A reaction vessel burst due to a sudden increase in its internal pressure as a result of abnormal reactions during the process producing intermediate pharmaceutical products.

[Circumstances of Incident]

The accident occurred in a plant that manufactures intermediate pharmaceutical products. The production train can be divided into reaction, maturing, analysis and degasing operations. The accident occurred during the degasing operation which byproduct gases are removed from the 6-kl reaction vessel.

On the day of the accident, two workers in the production section were carrying out the second day degasing operations under the supervision of the production manager.

As not all of coolant (ethylene green in a water solution) had been removed from the vessel jacket on the previous day, two workers had been working since the morning to try to remove the coolant by washing the vessel with steam.

Temperatures inside the vessel were elevated partly as a result of the washing operations, and additional mixing operations caused abnormal chemical reactions within the vessel, leading to the generation of heavy foam on the liquid surface at about five o'clock in the afternoon.

As the manager was absent from the operational site at the time, the two workers tried to reduce the internal pressure by opening the pressure-reducing valves at about 5:35, and then evacuated the site in anticipating imminent danger.

The vessel burst, soon with the cover plate with clamp coming off. Scattered chemicals injured five employees, including one fatality.

[Causes]

A major cause of this accident can be attributed to the plant managers who did not anticipate the occurrence of abnormal chemical reactions in the process of producing benzyl chloroformate. The following conditions can also be pointed out in relation to this.
(1) The vessel's internal pressure rapidly increased due to an abnormal reaction, thus exceeding the vessel's capability to withstand internal pressures. The vessel was not equipped with safety devices, such as safety valves or burst plugs, to release internal pressure to the outside before reaching the bursting point.

(2) Appropriate operational manuals were not prepared regarding countermeasures to deal with abnormal reactions. Namely, workers engaged in the manufacturing process cannot take the necessary measures to respond to abnormal conditions as they are not properly educated or trained.

(3) Indirect causes may include inadequate organizational measures, as shown by the lack of detailed safety and health education for related workers, and an undefined command and responsibility structure to ensure safety in production facilities.

[Type of business] Pharmaceuticals manufacturing
[Type of accident] Bursting
[Number of victims] Four injured and one fatality