

Terra Industries Ammonium Nitrate Explosion

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<https://archive.epa.gov/emergencies/docs/chem/web/pdf/cterra.pdf>

Activity

Terra Industries fertilizer plant located in Port Neal, IA produced nitric acid, ammonia, ammonium nitrate, urea, and ureaA ammonium nitrate. The process was being shut down and ammonium nitrate solution was left inside multiple vessels.

Hazard

The Safety Data Sheet for ammonium nitrate states:

May intensify fire; oxidizer

Causes serious eye irritation

Preventative Actions and Safeguards

Ensure proper operating procedure is in place for all parts of the process.

Contingency Plan/ Mitigating Actions

Have awareness of the chemicals and the hazards that you are working with. Have proper evacuation with any emergency.

Initiating Event

Ammonia from the urea plant offA gas or from ammonia storage tanks would be added to the neutralizer through a sparger in the bottom of the vessel, and 55% nitric acid was added through a sparging ring in the middle of the vessel. The product, containing 83% ammonium nitrate, was sent to a rundown tank through the overflow line for transfer to storage. A pH probe placed on the overflow line, which kept the pH around 5.5A 6.5, maintained the nitric acid flow to the neutralizer. The temperature also was maintained around 267F. The neutralizer and rundown tank were vented to the scrubber, and the vapors were absorbed by 55A 65% nitric acid. A stream of 50% ammonium nitrate was recycled back to the neutralizer. A few weeks earlier to the incident, the pH probe was defective, so the plant switched to manual pH sampling.

Incident

Two days prior to the incident, the pH was found to be 1.5 and was not brought into acceptable range until 1am on December 12th. The ammonium nitrate plant was shut down around 3pm on December 12th because the nitric acid plant was out of service. Operators purged the nitric acid feed line to the neutralizer using air, and a few hours later the scrubber solution got pumped to the neutralizer. A 200A psig steam, at a temperature around 387F, was applied through the nitric acid feed line to prevent backflow of ammonium nitrate into the line. An explosion occurred at 6am on December 13th, killing four people and injuring eighteen others. There was serious damage to the plant, and nitric acid was released into the ground and anhydrous ammonia into the air. Ammonium Nitrate is sensitive to decomposition and detonation at low pH levels, high temperatures, lowA density area, confined spaces, and in presence of contaminant. After investigation, it was found that the pH dropped to 0.8 during shutdown, and the steam was left on for 9 hours, raising the temperature of the solution to its boiling point. Also, the air and steam created bubbles in the solution and chlorides from the nitric acid plant were also present in the solution. All the factors contributed to the explosion at the fertilizer plant.

Lessons Learned

Terra Industries had no proper safe operating procedures for when their vessels were being shutdown or for monitoring while they are shutdown. Operating procedures should cover all phases of the process, from start up to shutdown. The plan had performed no hazard analysis prior to running the ammonium nitrate plant. The workers were unaware and not properly training on the many hazards of ammonium nitrate. It is imperative before start up of any plant to be fully aware of the chemicals you are working with and be aware of their hazards and train workers accordingly.

