SAFETY NEWSLETTER

No. 162
MATERIALS, EQUIPMENT AND PEOPLE

An Engineer's Casebook — No 62
Safe Drilling

IMPERIAL CHEMICAL INDUSTRIES LIMITED

PETROCHEMICALS DIVISION

162/1 ITS ONLY PRESENT AS A TRACE, SO IT DOESN'T MATTER... OR DOES IT?

In many of our processes, a refining stage removes the impurities known to be present and these are disposed of in the effluent or collected as a by-product. But what about the impurities we don't know about, either coming in with raw materials or generated in the process and not removed?

In an incident involving one of our products, minute traces of a nickel catalyst passed a defective guard filter and were collected with the crude product which was later distilled. It was expected that the catalyst traces would be removed in the column bottoms stream. However, the boiler contents foamed badly and particles of nickel were deposited on the upper surfaces of the boiler. When it was opened up, the incoming air reacted with the nickel which was pyrophoric and became hot, igniting the residual solvent in the vessel. Flames emitted from the inspection port gave the operator a nasty fright!

The Institution of Chemical Engineers' Loss Prevention Bulletin 003 gave details of similar cases where incidents have been caused by the presence of impurities.

We must be on our guard for:

1 Traces of catalyst 'lost' in the process.

2 The effect of water in various stages of the process.

3 The build-up of traces of a by-product in the plant — eg in a distillation column.

4 The effect of trace impurities upon corrosion rates — eg chloride on stainless steel giving rise to stress corrosion cracking.

5 The effect of corrosion products — eg Iron, Chromium, Nickel on the process.

6 The effect of chromate from treated cooling water in the event of a tube leak on an exchanger.

These are just a few examples. Readers may like to let us know of further examples which could form the basis of a check list.

162/2 HOW WELL DO YOU KNOW YOUR PRODUCT?

At an Open Day a plant operator showed his son round the plant in which he worked. He pointed out the reactor in which the crude product was made and then the pipelines carrying it to the distillation section and then transferring it to the final storage tank. "Yes dad", said the boy, "but what does it look like?" "I don't know" said the father, "I've never seen it"!

How well do you know your product? Is it affected by water or heat? Does it react violently with any other products handled on your plant or on the Works? Another company recently had a nasty shock... and they thought they understood their product!

The product in question was known to be subject to thermal decomposition with the formation of heat and the production of gaseous products of decomposition. Laboratory tests on the pure product had indicated that the temperature at which significant thermal decomposition occurred was higher than the maximum temperature likely to occur in the drying stage of the process, which operated under vacuum, and was carefully temperature controlled. In spite of these precautions and the test work carried out, a drying vessel exploded. What had gone wrong?

Further testing showed that the presence of alcohol and water in the feed to the dryer resulted in an initiation temperature about 100°C lower than that for the pure product! Furthermore, the initial mixture gave a decomposition rate much higher than that measured for the pure material. The production of heat resulted in the sudden generation of a large quantity of vapour by evaporation of the alcohol and water present. This greatly overloaded the vacuum system and exceeded the relief capacity of the vessel which then exploded.

Ensure that any tests of this nature are carried out to simulate the plant conditions as closely as possible and use the quality of material likely to be present in the process.

Incidentally, there are Hazards Data Sheets for nearly all our raw materials, intermediates and products. You should be familiar with those for your plant.

162/3 BURSTING DISCS THAT DON'T!

A recent report records yet another incident caused by the failure of a bursting disc protection device with the result that a vessel was overpressured and exploded.

There are a number of types of bursting disc, but the one in question was the "reverse-acting" type, called a rupture disc rather than a bursting disc because of the way in which it operates. This unit has a domed shape facing the process pressure and when it operates, the excess pressure pushes the dome so that it flips over onto a point and a crossed knife-edge which cuts the disc in a petal fashion.

The failure mentioned above occurred because the disc had, some time previously, suffered "roll-through", which is a term used to describe a mode of reversal where there is insufficient energy available for the disc to be cut. The metal disc then rests on the knife edge without rupturing or with only partial rupture. This can occur under certain hydraulic conditions if the vessel becomes completely filled with liquid, particularly liquid with high viscosity, or for mechanical reasons if the point or knife edges are damaged, blunt or very rusty. It has been reported that in a "roll-through" condition the disc can withstand between 4-5 times the designed rupture pressure.

For further information, see the Institution of Chemical Engineers' Loss Prevention Bulletins Nos 023 and 045.

The reverse acting rupture disc is a particularly useful device used in conjunction with a relief valve when it is considered desirable to protect the relief valve from a corrosive product. It can function continuously at up to 90% of its rated burst pressure and has a good resistance to fatigue by pressure cycling. In order to check its integrity when used in conjunction with a relief valve, a pressure gauge should be fitted to monitor the pressure of the interspace. Alternatively, a pressure switch can be fitted together with an alarm which will show if the disc begins to leak.

In order to function properly, the disc must be installed correctly and the right way round. Some good advice on fitting these disc holders and tagging are covered in An Engineer's Casebook No 19 (Safety Newsletter No 119).

The reverse-acting rupture disc can also be manufactured as a scored type without the use of a cutting edge. This type opens up to permit full bore flow by splitting evenly along the score-lines. The unit has been proved to burst at a pressure not exceeding 1.33 of its normal burst pressure which means that the safety device will always function before the hydraulic test pressure of the vessel it protects is reached.

An alternative design of bursting disc which doesn't rely upon a point or knife blade for opening is the composite disc which, as the name implies is made of a number of layers. The downstream side of the disc is scored and on bursting opens up in a petal form. The disc can also be provided with a vacuum support.

Bursting discs can be subjected to metal fatigue, creep and corrosion, so it is recommended that new discs are fitted at regular intervals even if the old unit looks alright.

162/4 SEARCHING FOR CAUSES

More and more attention is being paid to the effects of chemicals on health. Sometimes the effects are delayed, possibly for years, though a delay of several hours is more common. A correspondent has sent me a brief account of such an incident involving oxides of nitrogen.

An operator noticed the smell of oxides of nitrogen during a plant patrol and reported it. Another man set out to find the cause. He found signs of a leak near the top cover flange of a vessel. In searching, he went far too close to the source without wearing any breathing apparatus. A few hours later this man developed the symptoms of poisoning and was detained in hospital for ten days suffering from oedema of the lungs.

All too often people looking for a fault fail to realise that when doing so they can be more at risk than when they are carrying out the more frequent usual tasks of plant operation and maintenance.

Some other examples which have caused nasty accidents in the past are:

a Examining a leaking mechanical seal on a pump. Occasionally pump seals fail catastrophically and anyone standing near can be badly sprayed with the liquid being pumped.

b Removing lagging to find the source of a leak. Disturbing the lagging removed the last protection covering a large hole from which a jet of steam emerged.

c A man climbed a ladder to examine a leaking flanged joint more closely. He didn't wear breathing apparatus, was overcome by the fumes and fell off the ladder.

162/5 BOUNDARY PROBLEMS: STAND BY TO REPEL BOARDERS

A contractor's men were digging a trench for a new water pipeline running along the boundary of one of the Company's sites. They did not apply for a permit to work, they were only just encroaching on our land and either simply didn't think or didn't think that permission was necessary. They were not to know, and no one told them, that there was an 11kV electric cable very close to their excavation.

Eventually the workmen were seen by a patrolman and an ICI engineer stopped the work until the safety precautions had been explained to all concerned and a permit issued. Even then, close supervision was necessary because the men concerned seemed to believe that an electric cable was 'just one of those things' and that cutting it would be an act of God, or, on Friday 13th, an act of the devil.

We apply tight standards of control in our plants but may be tempted to ease off on the boundaries. This is a useful reminder that we shouldn't.

It is important to brief strangers fully on the hazards of the job — we should not assume that they have our standards or procedures for safe working.

Even having briefed them, it is important to monitor their performance.

If this sounds like an indictment of contractors, it isn't. We do have to remember that they have a different background.

162/6 DOTTING I s AND CROSSING t s
CORRECTIONS TO ITEM "WHO'S WHO IN SAFETY" - ISSUE NO 160

There were one or two printer's errors which we failed to pick up in the above Newsletter item. These have caused some difficulties for would-be users of the system and we apologise for any irritation caused. The important corrections are as follows and we ask you to amend your copy accordingly.

1 The telephone dialling code at the bottom of page 6 should be 0606.

2 The logging command on the second line of page 7 should read ZAIB.

3 The print-out command on the second line of page 8 should read T1Ø/2/ø1-Ø4

We are grateful for the comments and suggestions received from readers and these will be taken account of in a Safety Note giving a much fuller description of the IRIS facility. This note is almost ready for issue to known interested readers within the Company (IRIS is not available for use outside the Company).

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.

August 1982

An Engineers Casebook No 62
SAFE DRILLING

Everyone involved in engineering work drills holes at some time. The use of drilling machines and twist drills is so common that it is easy to forget some of the basic safety rules. The consequences can be serious. Recently an assistant lost an eye in a drilling accident, and in the past there have been accidents causing fractures or even amputation of fingers.

Some basic safety rules are listed below. We should make sure that everyone who might use a drill understands these rules. You could display them alongside your drilling machine.

SAFETY IN THE USE OF DRILLS

1 Accurately mark out and punch hole centre. For holes above about 25 mm diameter you will need a pilot hole. The pilot should have a diameter equal to the web thickness of the main drill.

2 Make sure that the drilling machine has a guard or instant stop device. When drilling have the guard in position or the instant stop device probe extended down to the work area. Note that these guards are to prevent you getting entangled with the rotating drill, not to prevent flying swarf.

3 Clamp the workpiece to the table. Use a vice to hold small items, and clamp the vice if necessary. If large or awkward shaped items are difficult to clamp, at least use a stop to prevent rotation of the workpiece.

4 Select a suitable twist drill. Check its condition; it should be free from chips or cracks and the cutting edge should be sharp. The drill point must be central, and the lip angle and lip clearance must be correct, see illustration.

Drill grinding is a precision job and attempts to grind a drill held by hand are unlikely to give satisfactory results, except for touching up a dull edge. Special drill grinding machines are available, for example in Central Workshops, and these should be used for all grinding of drills.

5 Check drill and spindle tapers for cleanliness. Fit drill into spindle and tap home with soft material. Rotate spindle to check drill runs true.

6 Switch on power. Select speed, as a guide use 100 ft/min on mild steel and 45 ft/min on stainless steel. Check direction of rotation.

7 Position screens if necessary to prevent hazards to others due to flying swarf. Wear appropriate eye protection (generally goggles) and ensure that anyone else helping you or just standing in the vicinity also wears eye protection. Take care not to get loose clothing or long hair caught in the revolving drill and spindle. Do not wear gloves while drilling because they can get caught in a revolving drill.

8 While drilling try to keep a steady feed. Rubbing of drills on metal dulls the cutting edge and can cause hardening of the surface being cut. Use coolant or lubricant. Ensure swarf does not form into long streamers by breaking cut occasionally. Do not attempt to clear swarf by hand from around revolving drill.

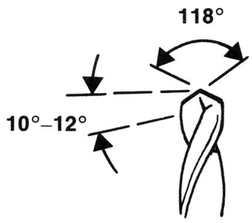
9 When job is finished switch off power. Remove drill carefully; do not let it drop onto a hard surface. Clear away swarf etc. Remove sharp edges from hole.

P W Bellamy

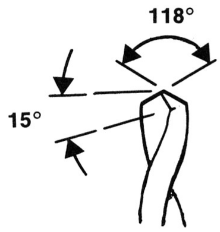
I D Pearce

August 1982

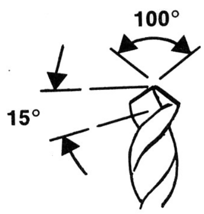
RECOMMENDED CUTTING ANGLES



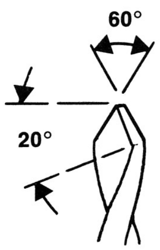
Point lip angle for mild steel on a drill having a standard helix.



Point lip angle for brass phosphor-bronze and gunmetal on a slow helix drill (ie small rake angle).



Point lip angle for aluminum and light alloys on a quick helix drill (ie large rake angle).



Point lip angle for plastics on a slow helix drill (ie small rake angle)

TWIST DRILL GEOMETRY