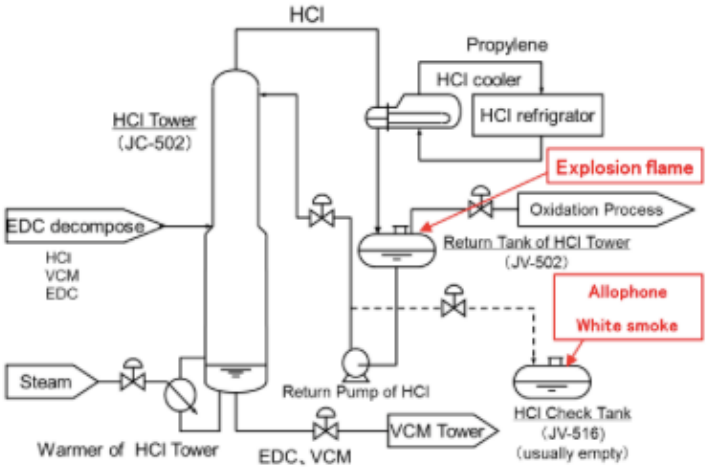
Process Safety Incident of the Week
Tosoh Accident in Japan

https://file.scirp.org/pdf/OJSST_2014092613341419.pdf

On November 13, 2011, there was an explosion and fire in the HCl tower in Tosoh Corporation in Japan. The ignition started when HCl reacted with VCM to produce 1,1-EDC catalyzed by FeCl3, which was produced by HCl and iron rust inside the back-flow tank of the HCl tower. The temperature of the back-flow tank of the HCl was increased and because it is an exothermic reaction, the reaction rate increased exponentially. It all started when the urgent discharge valve for disposal facilities of oxidation line A was broken and the valve suddenly opened during line A operation. An interlock stopped the operation on line A while line B was still operational. Stopped lines A & B of the EDC decomposition process to regulate the production of EDC, which was only produced by line B of the oxidation process. The operating line for the EDC decomposition process changed to line A only changing the operation load from 100% to 45%. The stoppage was partial, the temperature balance of the HCl tower changed and the middle tier temperature fell from 80C to 57C. To recover the temperature lost, steam was increased and reflux volume was decreased. The operator did not realize that they should control the top and bottom temperatures of the HCl tower. The temperature at the top of the tower typically is -24C, but it increased to 38C. The VCM was mixed in the upper part of the tower and the back-flow tank also. The operators thought the HCl tower condition was stable because the middle stage returned to its normal temperature. After the VCM mixed in the back-flow tank, it then mixed with the oxidation line B causing the entire production facility to stop. The managers realized the temperature at the top of the tower was not normal and assumed the VCM mixed into the back-flow tank, but were unaware of the 1,1-EDC that was generated. They stopped the back-flow pump, which brought the level of HCl in this tank back to 100% and then sealed it. The HCl tower refrigerator was stopped and the back flow tank of the HCl tower was disconnected from the main tower, so the backflow tank of the HCl tower was sealed. The transfer of liquid from the back-flow tank of the HCl tower to the liquid HCl temporary receiving tank started and the pressure of the liquid HCl in the temporary tank began to increase, something the operators were unaware of.



They soon realized the pressure increase in the temporary tank and they started pressure relief action. The allophone sounded and white smoke discharged from the top of the liquid HCl temporary tank during the relief. The pressure of the back-flow tank of the HCl tower rose to 2.0 MPaG and it can hold only a pressure of 1.9 MPaG. This pressure caused the tank to rupture, explode and burst into flames.

Key Lessons

First thing is the lack of training for the operator when he was restoring temperature to only the middle stage. It is necessary to take both the top and bottom into consideration also when increasing temperature anywhere and this was something the operator was unaware of due to gaps in his training. There was also no alarm for detecting abnormal temperatures at the top of the tower, which caused the operator to be only focused on the middle tier to be monitored. There was also a lack of written record saying the standard value of temperature of each part of the HCl tower. This plant lacked any operating standards, which did not help operators safely solve their problems.