for a new healthy bearing. SPM is used to monitor this level and to detect the onset of incipient damage. There has, of course, to be some increase in shock wave production by way of trampling more debris before SPM can alert a potential problem and it might, by then, be said that the 'writing is on the wall'. The equipment is not therefore truly preventive. It does however have considerable merit in detecting deterioration at an early stage so that replacement work can be planned before enforced outage and possible consequential damage ensues. The manufacturers claim that the read-out can be interpreted to indicate defects or malfunctions other than deterioration of bearings by displaying the output on a cathode ray tube or graphically. It should not however be considered as a substitute for conventional vibration monitoring equipment.

SPM equipment has been used by Organics Division for some years and a useful paper describing the equipment together with some actual case histories has been written by two of their Engineers. Copies can be obtained from Miss S M Collins (ext. P.2665) in Petrochemicals Division HQ.

E. H. Frank

WHO'S WHO IN SAFETY

No 19- DW HIMSWORTH and No 20- G HOLMES

This month we introduce two of the Wilton Site Shift Fire Officers. Each of them has charge of a team of 8 Fire Service personnel.

Bill Himsworth served in the Royal Navy during the war and joined ICI in 1957 after some time with the Local Authority Fire Brigade. He was promoted to Shift Fire Officer in November 1968. He tells us his hobbies are reading, listening to light music and "doing as little as possible". He is married with one daughter who recently obtained a BSc in biochemistry.

George Holmes joined ICI in 1955 after three years in the Middle East with the Royal Engineers and was a fireman at Wilton for fourteen years before being promoted to Shift Fire Officer in December 1969. His hobbies include collecting stamps, particularly first day issues, and dancing. He is married with four sons.