Process Safety Incident of the Week
Tank Rupture from Mixing Waste Acids and Organics
(http://onlinelibrary.wiley.com/doi/10.1002/prs.10433/full)

Two companies on the same small multi user site in the United Kingdom together operated Tank T2 (glass reinforced plastic construction) to blend waste acids from processes. The tank ruptured in the spring 2008, releasing a cloud of NOx fumes and spilling most of its ~20,000 L of mixed acids into the bund below. The plume drifted over an unpopulated area and caused no injuries. The streams involved were being mixed in this tank without a problem since the summer of 2006. Tank T2 was then relocated and put in mixed-acid service. At the end of January 2008, the plant management discontinued running an aqueous acetic acid stream to the tank. Before the event, after being cleaned and relocated, the tank was restarted in mid-afternoon by adding 20,000 L of acidic effluent. This effluent contained 17% hydrochloric acid, 3% isopropyl alcohol, and 2% organic byproducts, which filled T2 to the 40% level. Two hours later, operators started to add 5,100 L of a stream containing 17% nitric acid. Ten minutes later, a witness observed brown fumes emitted from the tank, and a minute later it ruptured. There were no other warning signs such as activation of flow, pressure, or temperature alarms on the tank. Two pieces of the tank were thrown about 30 meters. The tank then collapsed primarily because of the loss of integrity and the weight of the pipework connections on the roof. The accident investigation established that a key change was discontinuing the acetic acid stream, which serves to dilute the exothermic reaction of nitric acid with the small quantities of isopropyl alcohol and other organics.

(Figure of ruptured tank)

Key Lessons

Based upon laboratory simulations conducted, the nitration reaction is highly concentration dependent and had either of the streams to T2 been at least 10% more dilute, the reaction would probably not have occurred. It is learned here the order of addition is critical and the ratio of each component in the wastewater streams is very important in determining the consequences. A combination of these events led to a very unusual waste mixture. The chemical reactions in this stream were capable of generating large quantities of non-condensable gases in a short time after a long induction time. It was the gas generation that led the pressure burst. It is important that a company applies their safety culture to all areas even waste. These materials are still products of a process and should be treated as such.