

ACCIDENTS OF THE NEXT 15 YEARS?

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From 1968 to 1983, the Heavy Organic Chemicals (later Petrochemicals) Division of ICI published a monthly *Safety Newsletter*, 171 issues in total. The circulation was at first small but grew rapidly and by the mid-seventies reached about 2500, as copies were sent to all parts of ICI, other oil and chemical companies, academics and regulators. It was an early example of open access.

Most of the incidents described are still recurring today so the IChemE is posting the *Newsletters* on the Internet. This paper describes their contents, illustrates them by examples and shows how they can be used to reduce accidents. This old information is still relevant as although designs have changed a more important factor – human nature – has not.

The *Newsletters* were not intended primarily for safety experts but for all those involved in design, operations, maintenance and construction, at all levels but especially at the professional level

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In 1968 I was appointed safety adviser to ICI Heavy Organic Chemicals (later renamed Petrochemicals) Division with responsibility for what we now call process safety. Among the many actions I took, described in (Kletz 2006), was the preparation of a monthly *Safety Newsletter*, usually 8 pages long. I sent copies of No 1 to the about 30 colleagues. Gradually, over the next fourteen years, the circulation and contents grew spontaneously. I did not advertise it, but added people to the circulation list at their request. By the mid-1970s the circulation was about 2500 and, as well as other ICI Divisions, included many outside companies in the UK and elsewhere, universities and the Health and Safety Executive. The *Newsletters* were not intended primarily for safety experts but for all those involved in design, operations, maintenance and construction, at all levels but especially at the professional level. I made it clear to the outsiders who received the *Newsletters* that they could be copied for circulation within their organisations but not offered for sale. Some companies circulated them widely.

Within ICI the *Newsletters* were seen by division directors, managers, foremen and, in some works, operators. The contents consisted mainly of reports on accidents of general and technical interest from ICI and also from other companies, which they supplied in exchange for the *Newsletters*. I did not copy the original reports, but rewrote them to bring out the essential messages. Many of the later *Newsletters* were devoted to specific themes, such as accidents due to plant modifications, preparation for maintenance, static electricity and human error. After I retired from ICI, I edited many items from old *Newsletters* and published them in a book called *What Went Wrong?* (Kletz 1998). Now in its 4th edition

it is twice as long as the first edition and is my best-selling book. I have added many later reports and also written a supplementary volume, *Still Going Wrong?* (Kletz 2003) Both books are available from IChemE (see www.icheme.org/shop).

Many people were surprised that ICI allowed me to distribute reports of our errors all over the world but if we have information which may prevent accidents there is a moral duty to pass it on to other people. In addition it was to our advantage in several ways:

1. **Economic:** ICI spent a lot of money on safety. By telling our competitors what we did we encouraged them to spend as much.
2. **Pragmatic:** we got useful information from other companies in return.
3. **In the eyes of the public, the chemical industry is one**. The whole industry suffers if one company performs badly. To misquote the well-known words of John Donne:

> No plant is an Island, entire of itself; every plant is a piece of the Continent, a part of the main. Any plant's loss diminishes us, because we are involved in the Industry: and therefore never send to know for whom the inquiry sitteth; it sitteth for thee.

Colleagues and other companies were willing to let me describe their accidents and so-called "near misses" (actually near accidents), which usually reflected no credit on them, because I did not say where they occurred (except when the location was stated in the title of a published report). The *Newsletters* were thus an early example of "open access" though the phrase was not then used. When I retired from ICI the company gave me permission to reproduce or quote from them as much as I wanted, provided I did not say where they occurred or in which company. If anyone asked me - only a few did - where an accident had occurred I apologised for my poor memory. Now, as a further step in open access, IChemE are making all 171 *Newsletters* available on the Internet. Other companies' reports may be added later.

The information in the Newsletters is given in good faith but without warranty. Much of the advice is decades old and better methods of prevention may be available today. There are many possible solutions to most problems. However, the accidents happened, many are still being repeated today, and readers should therefore ask themselves, "Could this occur where I work and, if so, how do I or should I prevent it?"

In the period covered by the *Newsletters* (1968–1983) the Factory Inspectorate, and after 1974 the Health and Safety Executive, had a lighter touch than today. For this reason there are fewer references to the law than there would be if I was writing today.

In rent years ICI has been is very different from the ICI I knew. Except for the paint factories, with which I had little contact, all the plants owned in 1982 when I retired have been closed or sold to one of a large number of different companies. None of the incidents described n the *Newsletters* occurred on plants operated or owned by ICI in recent years.

I wrote everything in the *Newsletters* myself except for the engineering articles in the later issues most of which were written by Harland Frank, an outstanding engineer.

After I retired from ICI in 1982 the *Newsletters* continued for 18 months, written by my successor, Alan Rimmer, and were then abandoned when he retired early.

Many companies' monthly safety reports look like all the other memoranda we get. The *Newsletters* stood out as they were printed in fairly large print on good quality paper with clear diagrams, essential features if we want busy readers to recognise them as something worth reading and as something they can read and absorb in odd moments. For the layout of your safety reports take advice from those who design the leaflets that are sent to your customers. The *Newsletters* have been retyped for the Internet so that there is a unity of font and style but the wording is unchanged except for a few extra cross-references.

Many readers may wonder if information from 1968–1983 is still relevant. When I retired in 1982 and started working as a consultant as well as a visiting professor I thought that my life as a consultant would be no more than five years as after that I would be out of date. It has not happened. Many of the accidents described in the *Newsletters* are still recurring and many of the problems discussed are still puzzling people, as shown by the examples below. (See also the Afterthought on the last page.) It is also important to remember that while equipment has changed a more important factor, human nature, remains the same. Are you any more reliable than your parents or grandparents? Perhaps less, as when the *Newsletters* were written there were more people in design and operations and industry had not adopted the extraordinary practice of retiring people when their knowledge and experience were at their highest

US readers should note that some engineering and management terms have different meanings in the two countries. There are glossaries of them in the two books mentioned above but the following can be particularly confusing:

- In the UK a plant manager is usually someone at the lowest level of professional management, equivalent to a supervisor in the US. The UK equivalent of a US plant manager is called a works manager or factory manager. In the UK supervisor is usually another name for a foreman but can be anyone to whom other employees report.
- A chargehand is a rather old-fashioned UK name for a lead operator.
- Lagging is a UK name for insulation; flex is a UK name for a hose.

SOME *NEWSLETTER* ITEMS THAT ARE STILL RELEVANT

You can search the *Newsletters* for accident reports or information on particular equipment, substances and operations. For example, if you are thinking of fitting a sight-glass a search for that term will take you to *Newsletter* 35 (November 1971) where you will see that:

> Level glasses are always liable to break and it is, therefore, the policy of the Division to install ball check cocks in the lines connecting a level glass to the parent vessel. If the level glass breaks the pressure of the liquid in the vessel pushes a ball against a seat and stops the leak.

The ball check cocks form part of an isolation valve. *They will operate correctly only if the isolation valve is fully open or almost fully open*. They will not work correctly if the isolation valve is half-shut.

When a level glass connection broke recently there was a large escape of gas which caught fire and injured a man. The ball check cock did not operate because the isolation valve was nearly closed.

Please make sure that your operators know that these valves must be fully opened and then left just cracked off the back seat position.

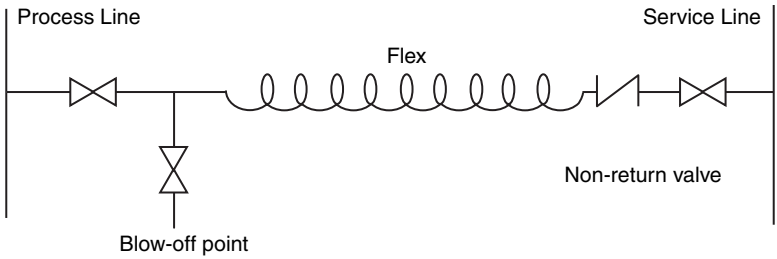
On some plants the balls have been found to be missing. You may like to check that on your plant they are all present.

For comparison, the American Institute of Chemical Engineers publishes every month on the Internet and reprints in *Chemical Engineering Progress,* a Beacon, an illustrated one-page summary of an accident report. The July 2007 Beacon reports that while dealing with a leak and fire an operator tried to kick a valve closed and accidentally broke a sight glass, thus making the leak and fire worse. The recommendations do not mention ball check cocks.

The original leak came from a hose which had been repaired with tape. There are many references to hoses in the *Newsletters*, for example, *Newsletter* 44/4 (September 1972) reports that:

Before removing a hose a man tried to drain it by loosening the coupling nut. Hot water came out of the coupling and scalded him. In the past, men have been burnt by corrosive chemicals in this way.

Whenever hoses are used at pressure, a valve should be provided for blowing off the pressure, as shown below:-



The best place for the blow-off point is at the process end as then it can be used to prove that the hose is clear, by opening the service and blow-off valves before the process vale is opened.

Note that in the diagram the hose is called a flex, at the time a common term in the UK.

There are many references to flexes in the *Newsletters.* The following one is from *Newsletter* 7/7 (January 1969):

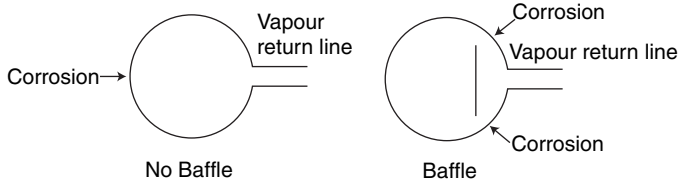
> An accident involving oxygen is described in the October 1968 issue of "Accidents", published by the Factory Inspectorate. Welding was taking place inside a tank. The cylinders were outside and flexible hoses led to the welding set. One of the men lit a cigarette and noticed that it burned away more quickly than normal and that his lighter-flame was longer than usual. He did not, however, realise what this meant. When the welder started to weld a spark fell onto another man's pullover; it immediately caught fire and spread to his entire clothing. He later died from his injuries.

A search for "flex" brought up the following report, containing the word "flexible", from *Newsletter* 47/4 (December 1972):

> Corrosion was suspected on a distillation column. Ultrasonic thickness measurements were therefore made on the outside of the shell. These showed that although some corrosion had occurred, the thickness was still well above the design minimum.
>
> Some months later, when it was possible to take the column out of use, the lagging (insulation) was removed and it was discovered that part of the column was so thin that it could be flexed by hand.
>
> The thin spot was immediately opposite the vapour return line from the reboiler. The thickness measurements had been made on the other side of the column where the staging and ladders made access more convenient.

The lessons to be learned are:

1. Thickness measurements in distillation columns should be made at the points at which corrosion is most likely to occur. In the case described above, this was opposite the vapour return line. Often there is a baffle near the return line and corrosion is then most likely near the edges of the baffle. The geometry of the column must be studied.



2. During design, access ladders should be positioned to facilitate thickness measurements at the points where corrosion is likely to be heaviest.

This report shows how a search for one term can lead to a voyage of discovery where all sorts of interesting and valuable information are brought to light. I hope I have convinced

you that the information in the *Newsletters* is still relevant. Here are a few more items from more recent *Newsletters*:

Newsletter 96/4 (February 1977) described two incidents caused by reverse flow:

Reverse flow of catalyst

Some gases reacted in the inlet line to a convertor. The pipeline got so hot that it swelled and burst. At the previous shutdown the reactor had been swept out with nitrogen in the opposite direction to the normal flow and some catalyst dust had been deposited in the inlet pipe.

Reverse flow through a pump

Failure of a non-return valve caused gas at 25 bar to flow back up a liquid line when a pump stopped. This caused the pump and motor to rotate in the reverse direction at high speed. The motor was damaged beyond repair.

When failure of a non-return valve can have serious consequences, it should be registered for regular inspection. The use of two in series should be considered, preferably different types to avoid common mode failures.

There were also references to other incidents of reverse flow in an earlier Newsletter and to an article on the subject.

Newsletter 97/4 (March 1977) described a trip test that could not improve reliability:

On one Works, drums are filled with liquid product by an automatic device which weighs the drum and closes a valve when a pre-set weight is reached.

One day the valve failed to close. The drum was overfilled and the liquid splashed the filling operator's legs and feet. He tripped the supply manually and went to the locker room to change his overalls. While doing so he slipped and twisted his knee.

The investigation revealed that this was not the first time that the valve had failed to operate. The operators said that it had happened "once or twice before in the last year or two".

Amongst the actions proposed to "try to eliminate" the incident was the institution of trip testing once every two weeks. This will have no effect on the failure rate because 700 drums are filled every week and the trip is therefore tested 700 times per week! Failure of the trip mechanism will almost certainly be followed by a drum overflowing so a test is very unlikely to detect the fault.

The investigation report also suggested a much more effective way of reducing the failure rate: check the mechanism for adjustment and look for signs of wear and for this a lower frequency would seem appropriate, say once per month.

Newsletter 83 (January 1976) was devoted to accidents caused by the unforeseen effects of plant modifications:

Minor modifications are those so cheap that they do not require financial sanction. Often the only documentation associated with them has, in the past That is, before the mid-1970s), been a workshop chit or just a permit-to-work (clearance certificate).

A small leak of liquefied petroleum gas (LPG) from a passing drain valve on a pipeline produced a visible cloud of vapour about 5 feet across. The leak was soon stopped by closing a valve but the investigation brought the following to light:

1. The company's standards required two valves in series or a single valve and a blank.
2. The valve was made of brass, was of a type which was stocked for use on central heating and domestic water systems and was not of the correct pressure rating for LPG.
3. The valve was screwed onto the pipeline, although the company' standards di not allow screwed fittings on new installations except for domestic water lines and certain small bore instrument lines.
4. Since the LPG fire at Feyzin in 1966, which killed 18 people and injured 81, the company had drawn up standards for LPG, tried to publicise them and carried out numerous inspections to see if the equipment was up to standard. £30,000 (at 1970 prices) had been spent on the plant concerned on improving the safety of the LPG handling equipment. Nevertheless, subsequently someone installed a sub-standard branch. Presumably the detailed design of the branch was not specified correctly, if at all, on the chit placed on the plumbers. In addition, neither the man who installed the branch, nor the supervisor who handed the job back, nor the man who accepted the clearance back, none of the men who used the branch and none of the men who passed by, noticed anything wrong.

Like the plants in our gardens, our plants grow unwanted (and often unhealthy) branches.

Other minor modifications which have had serious affects on plant safety are:

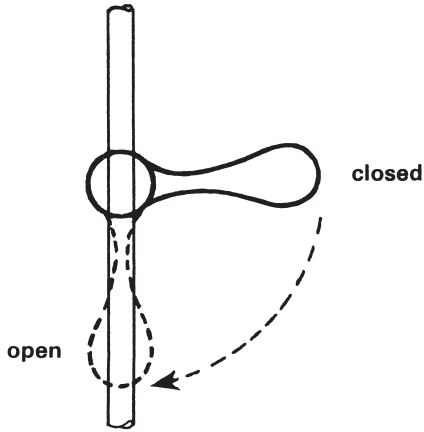
Removing a restriction plate which limits the flow into a vessel and which has been taken into account when sizing the vessel's relief valve. A length of narrow diameter pipe is less likely to be removed than a restriction plate.

Fitting a larger trim into a control valve when the size of the trim limits the flow into a vessel and has been taken into account when sizing the vessel's relief valves.

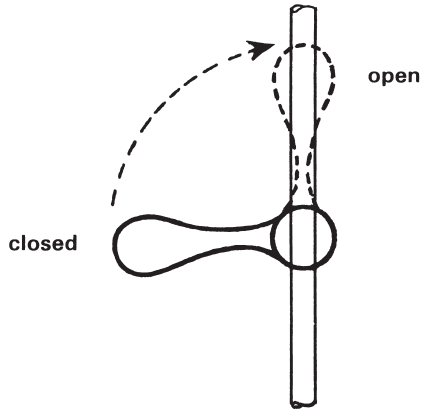
The *Newsletter* also discusses other sorts of modification such as those made during start-ups, temporary ones, modifications made during maintenance and sanctioned ones, that is modifications for which money has to be approved and which are usually – though not always – considered more thoroughly than others.

None of the incidents described occurred because of a lack of knowledge of methods of prevention; they occurred because no-one foresaw the hazards and no-one asked the right questions. The *Newsletter* described ways to prevent similar accidents in the future.

Finally, here is a short item from *Newsletter* 68/5 on **how to stop ball valves or cocks on vertical lines vibratingen**.



To prevent this happening the valves should be installed so that when they are open the valve handle points upwards.



HOW TO GET THE BEST OUT OF THE *NEWSLETTER*S

I do not expect anyone to read right through the *Newsletters* as if they were a book but you may like to browse them, as I have done above, to see their scope.

At a safety meeting you can describe or distribute an accident report from the *Newsletters* and then ask those present why the incident occurred and if it could occur on

the plant they operate or are designing. If it could, what have they done or should they do to prevent it happening. Remember that the advice given in the *Newsletters* may not be the best available today or the best for your company. "Believe in the motto: 'If it ain't broke …' And even if it is broke, you don't need to mend it the same way as everyone else." (Kellaway 2007). Also remember that discussions are a more effective method of learning than listening to a lecture or reading (Kletz 2006).

Alternatively, you can give a different accident report to everyone present and ask them to answer the same questions at the next meeting.

Another way of using the *Newsletters* is, when an accident occurs, to look in them to see if anything similar is reported in them. This will encourage your colleagues to use the *Newsletters* in the future.

Whichever way you use the *Newsletters* they could help you prevent the accidents described in them, most of which occurred between 1968 and 1983, happening again during the coming 15 years.

AFTERTHOUGHTS

Only that shall happen
Which has happened,
Only that shall occur
Which has occurred;
There is nothing new
Beneath the sun. – *Ecclesiastes 1:9*

"The reality is that mission statements have done little to change the corporate world for the better… People do not change by dint of a statement, no matter how carefully drawn up it might be" (Kellaway 2007). Telling them what has happened and will happen again unless they learn from it is more effective. Better, let them tell you what they think is the bet method of prevention.

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