Explosion and Fire at the Former Horsehead Zinc Facility

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https://www.csb.gov/horsehead-holding-company-fatal-explosion-and-fire/

Activity

In Monaca, Pennsylvania, Horsehead Zinc Facility specialized in zinc refining which included stages such as zinc distilling. The plant had multiple zinc distillation columns in their refinery building. Horsehead used the "New Jersey" zinc process, which is a distillation-based method that was first developed in the 1920's. Some of these indoor columns were several stories tall. The column of interest contained 48 silicon carbide trays; a reflux tower was at the top while the bottom was surrounded by a masonry combustion chamber fueled by natural gas and carbon monoxide waste gas. At this facility, the columns typically operated up to 500 days and then disassembled and rebuilt with new trays. A new column was constructed 12 days earlier. This column typically running at 1600F flowed zinc as a liquid from the bottom of the column from lower- boiling impurities such as cadmium, which left as a vapor from the overhead line. There normally were only small amounts of liquid metals in various trays, and flooding of the column creates very dangerous conditions.

Two operators at the plant were performing maintenance work on one of the columns in the refinery building.

Hazard

The Safety Data Sheet for zinc notes the hazards of this material including:

- Causes serious eye damage
- Harmful if swallowed
- Very toxic to aquatic life

Preventative Actions and Safeguards

Make sure the proper equipment is being used for the process it is running.

Contingency Plan/ Mitigating Actions

Ensure proper training is in place to know the dangers of the process and the equipment.

Initiating Event

The indoor distillation column was several stories tall that caused problems. The underlying cause of was assumed to be flooding. With further investigation the flooding was likely caused due to partial obstruction of the column sump, a drain-like masonry structure, which had no been replaced when rebuilt. The column before was shut down early due to sump draining problems and the issue was never properly corrected. Under extreme pressure the tray walls collapsed and there was a large amount of zinc vapor. The failing of the trays caused the combustion chamber blast panels to be dislodged, which allowed the vapor to be released into the air. At high temperatures, zinc vapor combusts spontaneously in the presence of air.

Incident

Ten minutes before the explosion, alarms sounded in the control room due to the big temperature change in the column waste gases. The operators who were performing maintenance on the nearby columns answered to the alarms by cutting the flow of fuel gas to the column, but did not lower the flow of zinc into the column. The operators did not understand the unsafe condition that the column was in so no evacuation took place. Two operators died due to the column bursting inside the refinery building, and another was seriously injured.

Lessons Learned

Several opportunities to prevent the accident were missed. The blocked column sump, which was apparent days before the accident, was disregarded. All incidents can be prevented, and this is a key example of how there are warning signs that are given that could have avoided this accident all together. Technician background and training is important as to know all the dangers that can happen in these columns.