No 167

# Safety NEWSLETTER



An Engineer's Casebook No. 67:-
**Acid Pickling For Plate Heat Exchangers**

In this Issue
**Human Ingenuity**

ICI
Imperial Chemical Industries PLC
Petrochemicals and Plastics Division

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## No Limit

**It is a common saying that there is no limit to human ingenuity and there is plenty of evidence to support it.**

If the chief engineer were to lock himself out of his car, half the engineering department would very quickly produce a selection of gadgets for opening the car and retrieving his keys. I once gave a lift to an apprentice motor mechanic and he passed the time by describing two simple ways of breaking into a well known luxury car that I would have thought impregnable!

Many years ago I was told that cinema projectionists were required to stay in the projection room whenever the projectors were running in case there was a fire. Highly flammable film and carbon arcs were a hazardous combination. In some cases the projectionist was required to stand on a spring loaded platform next to the projector. If he stepped off a cut-out switch would shut down the projector. It did not take the projectionists long to realise that if they placed the fire buckets, filled with sand, on the platform then they could walk out on to the balcony for a smoke!

The same happens in industry. There are few things that cannot be modified, or adapted for an unusual purpose or their original purpose defeated. I make no apology for returning in this issue to this theme. Ingenuity is fine. We could not survive without it. But it must be used with care and a sense of responsibility.

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## A light-weight winter coat

**On a pressurized storage tank, the existing lagging deteriorated and was replaced by a different, lighter insulating material.**

**When the tank was recommissioned, the tank bottom lifted and failed at the welded junction with the wall.**

**Why?**

Originally, the weight of the tank, contents and lagging was greater than the upward thrust calculated from the area of the tank multiplied by the internal pressure. This meant that the net downward force held the tank on its base.

The new insulation was so much lighter than the old, this was no longer true and so the tank lifted up and bent the bottom.

Again a change for the better in one feature led to a change for the worse in another.

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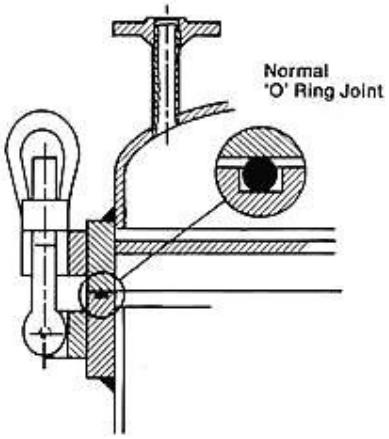
## Another Wrong Joint Ring

In this case the vessel was cylindrical in shape, mounted vertically. It was necessary to open it frequently so the domed top was secured by swing bolts and wing nuts. The joint between the top and the main body was made using a

**A recent failure of a joint ring resulted in a passer-by being sprayed with hot solvents. The wrong type of joint ring had been fitted to the vessel.**




captive ‘O’ ring.

At some time the 'O' ring was replaced by a flat rubber gasket. At first this enabled a seal to be made but over a period of time the solvents in the vessel attacked the gasket and it became very swollen. After being re-used several times a part of the gasket was blown out.

The use of ‘O’ ring joints is fairly common on this sort of duty. The following points should be borne in mind:-

a) Captive ‘O’ rings must be replaced by ‘O’ rings. The type of flange used with them is not designed to grip a flat gasket.

b) The material from which the ring had been made ought to have been carefully chosen for duty with the particular process materials in mind. Different material must not be used for a replacement ring without a satisfactory check on its suitability.

c) All joint rings should be carefully checked to see that they are free from damage of any sort before they are re-used.

Similarly, if the process materials are to be changed for any reason, then check that the material of the joint ring is still suitable. If not, change it for something that is known to be suitable.

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## More puff, less effect

**Several carbon dioxide fire extinguishers were sent to an agent for servicing. Afterwards, they were found to discharge far more rapidly than they had done before servicing.**

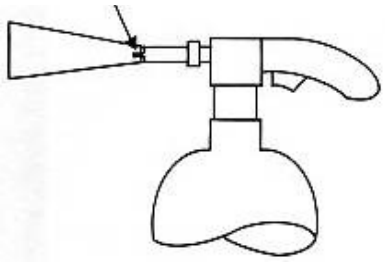
This created a dangerous situation when extinguishing small liquid pool fires during practices. The greater force of the discharge caused liquid to be blown out of a shallow tray, forming a fireball.

Two sizes of extinguisher were involved; each had a small orifice at the base of the discharge horn.

The servicing agent was unable to obtain replacement orifices from the original manufacturer so he obtained some from another supplier. The new ones were more than twice the diameter of the corresponding originals. The complete discharge of the extinguishers took about half the time and jets, which were longer and narrower than originally, did not emit solid particles of carbon dioxide.

Some changes had also been made in other components. Some experiments and further modifications were necessary before a satisfactory situation was restored.

Horn Orifice



Carbon dioxide fire extinguisher

British Standard Specifications give some guidance on discharges. They require that 75% of the contents be discharged in the liquid phase discharge and that this discharge shall last for at least six seconds (2½ lb size) or 9 seconds (10 lb size). Additionally, the extinguisher should be capable of extinguishing a liquid tray fire of a given size. The serviced extinguishers met the first part of the requirements. They only met the second part if extreme care was used in approaching the fuel.

(BS 5306: Part 3: 1980— Fire Extinguishing Installations and Equipment on Premises— Portable Fire Extinguishers. BS 5423: 1977— Portable Fire Extinguishers).

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## Similar name – different animal

**In earlier newsletters I have stressed that, although jargon and abbreviations of various kinds have their uses for close colleagues, proper names should be used when other people and organisations are involved. This is especially true when everyone concerned is dealing with innovations.**

Research staff, managers of semi-technical units and development staff in manufacturing plants are in the business of making changes and modifications. Without them our industry would be a dull routine affair indeed. However they do have a special responsibility to be watchful.

A tanker load of a new raw material was delivered to a Works. It was a mixture to be distilled to separate the main component which had a boiling point of about 120°C. The mixture had been chosen as a suitable source of the component and arrangements had involved the supplier, research department, the production staff and marketing department.

A sample was taken from the tanker and sent to the laboratory for a trial distillation. Without waiting for the results the plant personnel transferred some of the mixture to their batch distillation column. Neither distillation went as expected. As the temperature was increased the expected initial boiling point was passed with no vapour reaching the condenser. Eventually the plant distillation was stopped.

When everyone compared notes it was discovered that the mixture delivered contained a different isomer (a compound with the same molecular weight and chemical analysis but a different molecular structure) than the one isolated during earlier satisfactory trials in another works. In buying the second trial delivery the full chemical name had not been used. The same shortened form was used for both isomers and no one had checked which was required. No one had checked in time that the right one had been received.

Fortunately no damage was caused.

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## He thought he was being helpful

**A pressure-vacuum valve on an atmospheric storage tank was due for inspection and was removed from the tank under the normal clearance procedure.**

The maintenance supervisor on hearing that rain was forecast instructed the fitter to cover the P/V valve branch in order to keep water out of the tank. The fitter used a sheet of plastic and an elastic band.

Some time later, a process operator made a transfer out of an adjacent tank which shared a common suction line and pump with the tank in question. When he returned several minutes later to switch off the pump he found that the tank with the P/V valve removed had collapsed inwards. The suction valve passed in the closed position and product had been pumped out. The tank was only designed to handle a few inches of water gauge vacuum and as there was no vent, the transfer of only a few tons was sufficient to cause the damage.

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## A modification you might like to make

**In Safety Newsletter item 163/1 I described an incident in which a man, not remembering where the nearest safety shower etc., were located, ran to one he did remember on the next floor**

A correspondent has reminded me of a change made some years ago on one of our plants. This change would help people to find safety showers, eye irrigation bottles etc., more quickly in an emergency. The fluorescent tubular strip light over each safety shower was replaced by one giving a green light. Anyone can now quickly spot the green light.

This change was quickly and easily made and has proved to be very effective.

**An Engineer's casebook No 67**
**A. Doyle**

## Acid pickling for plate heat exchangers

**Plate heat exchangers are used quite extensively throughout the chemical Industry. They have various advantages over the conventional shell and the tube type, not the least of which is their ability to be completely stripped down for cleaning.**

The recommended method of assembly of these exchangers is to attach the joint to one side of the plates with an adhesive. However, the removal of these joints and in particular the adhesive can be very difficult. The procedure adopted on one plant involved the use of a highly flammable solvent and took several man days. After this, the plates themselves still had to be cleaned, normally by shot blasting. All in all the exercise took several days, involved several people, used hazardous materials and was very costly.

In a very large Works two fitters with experience of one section of the Works were given the task of cleaning cooler plates on a different section. They were instructed on the method to be used and given all the necessary materials. They quickly realised, however, that the acid pickling baths on another plant, with which they were familiar, could possibly be used to clean the plates in one step. They therefore arranged a trial and installed the dirty plates in the

bath as they were removed from the plant, that is with dirt, sludge, joints and adhesive. The result was very successful, not only did the hot pickle remove all the adhesive, but the plates, after a quick wash with water, were as new. This is now the accepted method for cleaning cooler plates and the fitters involved received a substantial award under the Works' Suggestion Scheme. A long tedious task has been replaced by one which is safer, quicker, cheaper and more effective.

Acid pickling was a favoured method of cleaning in years gone by, superceded in many cases by high pressure water cleaning, which is now much easier and more reliable. However, there are still some cases where acid pickling can be very effective. The system used in this Works uses nitric acid as the medium. The acid strength, temperature and length of pickle are all varied to suit the particular need.

May 1983