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Seveso disaster, 1976

When a runaway reaction changed European process safety legislation

Description

On 10 July 1976, at approximately 12:37, a bursting disc ruptured on a chemical reactor at the ICMESA chemical plant near Seveso, Italy. A vapour cloud was released from a vent on the roof and drifted off-site.

The reactor was used for the production of 2,4,5-trichlorophenol. Under elevated temperature conditions, a side reaction could form 2,3,7,8-tetrachlorodibenzo-p-dioxin, commonly known as TCDD or dioxin.

On the day of the accident, the batch was shut down before completion, with only part of the solvent removed. The reactor was no longer stirred or actively cooled. Several hours later, the bursting disc ruptured and material from the reactor was released to the atmosphere.

The surrounding area was contaminated. No human deaths were attributed to the release, but many people became ill. Thousands of animals in the contaminated area died and many more were slaughtered to prevent dioxin entering the food chain.

The accident prompted European legislation on the prevention and control of major accidents involving dangerous substances.

Key findings

The accident that involved a batch reactor, an exothermic reaction and the formation of a highly toxic by-product under elevated-temperature conditions showed the importance of understanding the thermodynamics of the reactions being carried out, including side reactions and decompositions that may occur under deviations from the intended procedure.

The process was stopped before completion. The reactor was left without agitation or active cooling, and the reaction mass remained in the reactor for several hours before the release.

The reactor control systems were inadequate in terms of measuring a number of fundamental parameters, and there was no automatic control system.

The bursting disc ruptured and the vapour cloud drifted off-site. Information on the chemicals released and their hazards was not available from the company. Communication was inadequate between the company and the authorities, and within the regulators.

The accident prompted European legislation on the prevention and control of major accidents involving dangerous substances.

Why does it concern me?

The Seveso disaster is a reminder that a major accident can occur when the behaviour of a chemical reaction is not fully understood under the conditions in the reactor.

The concern is not only the intended reaction. In this case, the relevant issues included increased temperature, decomposition, lack of agitation, lack of active cooling system and the formation of dioxin.

Exothermic reaction hazards require independent protection and mitigation layers. This includes suitable instrumentation, emergency cooling or other safeguards, and emergency relief arrangements that consider where released material will go.

In the Seveso case, once the runaway reaction had developed, material from the reactor was released to the atmosphere through the vent system.

For operators, engineers, managers and regulators, the case remains relevant because it links reaction hazard knowledge with operating procedures, process control, design of relief systems, communication with authorities and major accident legislation.

Ask the following questions:

- Are the hazards of exothermic reactions sufficiently understood for the chemicals and intermediates involved?
- Are the thermodynamics, side reactions and possible decomposition products understood under intended and abnormal operating conditions?
- What can happen if a batch process is stopped before completion?
- Are agitation, heating and cooling conditions clearly defined for safe operation and shutdown?
- Are fundamental process parameters measured and visible to operators?
- If a bursting disc or relief device opens, where will the released material go?
- Is information about the chemicals released and their hazards available quickly to authorities?

The 50th anniversary is not only about remembering the accident. It is a reminder that major accident legislation matters because Seveso showed what can happen when major accident hazards are not understood, controlled and communicated.