IMPERIAL CHEMICAL INDUSTRIES LIMITED

PETROCHEMICALS DIVISION

SAFETY NEWSLETTER No.93

SOME ACCIDENTS WHICH HAVE RECURRED AFTER TEN OR MORE YEARS

ICI was formed almost fifty years ago in December 1926, so this month the Safety Newsletter is devoted to some major incidents of the past which recurred after a decade or more. The information in the following pages — some of which has appeared in earlier Newsletters — is based on the discussions held in the Division during 1976. Nearly every week from January to August a group of managers and engineers from design and production discussed the incidents and made the recommendations which appear in the following pages. This Newsletter is therefore a record of those discussions and a reminder or souvenir for those who were present.

If you attended one of the discussions may I remind you that the recommendations are *yours,* not mine (though I agree with them) and that it is up to you to see that they are followed, where appropriate, on the plants that you operate, maintain or design.

If you see the Newsletter on circulation but would like your own copy of this issue please let us know.

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"What experience and history teach us is this — that people and governments have never learnt anything from history, or acted on principles deduced from it."

G W Hegel, German Philosopher, 1770-1831

"If you don't mind me quoting a French philosopher, a guy named Gide once said that everything has been said before, but nobody listens, so it has to be said all over again."

W H Doyle, Loss Prevention 1973, Vol. 7, p.120

"Organisations have no memory.

"Our education system teaches us not to look up the answer and not to copy. We have got to learn to do both of these things."

Comments made at the discussions of the incidents described below.

In the discussions on which this Newsletter is based we were, like Dr. Who, "Travellers in time". We travelled back up to fifty years and investigated an accident. We moved forward ten or more years and found that a similar accident had occurred. Staff had changed and the lessons of the earlier accident had been forgotten.

1 ISOLATION FOR MAINTENANCE

1928

In 1928 a fatal accident occurred in the Billingham factory.

A 36 inch diameter gas main was being modified and a number of joints had been broken. The line was isolated from a gas-holder by a closed isolation valve which, unknown to those concerned, was leaking. The leaking gas ignited; there was a loud explosion and flames appeared at various joints on the main. One man was killed.

The source of ignition was a match struck by one of the workmen so that he could see what he was doing. However once an explosive mixture is formed a source of ignition is always liable to turn up and the real cause of the explosion was not the match but the leaking valve.

The following are the conclusions of the original report:-

1 Never trust an open gas main which is attached to a system containing gas, and keep all naked lights clear.

2 When working on pipebridges at night, adequate lighting should be available.

3 Never place absolute reliance on a gas-holder valve, or any other gas valve for that matter. A slip-plate is easy to insert and absolutely reliable.

1967

A large pump was being dismantled for repair. When a fitter removed a cover hot oil came out and caught fire as the suction valve had been left open. No slip-plates had been fitted as it was not custom and practice to fit them.

The oil was above its auto-ignition temperature.

Following the fire, instructions were issued that before any equipment is given to maintenance:-

1 The equipment must be isolated by slip-plates or physical disconnection unless the job to be done is so quick that fitting slip-plates (or physical disconnection) would take as long *and* be as hazardous as the main job.

2 Valves used to isolate equipment for maintenance, including isolation for slip-plating or physical disconnection, must be locked shut with a padlock and chain.

3 When there is a change of intent, for example, if it is decided to dismantle a pump and not just work on the bearings, the clearance certificate must be handed back and a new one taken out.

Comment

In the period of nearly forty years that elapsed between these two incidents, the practice of slip-plating had lapsed — no-one knows when or why. Perhaps the men who remembered the original incident had left and their successors did not see the need for slip-plating. “It is a lot of extra work”, they might have said, “Other companies don’t do it”.

It is now nearly ten years since the last incident. Will we forget again?

2 EXPLOSIONS IN BUILDINGS DUE TO LEAKS OF GAS

1956

A leak of propylene occurred from the gland of an injector — a reciprocating pump — operating at 250 bar, due to the failure of the studs holding the gland in position. The propylene was handled as a liquid under pressure and the escaping liquid vaporised. The injector was located in an unventilated building but the vapour escaped through a large open door and was ignited, a few minutes after the leak occurred, at a furnace about 250 feet away. Four men were badly burned. Damage to the building was slight: some windows were broken.

After the fire £300,000 was spent on:-

1 Resiting the injectors in an open-sided building so that small leaks could be dispersed by natural ventilation.

2 Surrounding the injectors and associated equipment by a steam curtain so that the vapour from leaks could not reach a source of ignition.

3 Installing gas detectors so that leaks were detected without delay.

4 Installing remotely-operated valves so that leaking injectors could be isolated and blown down from a safe distance.

5 Installing a flare system so that deliberate leaks, for example, when preparing equipment for maintenance, did not have to be vented to atmosphere.

6 Locating the storage tanks for liquefied flammable gases (LFG) away from operating plant.

In part, the fire occurred because the difference between petrol and LFG was not fully appreciated. Equipment which had been used originally for handling petrol-like liquids was used for LFG. No-one realised that the vapour from an LFG leak would form a large cloud and spread a long way until it met a source of ignition.

By re-using old equipment, a plant had been built cheaply. It was not so cheap in the end.

The recommendations above were followed in the design of new plants handling liquefied flammable gases until 1968 when an almost fully enclosed compressor house was designed in order to reduce the noise level in a neighbouring workshop. The reasons why open buildings were built had been forgotten. The building was finished just as the report on the incident below was issued — and the walls were quickly pulled down.

1969

A leak of ethylene gas occurred from a high pressure pipe joint in the ground floor area underneath a compressor house. The ventilation in the area was poor. The leak ignited after a few minutes. The cause of ignition was never established with certainty, but might have been faulty electrical equipment. The resulting explosion killed four men and caused serious damage; half the building had to be completely re-built.

The following recommendations were made for future plants:-

1 Locate compressors in an open-sided building so that small leaks can be dispersed by natural ventilation.

2 Surround the compressors and associated equipment by a water curtain so that the vapour from leaks cannot reach a source of ignition.

3 Install gas detectors so that leaks are detected without delay.

4 Install remotely operated valves so that leaking compressors can be isolated and blown down from a safe distance.

Comment

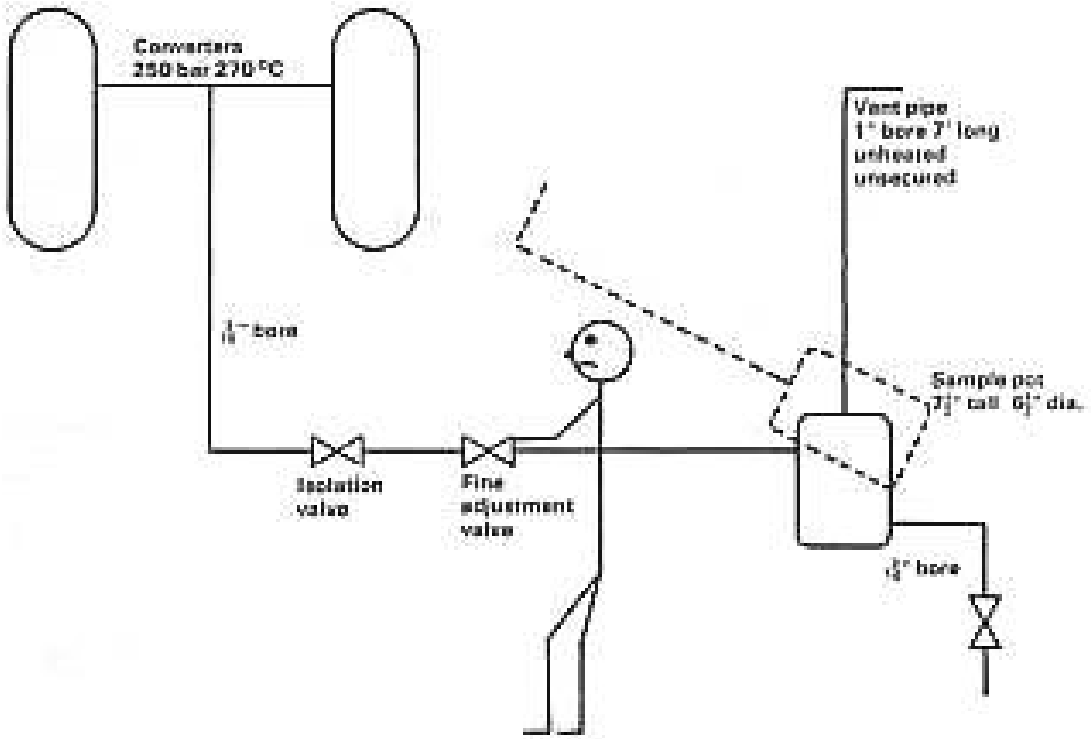
The similarity between these two incidents is obvious. In this case information was not lost but was not passed from one part of the Company to another, or, if passed, its significance was not realised. If we handle *ethylene as gas* it may not be immediately obvious that we can learn anything from a fire on a plant handling *propylene as liquid.*

The lessons of the 1969 explosion were widely publicised. Nevertheless, another explosion occurred in 1971 in an unventilated hydrogen compressor house. The lessons of the 1969 explosion had not been "heard" because hydrogen was widely believed to be different from ethylene and to disperse readily.

1948

A vegetable oil was being hydrogenated on a pilot plant and samples had to be taken from the line joining two reactors.

The sample pot was filled by opening the isolation valve and cracking the fine adjustment valve. Both valves were then closed and the sample pot drained into the sample can.



Two weeks after this system had been installed, the operator was unable to get a sample and informed his chargehand. Suspecting a choke — the raw material and product both melted at 20°C — the chargehand tried to clear it by opening the isolation valve and drain valve and then gradually opening the fine adjustment valve so as to get a blow straight through. The vent pipe suddenly moved and hit the chargehand on the head; he died later from his injuries.

The sample pot and vent line were not clamped and were free to rotate by partially unscrewing the flange on the inlet pipe. It had been intended to clamp them but this had been overlooked.

The sample line and pot were heated but the vent line was not. It is believed that there had been a choke somewhere in the system and that when it cleared the sudden rush of gas caused the vent pipe to move backwards.

The main recommendation was that plants handling materials which are solid at ambient temperatures should be adequately heated.

1968

The end of a tank was blown off, killing two men who were working nearby. The tank was used for storing, as liquid, a product which melts at 100°C. It was therefore heated with a 100 psig steam coil.

The line into the tank was being blown with compressed air to prove that it was clear — the usual procedure before filling the tank. The vent on the tank — an open hole 3 inches in diameter — was choked and the air pressure (80 psig) was sufficient to burst the tank (design pressure 5 psig).

The vent hole was not heated. It was known that the vent was liable to choke, but this was looked upon as an inconvenience rather than a danger. Many of those concerned did not realise that the air pressure was sufficient to burst the tank.

Comment

The locations of these two accidents, separated by 20 years, were only 200 yards apart, although in areas under the control of different Works. The first incident was completely unknown to all those involved in the second.

4 OPENING PRESSURE VESSELS BY OPERATORS

Every day equipment which has been under pressure is opened for repair, but this is normally done under clearance — one man prepares the equipment and issues a clearance to another man who opens the equipment.

Both incidents described below occurred when equipment was opened as part of a process operation.

1965

A suspended catalyst was removed from a process stream in a pressure filter. After filtration was complete steam was used to blow the remaining liquid out of the filter. The pressure in the filter was blown off through a vent valve and the fall in pressure observed on a pressure gauge. The operator then opened the filter for cleaning. The filter door was held closed by eight radial bars which fitted into U-bolts on the filter body. The bars were withdrawn from the U-bolts by turning a large wheel, fixed to the door. The door could then be withdrawn.

One day an operator started to open the door before blowing off the pressure. He was standing in front of it and was crushed between the door and part of the structure and was killed instantly.

In this sort of situation it is probable that sooner or later, through oversight or neglect, an attempt will be made to open the equipment whilst it is under pressure; on this occasion the operator was at the end of his last shift before going on holiday. It is too simple to say that the accident was due to the operator’s mistake —the accident was the result of a work situation that made an accident almost inevitable. This, however, was not fully recognised at the time and less change was made to the plant than we would make today. We would now recommend:-

1 That whenever an operator has to open up equipment which has been under pressure:-

(a) Interlocks should be provided so that the vessel cannot be opened up until the source of pressure is isolated and the vent valve opened

and

(b) The design of the door or cover should allow it to be raised about ¼ inch while still capable of carrying the full pressure, and a separate operation should be required to release the cover fully. If the cover is released while the vessel is under pressure, then this is immediately apparent and the pressure can blow-off through the gap or the cover can be re-sealed.

2 The handle should be modified so that the operator does not stand in front of the door (this was done).

3 The pressure gauge and vent should be near the handle.

The plant operators were surprised that the pressure in the filter, about 30 psig, could cause so much injury. They did not realise that 30 psig over 10 sq ft. the area of the door, produces a *force* of *20 tons.*

1974

Plastic pellets are blown out of a road tanker by compressed air. When the tanker is empty the driver opens a man-hole cover on the top of the tanker to check that the tanker is empty. One day a driver, not a regular man, started to open the manhole before releasing the pressure. When he had opened two of the quick release couplings, the cover was blown open. The driver was blown off the tanker and killed by the fall.

Either the driver forgot to vent the tanker or thought that it would be safe to let the pressure (10 psig) blow-off through the man-hole.

After the accident the manhole covers were replaced by the type described in 1(b) above and the vent valve was moved from the side of the tanker to the foot of the ladder (see (3) above).

Many of those concerned were surprised that 10 psig could cause so much injury. 10 psig is not a small pressure. The damage at Flixborough was caused by a pressure of about 10 psig.

Comments

Here again an accident recurred after about 10 years. In this case all the lessons that might have been learnt were not learnt at the time.

5 ANOTHER INDUSTRY

In 1966 a pit tip collapsed at Aberfan in South Wales, killing 144 people, most of them children. The following is taken from the official report.

> *"Here, forty years before it occurred, we have the basic cause of the Aberfan disaster being recognised and warned against. But, as we shall see, it was a warning which went largely unheeded."*
>
> *"The stark truth is that the tragedy of Aberfan flowed from the fact that notwithstanding the lessons of I the recent past not for one fleeting moment did many otherwise conscientious and able men turn their minds to the problem of tip stability These men were not thinking and working in a vacuum. All that was required of them was a sober and intelligent consideration of the established facts"*

6 THE FUTURE

How can we prevent these and other serious accidents repeating themselves after ten or more years?

When these incidents were discussed the following was suggested:-

To improve communication and memory:

1 Discuss the accidents (and others) every few years. Discussions will make more impression on the memory than listening to a talk on them or reading about them. Supervisors and operators should attend as well as managers.

What action are you going to take in your Works or Department?

2 Invite more people from other parts of the Company (or even other companies) to attend the discussions and suggest that they should give more publicity to incidents that have occurred in their organisations.

3 Remind people of the incidents every few years in Safety Newsletters and other publications.

4 Devise better information retrieval systems so that when we become interested in, for example, compressor houses, we can readily locate details of previous incidents in compressor houses and the recommendations that have been made. The index to the Safety Newsletters (see Newsletter No 88/6) is a step in this direction.

To improve the way we do things.

5 Remember that the first step down the road to repetition of a serious incident occurs when a manager allows standards to slip on his plant, section or works — when, for example, he turns a blind eye to a missing slip-plate.

6 Design our plants so that the recommendations made in accident reports can be carried out. For example, slip-plating may have lapsed after 1928 because plants were not designed so that slip-plates could be inserted.

7 Add a note to each standard and specification explaining *why* it has been adopted.

8 When we change the duty of a piece of equipment we should not just look at its mechanical suitability for the new duty, but at the wider questions (see 1956).

We paid a high price for the knowledge summarised in this Newsletter — 13 deaths and 8 serious injuries, several million pounds damage to plant and several million pounds lost production. Will we pay the price again?

POSTCRIPT

In a recent book Bernard Lewis distinguishes between three sorts of history — “History — Remembered, Recovered, Invented” (Princeton University Press, 1975).

In History Remembered, knowledge of events has been passed on, without a break, by the written word or by word of mouth. The more recent incidents described in this Newsletter are History Remembered — we have never (not yet?) forgotten them and those who have not read the reports may have heard about them from others.

In History Recovered, knowledge of events which has been completely forgotten is brought back to light by archaeologists or by the discovery of ancient documents. The 1928 incident is History Recovered. It had been completely forgotten until I discovered the report in the files. The 1948

incident had been almost forgotten but an old hand vaguely recalled it and after much searching the report was unearthed. How much more history is waiting to be Recovered?

In History Invented, history is rewritten or invented to suit political ends or destroy distasteful memories. The past is described, not as it was, but as the writer thinks it should have been. Though rewriting history is a flourishing industry in many parts of the World, there are (I hope) no examples of History Invented in this Newsletter. We must, however, always be on our guard against the temptation to select from the past only those events which support our views. History can be invented by omission and selection as well as by deliberate deceit.

There is much food for thought in Lewis's book for all who seek lessons from the past.