

# IMPERIAL CHEMICAL INDUSTRIES LIMITED PETROCHEMICALS DIVISION

## SAFETY NEWSLETTER No 69

### **69/1 ANOTHER EXPLOSION IN A STACK - ON A PLANT WHICH HAD BEEN MADE SAFE FOR MAINTENANCE**

A few years ago there were a number of explosions on flare and vent stacks in the Division (see Newsletters 3/3, 5/3, 10/2, 14/5, 40/8 and 45/6 and the article by J L Kilby in "Chemical Engineering Progress", June 1968, p.49). These incidents taught us how to prevent explosions in stacks:-

- 1 Keep a flow of gas, preferably inert gas, up the stack to prevent air diffusing down and to sweep away any small leaks of air into the stack. Make sure the gas is flowing; the best way is to measure the flow.
- 2 Test the atmosphere in the stack regularly for oxygen. On large stacks measure the concentration of oxygen continuously.
- 3 Avoid leaks of air into the stack by blanking open-ends immediately. When large relief valves are removed for test, use the special sealing plate shown in Engineering Standard TDB 2411.

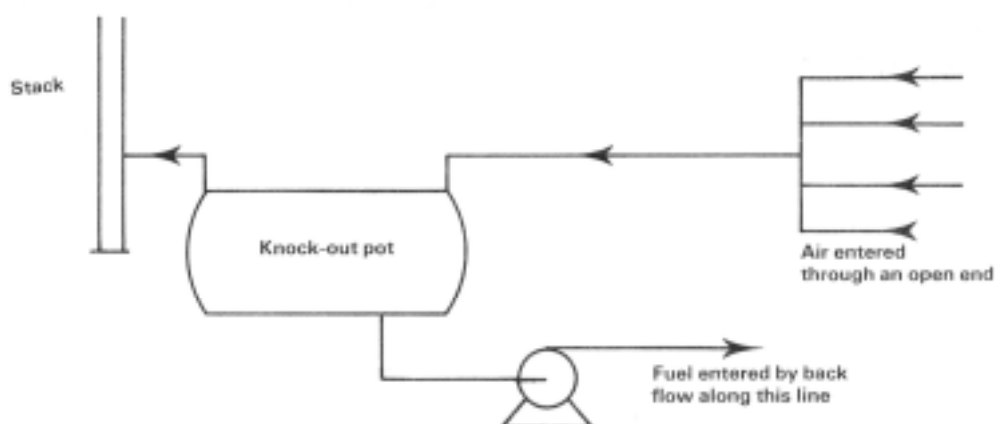
Now an explosion has occurred in a flare stack while the plant was shut-down for overhaul. Fortunately no-one was hurt and there was no serious damage.

For an explosion to occur we need air, fuel and a source of ignition.

Air got into the stack because some relief valves were removed, and, as the plant was shut-down, it was decided not to blank the open-ends.

Fuel may have got into the stack by back-flow through the pump-out line and pump on the knock-out pot. In addition, the knock-out pot was not freed from hydrocarbons with the same thoroughness as on a normal running plant.

The source of ignition may have been traces of pyrophoric iron sulphide.

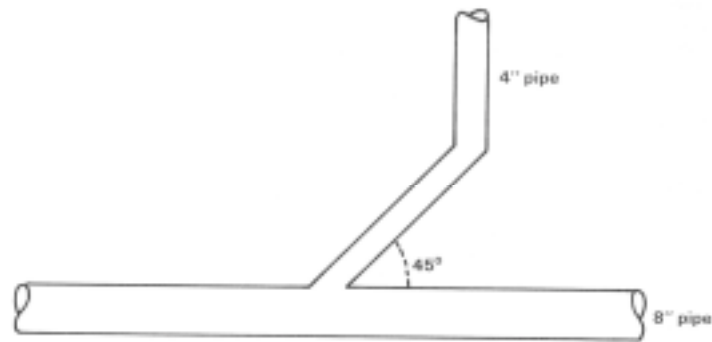


We should treat stacks like other pieces of equipment and never allow air to enter unless we are sure that any fuel present has been removed and all sources of fuel have been isolated by slip-plates or physical disconnection.

### **69/2 A MAJOR BREAK IN A PIPELINE**

Another Company has told us about a pipeline failure a few years ago that might have produced a serious fire or explosion. Thirty tons of hot hydrocarbon formed a vapour cloud hundreds of feet across, but fortunately it did not ignite.

A 4 inch branch had been fitted into an 8 inch pipe at an angle of 45°. The line was subject to vibration and failed by fatigue.



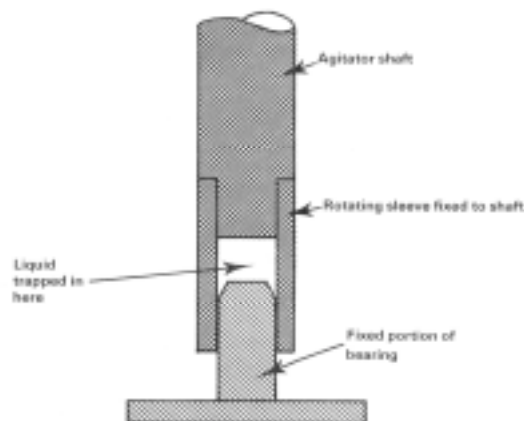
Failure was due to poor mechanical detail at the junction of the two pipes, and to the fact that the 4 inch branch was much thinner than the 8 inch pipe. In particular,

- (A) The abrupt change of section, the oval shape of the hole in the parent pipe and dissimilar wall thicknesses resulted in a stress intensification factor of 9.33. The stress concentration could have been reduced by using weldolets or forged reduced offtake tees. Other, less satisfactory, methods are to use gussets, compensating rings, flanged connections or butt welding to a thick-walled branch slab.
- (B) The smaller line should have been better supported so that no undue strain was imposed on the weld.
- (C) The reasons for the vibration should have been investigated.

#### 69/3 ENTRY TO VESSELS - LOOK OUT FOR PLACES WHERE LIQUID MAY BE TRAPPED

Another Company has reported that a man was overcome by poisonous fumes while working in a vessel which had been cleaned and isolated and had been open for 17 days.

The man was working on a stirrer and probably disturbed some liquid which was trapped in the bearing.



#### 69/4 SOME QUESTIONS I AM OFTEN ASKED

##### 4-WHAT IS OUR POLICY ON SAFETY?

I am sometimes asked if there is a detailed statement of the Division's Safety policy.

A brief statement appeared on the cover of our 1973 safety calendar. Personally, I am not in favour of long, detailed statements of policy. If I want to know a company's policy on canteens, I do not ask to see a statement of policy, I go and sample the canteens. In the same way, our policy on safety is not what we say but what we do. If you want to know the policy of the Division or of your Works, look around you. If you are not satisfied with the policy of your Plant, do not write out a new statement of policy, just do things differently. That will be the new policy.

**69/5 FIVE YEARS AGO**

Some extracts from Safety Newsletter No. 14, November 1969

*(a) LOOSE INTERNAL FITTINGS BLOCKS A RELIEF VALVE*

*Another company have reported an extraordinary accident. An internal ball float in a propane storage tank came loose and when the tank was over-filled the ball lodged in the relief pipe, in which it was almost an exact fit. When the tank warmed up, the pressure increased its diameter by 6 inches.*

*The incident was noted when the access stairway was found to have broken away from the shell.*

*This is perhaps a one-in-a-million incident but nevertheless, I urge that you check the sizes of all fittings in your pressure vessels to make sure this does not happen in the Division.*

*(b) HOW TO FIX THE SIZE OF RELIEF VALVES*

*A new Process Design Guide on "Pressure Relief and Blowdown" (J.S.Fitt, 15.10.69) describes how this should be done. The Guide is well written and easy to read. The section dealing with "Traps, Snares and Pitfalls" should be read by everyone who ever has to size a relief valve.*

John Fitt's Design Guide has now been published (in the Proceedings of the Symposium on Loss Prevention held in Holland in May 1974) and a copy is available on request.

*(c) WHY DO WE NEED NEW RULES FOR PREPARING EQUIPMENT FOR MAINTENANCE?*

*"We have become amphibious in time. We are born into and spend our childhood/n one world; the years of our maturity in another. This is the result of the accelerating rate of change."*

*This quotation from the novelist, B W. Aldiss, might apply to the petrochemical industry; those who have been 20 years or more in the industry have moved into a different world where new standards are needed.*

*Why do we need the HOC rules on the isolation and identification of equipment for maintenance? They were introduced in 1967 but Billingham managed for 45 years without them.*

*During those 45 years there were no doubt many occasions when fitters broke into equipment and found it had not been isolated, or broke into the wrong line because it had not been identified positively. But pipelines were mostly small, and the amount of flammable gas or liquid on the plant was not usually large.*

*Now pipelines are much larger and the amount of gas or liquid that can leak out is much greater. Several serious incidents in recent years have shown that we dare not risk breaking into fines that are not properly isolated. As plants have got larger we have moved, like frogs coming ashore for the first time, into a new world where new methods are needed.*

As plants have got larger, we need not only better methods of isolation for maintenance but we also need to take more care over the checking of plant modifications.

**69/6 TWO MAJOR FIRES**

The Fire Prevention Association has published a 16 page summary of the official report on the Summerland fire in the Isle of Man last year. Fifty people died in the fire.

The design was criticised. The Commissioner "was not impressed by repeated attempts by the designers to suggest that other people should have told them of any mistakes or inadequacies in the plans".

The architectural profession was criticised: "An assessment of safety, particularly fire safety, appears so far to have been generally neglected in architectural education".

The management was criticised. An excellent safety guide existed, but only a few employees had seen it; even the General Manager had not seen it. The fire brigade were not called until 20 minutes after the fire was discovered.

Copies of the account of the fire can be obtained from the FPA, Aldermay House, Queen Street, London EC4N 1TJ, price 50p.

The FPA have also published (for 70p) an account of the fire in a new office building in Sao Paulo,

Brazil last year in which 179 people died. Coloured pictures show the flames spreading up the building. As on the Isle of Man the design encouraged the spread of fire and local regulations had been ignored.

### 69/7 UNUSUAL ACCIDENTS NO 39

A householder called his local fire brigade because he could smell burning but could not locate the fire.

The brigade arrived; they searched high and low but they could not find the fire either. Eventually one of the seekers sank baffled into the nearest armchair — only to shoot up again shouting with pain! Apparently the offending chair seat was made of latex foam with a fabric cover. It had been close enough to a fire for the filling to warm up and self-heat; in so doing it emitted a strong smell of burning but exhibited no visual evidence. Having established the whereabouts of the “seat” of the fire the brigade quickly removed the offending piece of furniture and no further damage was sustained.

From JoFRO, The Quarterly Journal of the Joint Fire Research Organisation, No 7.

### 69/8 RECENT PUBLICATIONS

- (a) The Institution of Chemical Engineers have published the first issue of a two-monthly “Loss Prevention Bulletin”. Copies can be obtained from the Institution of Chemical Engineers, price £50/year (extra copies £1.80/year). Each ICI Division will subscribe separately and, within Petrochemicals Division, extra copies can be ordered from the Library.

The first issue consists mainly of extracts from these Newsletters but it is hoped that other companies will contribute to future issues. The Bulletin is still published, every two months.

- (b) Report No. PC200,801/A, available from Division Reports Centres, shows how to calculate the minimum velocity at which flammable gases can be safely discharged to atmosphere. It also shows how to calculate the size of the flammable zone and the gas concentration in neighbouring buildings.
- (c) Report No EDN 1366, available from Division Reports Centres, describes the methods used for assessing the safety of hot-tapping and leak-sealing operations on plants which are under pressure.
- (d) On one occasion, sparks were seen jumping between the handle and the body of a ball valve. Safety Note 74/26 considers the hazard and makes recommendations.
- (e) An article by three Fluor engineers describes some new methods of reducing the size of flare systems, for example, collecting the gases for re-use or scrubbing the gases with oil to remove condensable hydrocarbons.
- (f) A note dated 17 September describes the (slight) progress made in the Division in fitting overfill protection to road tankers.

For copies of (d)—(f) or for more information on any item in this Newsletter, please phone P2845 or write to E.T. at Wilton. If you do not see this Newsletter regularly and would like your own copy, please ask Mrs T to add your name to the circulation list.

October 1974

## Case Histories on Loss Prevention

**Long experience has developed a high degree of concern about protection against over-pressure, but there remains a blind spot toward protection against over-temperature.**

T. A. Kletz, Imperial Chemical Industries, Ltd., Billingham, Teesside, England

Several dangerous occurrences are analyzed in detail here, not only to determine the immediate causes and the actions necessary to prevent their recurrence, but also to find the underlying reasons why they happened. We will be interested in the human misconceptions and the organization shortcomings, etc., that lay behind them, as much as in the piece of equipment that failed. By identifying the host of contributing factors, we stand a better chance of preventing the accident from happening again than if we dealt only with the events and circumstances just prior to it.

None of the incidents discussed in this article caused any injuries, but that was only due to good fortune, not good planning. All of the incidents damaged the plant and interfered with production.

### A heater shell bursts

An electric heater heated a stream of circulating nitrogen which was used, for a few days every two months, to regenerate a catalyst bed, Figure 1. The instrumentation and control were simple because the unit was not used very often. The heater was a shell-and-tube type, with electric heating elements in the tubes.

One day, the heater shell burst (see Figure 2). Subsequent investigation disclosed the following:

1. The cooler choked with catalyst dust, thus stopping gas circulation.

2. The flow indicator was not working, because it was also choked with dust. It had never worked since the plant start-up, and the operators had learned to manage without it, controlling the plant by watching the temperature inlet to the catalyst bed. If this temperature was

low, they switched on more heating elements; if high, they switched some off.

3. The temperature recorder on the inlet to the catalyst bed was stuck at its normal reading. However, if it had been working it would not have prevented the incident but would have shown a *fall* in temperature when the circulation stopped and the operator would then have switched on more heating elements.

4. As a result of the loss of circulation, the temperature in the heater rose and the high temperature trip on the *elements* operated, at 740~'T, and isolated the electricity supply.

5. The operator, not noticing anything unusual in his other readings, assumed the trip to be faulty, and after a few minutes switched the power back on. The elements, which had a low-heat capacity, had cooled a little, and it was another ten minutes before the trip isolated the electricity again.

6. Altogether, the trip operated and the electricity was restored three times in one hour. There was a shift change during this hour. Finally, the heater shell burst.

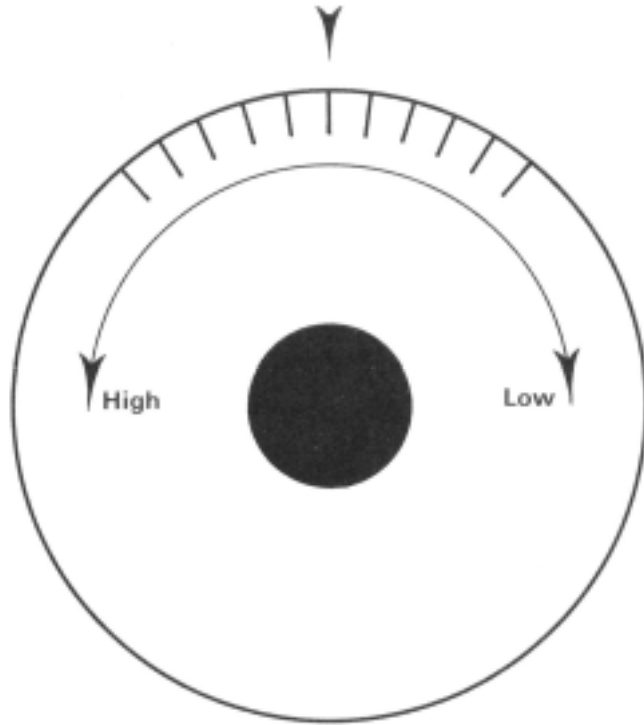
The action of the plant staff after the incident was as instructive as the incident itself. Because the shell had burst, they assumed that the relief valve was faulty and sent it to the workshops for test. The test showed that it was lifting a little above the set pressure, but not

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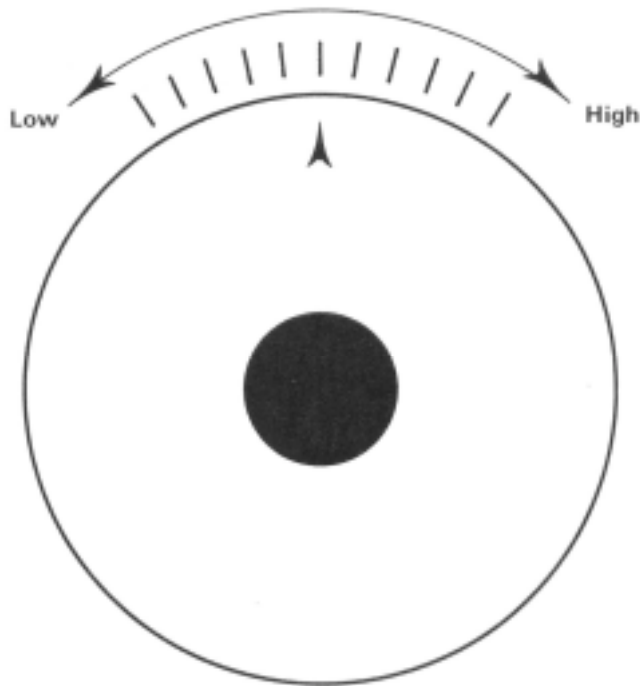
**CHEMICAL ENGINEERING PROGRESS (Vol. 70, No. 4)**

A copy of the complete article is available on request.

**PUZZLE - WHICH WAY DO YOU TURN THE KNOB TO INCREASE THE READING?**



**It is better to put the scale on the base-plate instead of the knob.  
There is then no doubt which way the knob should be turned**



**From "Man-machine Engineering" by A. Chapanis, Tavistock, 1965**