

The agitator stopped! Now what??

November 2023



Figure 1. Resin building after the internal explosion
(Source: CSB report No. 2021-04-I-OH)

The incident occurred when the reaction in a vessel was nearly complete. While the operator was not near the reactor, the agitator shut down. A few minutes later, the operator began cooling the kettle's contents; the agitator should have been running, but it remained stopped.

The operator added solvent into the top of the kettle. The batch temperature was about 430°F (221°C), and the solvent was at approximately 70°F (21°C). The operator noticed that the temperature was not dropping and looked through the sight glass on the manway and noticed the agitator had stopped. Knowing that the agitator was supposed to run while cooling, he turned it back on.

The agitation mixed the stagnant layers of hot resin and liquid solvent. The solvent vaporized, and quickly increased the pressure inside the kettle; this triggered the kettle's high-pressure alarm. Within a few seconds, liquid resin and flammable solvent vapor were ejected from the manway, which quickly filled the enclosed room with white vapor. The operator tried to turn off the agitator, but failed because he could not see and had been sprayed with hot resin. He then evacuated. About 2 minutes after the release began, the vapor cloud ignited and exploded. One employee was killed, eight others required medical attention. The resin building was destroyed. (See Figure 1)

Did You Know?

- Agitators can stop due to mechanical, power or control failures. Agitator failure may be detected by the control system, or through visual inspection.
- When some mechanical failures occur, the agitator motor can be running, but there is no mixing.
- Certain process steps, such as sampling, may require the agitator to be temporarily stopped. Operating procedures need to explain when to stop and restart agitation.
- Adding a volatile material or solvent to a process above the solvent's boiling point can produce rapid boiling and increase pressure.
- Agitation moves material to the cooling surfaces. When agitation is stopped, cooling is also reduced.
- When the agitator is restarted, volatile materials may vaporize and increase the reactor pressure.
- The decision to restart the agitator depends on many factors such as how long it has been off, the materials in the process, and others. (See the August 2018 Beacon)
- Process Hazard Analyses (PHAs) should include agitator failure and restart as a topic of review and discussion.

What Can You Do?

- Operating chemical processes requires careful monitoring of the process variables: temperature, pressure, and agitator status.
- When the procedure directs you to stop the agitator and take an action, read the entire step to determine whether to restart it or not after the action is completed.
- If the agitator stops or you find it did not restart, contact your supervisor to determine the correct action.
- During PHAs, agitator failure must be carefully reviewed. There are many variables to determine the hazards and proper corrective actions.

When the agitator stops – Ask for help!!