SAFETY NEWSLETTER

No. 166
BOOBY TRAPS

IMPERIAL CHEMICAL INDUSTRIES LIMITED

PETROCHEMICALS DIVISION

166/1 BUILT IN FAULTS

Conditions on construction sites are often far from ideal. It is not easy to give that careful attention to detail which is so very necessary if modern sophisticated chemical plants are to be built as the designers intended them to be. The weather always appears to be inclement and weather protection inadequate. Labels and identification marks on equipment get lost or erased. Mud gets everywhere. Drawings get dirty and the detail obscured. It is not surprising that mistakes are made and that some lie undetected even by exhaustive checks during the commissioning period.

Moreover, after delays at all the earlier stages, the construction and commissioning teams are under considerable pressure to make up for lost time. If a short length of pipe or a small fitting cannot be found then another may be substituted to ‘get the job away’. The substitute may last for some time but nevertheless fail prematurely and unexpectedly when the plant is on line.

These built-in faults often lie undetected until they reveal themselves, sometimes with very unhappy results. Here are some examples. It will help you to understand them if you try to draw simple sketches or diagrams to illustrate them!

166/2 PNEUMERCATORS WRONGLY INSTALLED

Pneumercator level indicators were installed on a group of product storage tanks on a new plant. The product was an extremely caustic aqueous solution of an amine which could rapidly discolour in air. Worse still it could absorb carbon dioxide and cause solid to be deposited in instrument impulse lines, vent pipes and the like. So it was decided to store the product under a small positive pressure of nitrogen and a nitrogen purge line was connected to the vapour space, near the top of each of the tanks.

Unfortunately the balance lines on the pneumercators were left open to atmosphere instead of being connected into the same vapour spaces. All the instruments gave wrong readings. Over many months there were fruitless searches for chokes, leaks and other typical faults because there were discrepancies in the materials transfers as the tanks were filled and emptied.

Then some additional tanks were correctly installed nearby. An observant new junior technical assistant noticed that the new pneumercators had been installed differently and asked for the reason!

Fortunately the discrepancies had been fairly small and there had been no accidents. However a lot of time and effort had been needlessly wasted — and there had been a lot of unnecessary worry.

166/3 AN IDENTITY PARADE PICKS OUT THREE ROGUES

A plant had twenty separate furnaces and each was connected by a T-piece and branch line to a ring main. The ring main supplied hot boiler feed water at a pressure of about 1000 psi. To reduce the possibility of leaks occurring and forcing an expensive shut-down there were no flanged joints and scarcely any isolation valves in the system.

After the plant had been in service for four years or so, and just after its second major overhaul, the plant personnel were dismayed to see a very severe leak at one of the T-pieces. Because of the escaping water and the clouds of steam close inspection was difficult. However, it was discovered that the faulty T-piece and two others had been fabricated by welding together short lengths of pipe. The other 17 branches had forged T-pieces which showed no sign of deterioration. Presumably, three T-pieces had been lost and in order to ‘get the plant away’ three inadequate substitutes had been fabricated.

It may sometimes be necessary to do similar things, but a careful record should be kept. Then, at the first opportunity (and in this case there had been at least two) the substitute should itself be replaced by an item made to the proper specification.

A split box with a drain valve was fabricated. With the valve open and positioned so as to direct the flow of water away from the welder, the two parts of the box were welded to the pipes and to each other so as to enclose the T-piece. The drain valve was then closed and the box, in effect, became a new T-piece. At the very next shut-down the offending T-piece and its box and two other faulty T-pieces were removed.

166/4 CROSSED CONNECTIONS

An electrical technician carrying out planned maintenance on one of two import pumps, installed in close proximity to each other, narrowly escaped severe electric shock. It was discovered that the cable to the anti-condensation heater of the pump under maintenance was live, although the proper electric isolation procedure for the pump had apparently been carried out. All fuses had been removed, the starter isolator had been locked off and cables checked at the starter button and motor; the motor terminal box lid was removed and terminals checked for supply voltage using a voltmeter.

The operating philosophy on the import pumps is that when the pump is in operation the corresponding anti-condensation heater is automatically switched off.

At the commencement of the planned maintenance, a road tanker was unloading through the adjacent import pump. In consequence the anti-condensation heater for that pump was supposedly switched off.

At the point in the planned maintenance programme when the technician was re-connecting the cable for the anti-condensation heater for his pump at the terminal box, the pumping operation on the adjacent pump stopped. The cables being handled by the electrical technician became live and on test the cable was found to have 240v present.

It was subsequently discovered that the person responsible for the installation of the pumps had erroneously connected the power for the anti-condensation heaters to the wrong pumps. Thereafter to completely isolate pump A the anti-condensation heater supply labelled for pump B had to be isolated and vice versa. No one had noticed until the particular circumstances at the time of this incident revealed the error.

Fortunately the electrical technician was handling the cable and did not have contact with the copper conductors otherwise he would have received full mains voltage through his body.

The fault has been rectified and the entire electrical installation at the Tank Farm re-commissioned.

166/5 A CASE OF CONSTIPATION

Two identical rotary vacuum filters were installed on a plant side by side and connected by similar pipework to other equipment. The flow of slurry to each filter was controlled by a separate hand operated control valve. The liquor overflows were connected to separate stainless steel braided flexible connections lined with plastic tubes.

One day a filter had been shut-down and the other immediately brought on line at the same rate. The flow into the second filter proved to be too high for the overflow to cope with. Liquor escaped down the solids discharge chute into the dryer below. The liquor contained some nitric acid and nitrous fumes were immediately released. The unit was shut down and a nasty accident narrowly avoided.

The investigation then revealed

1) that it had never been possible to run the second filter at the same high rate as the first. The reason had never been understood.

2) the flexible connection in the overflow of the second filter was found to be completely choked. The plastic liner had broken and solids had lodged in the hole. They had gradually forced the lining away from the braided wall until the blockage was complete.

3) the plastic lining had probably been damaged during construction.

4) the lining was not PTFE, as it should have been, but was a quite different plastic.

Reasons for differences in behaviour between ostensibly similar items should be investigated, identified and cured. They should not be allowed to become part of the plant mythology.

166/6 PUT HOLES WHERE THEY SHOULD BE

In a new installation in a new company, water was stored in a large atmospheric tank. The level was detected by a float suspended inside a vertical tube stretching from the top of the tank to the bottom.

One day the tank overflowed and the top came oft, although the level indicator showed the tank to be less than full.

To make sure the water level inside the tube was the same as that in the rest of the tank, the designer had asked for holes along its length.

When the tank was inspected after failure, there were no holes found in the top part of the tube. The manufacturer had forgotten to drill them, subsequently no one had spotted the error.

As the water level in the tank rose, the air inside the tube was compressed and so prevented the water rising as freely as that in the rest of the tank. The level indicated was therefore false.

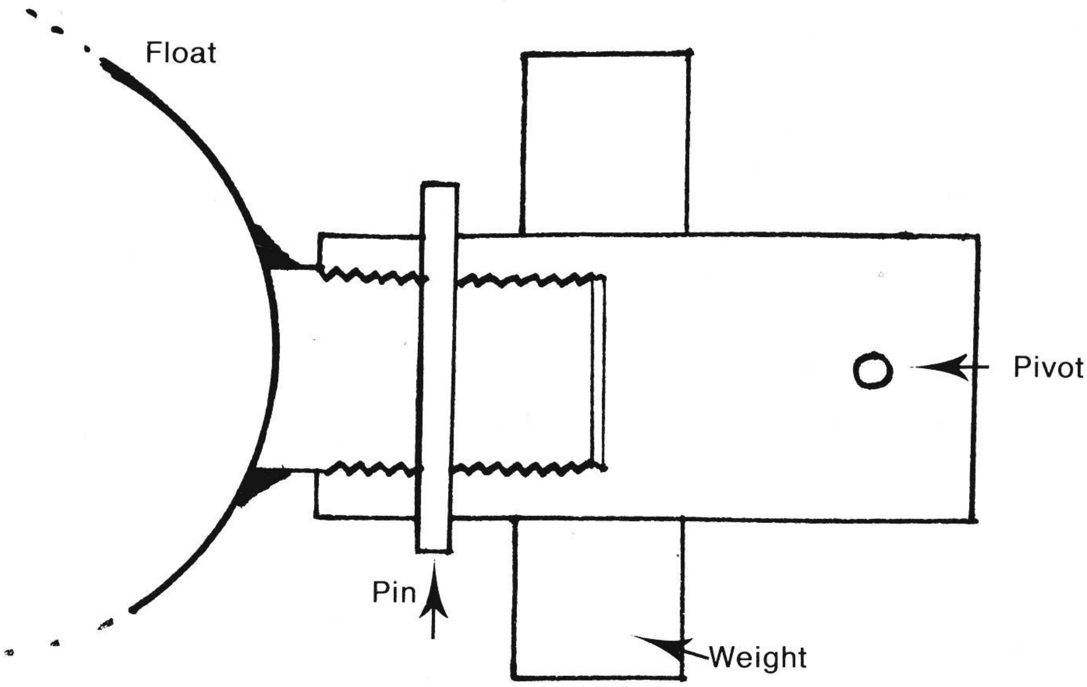
In the inquiry following the failure many people expressed surprise.

‘It’s only a water tank’, they said. ‘Why should it fail?’

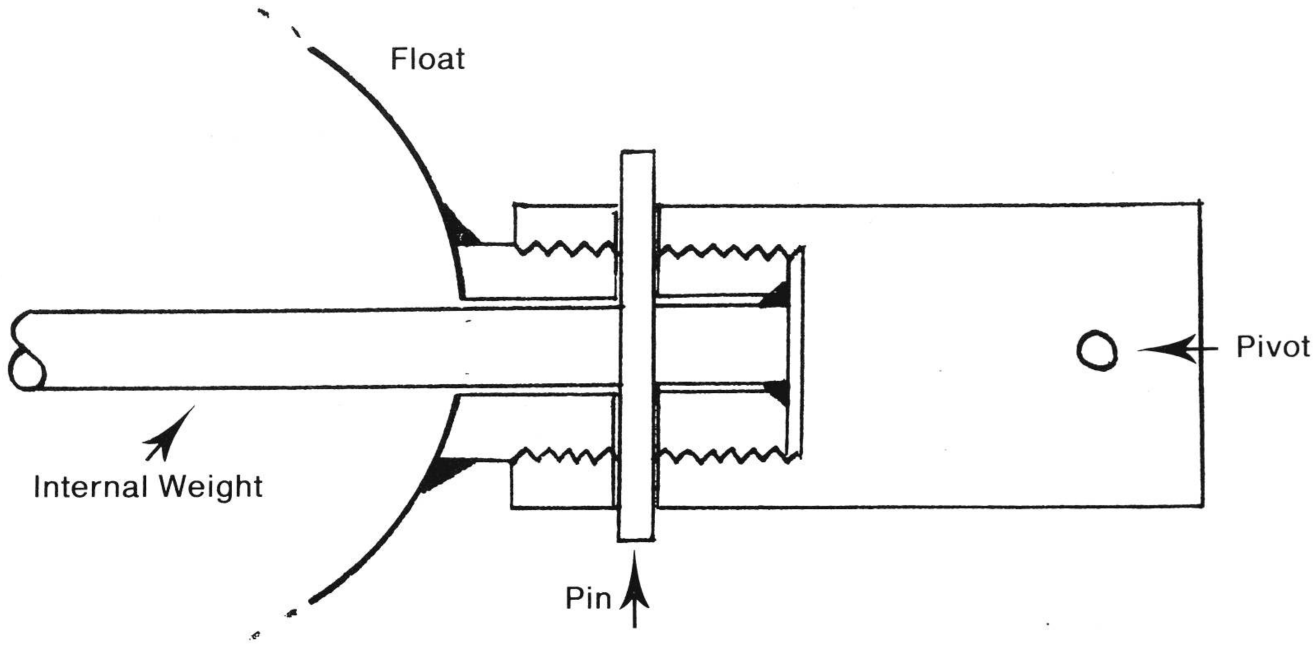
Just because water seems harmless, does not mean that we should not take the same care in constructing and operating the tanks we store it in as with any other process material.

166/7 — AND DO NOT PUT HOLES WHERE THEY SHOULD NOT BE

Originally, the float for a liquid level instrument was made like this:



After some time, the design was altered to put the balance weight inside the float



Several new level instruments were needed for a high pressure brine installation.

When put into the plant and tested, they all registered incorrect level. The instruments were removed and the floats taken out while the cause of failure was probed.

After a while it was noticed that an encrustation of salt was building up round the securing pins. When the floats were completely dismantled brine came out from inside.

It was then realised that although the ends of the new weights had been sealed, small gaps had been formed between the pins and their holes. Brine seeping down these had entered the floats and caused false readings.

When the design was altered, the manufacturer had not altered the ordering code so no one on the plant was alerted to the change and the need to check.

Many incidents in these Newsletters have been caused by failure to see the effects of design or operating changes.

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.

April 1983

Engineer's Casebook No 66
RECOGNISING AND REPAIRING DEFECTIVE CONCRETE

The Plant Engineer's reaction to the humble medium of concrete in chemical plants seems to vary according to whether or not he has constructed a garden path. The one who has, considers himself an expert in the matter of mixing cement, water and aggregates. The one who has not, never gives concrete a thought. An exaggeration perhaps, but it would be fair to say that concrete is probably not accorded the care and attention it deserves if it is to fulfil its function of supporting equipment safely throughout the life of a plant.

Concrete is a complex medium and few people would claim to understand its behaviour fully. But for the Plant Engineer with many other matters to concern him a few symptoms of trouble should be looked for:-

i Cracking

Cracks can arise from overload in bending or shear, differential temperature stress, drying shrinkage or corrosive expansion of embedded metal. Some hairline cracking of concrete is quite normal and acceptable. However, cracks over 0.5 mm in width often signal trouble and may need attention.

ii Spalling

The loss of lumps of concrete from a member, usually from corners, may arise as a result of mechanical damage, corrosive expansion of reinforcing steel, compressive overload or chemical attack within the concrete. If left unattended serious deterioration of the reinforcing steel can result leading to, at best, a difficult and expensive repair job, at worst, a failure.

iii Pitting

General roughening of the concrete surface and exposure of the coarse aggregate is usually associated with chemical attack or excessive wear or a combination of both. Frost can cause similar damage to concrete in paved areas and in exposed locations general weathering can cause problems.

iv Staining

Rust staining sometimes appears on the outside faces of concrete members; particularly on beam slab soffits. This is usually due to embedded metal being too close to the concrete surface. If this is simply due to tying wire that has not been cleaned out of the shutter before concreting then the outcome is unsightly but not serious. However, if staining is arising because of the corrosion of reinforcement that has inadequate concrete cover then the consequences can be significant.

In marine and tidal environments, all these problems can be exacerbated by the damp, salt-laden atmosphere, by alternate wetting and drying and by wave action.

Having identified a problem the repair method is not always obvious. For instance, some types of cracking can be effectively sealed by the injection of cementaceous or synthetic grouts but cracks arising from fluctuating temperature differentials would probably recur if rigidly grouted. In such cases a flexible sealant is perhaps more appropriate. Similarly, a surface patch repair to a chemically eroded surface would last only a very short time unless carefully executed. Identification of the cause is of prime importance in deciding on the repair method and this may require skilled investigation. Having found the cause an appropriate repair method can be chosen and a detailed specification prepared for the required materials, surface preparation, application and curing.

The necessary skills to identify the cause of the more common concrete problems are available in Engineering Department through Civil Group and Materials Group and in the more complex cases they obtain specialist assistance for concrete investigation, testing and diagnosis, If problems can be spotted early and appropriate action taken then failures or expensive repairs can be avoided.

M J WADE

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