SAFETY DIGEST
U.S. Chemical Safety and Hazard Investigation Board
20 Years of Driving Chemical Safety Change 1998 2018
CSB U.S. Chemical Safety and Hazard Investigation Board

Combustible Dust Explosion

> **Incident Date: January 29, 2003**
> **Kinston, North Carolina**
> **6 Killed, 38 Injured**
> **Full Report on CSB Website**

Aerial view of the West Pharmaceuticals Services following 2003 dust explosion

CSB Driver of Critical Chemical Safety Change

Combustible dust has been identified as one of the CSB's Drivers of Critical Chemical Safety Change. Combustible dust-fueled fires and explosions continue to injure and claim the lives of workers across a broad spectrum of industries, including the food, chemical, paper, pharmaceutical, and metal processing industries. In 2006, after investigating three combustible dust-related incidents over a two-year period, the CSB conducted an in-depth study that identified 281 combustible dust incidents between 1980 and 2005 that killed 119 workers, injured 718, and extensively damaged industrial facilities. Since that time, the CSB has conducted four additional investigations into dust-related incidents, and the agency's Office of Incident Screening and Selection continues to identify serious dust-related incidents on a regular basis. The CSB believes that a general industry standard for combustible dust is greatly needed to prevent future tragedies. More information can be found at: http://www.csb.gov/recommendations/mostwanted/combustibledust/

Incident Summary

On January 29, 2003, an explosion and fire occurred at the West Pharmaceutical Services rubber-manufacturing plant in Kinston, North Carolina, taking the lives of six employees, and injuring 38 others including two firefighters who responded to the incident. The blast occurred without warning at 1:28 PM during a routine workday and could be heard 25 miles from the plant. A student at a school more than half a mile away was injured by shattered glass. Flaming debris set woods on fire as far as two miles away.

The CSB investigation traced the explosion to a hazard that had developed in the plant over the years: combustible dust from a plastic raw material had accumulated on hidden surfaces above the production area, creating the fuel for a massive explosion and fire. At the plant, batches of rubber were compounded in mixers, rolled into strips, and then either molded or shipped off site. To reduce the stickiness of the rubber, the strips were conveyed through a tank containing very fine talc-like polyethylene powder mixed with water. The coated rubber strips were then blown dry with fans. Polyethylene dust became airborne in the process.

The polyethylene dust settled on surfaces around the production area. Because the facility produced supplies for medical use, cleanliness was a high priority, and crews continuously cleaned dust from visible areas. However, dust was also drawn upward

through several ventilation air intakes that were located over an acoustic tile ceiling installed above the rubber-production area. Above that ceiling, visible only to maintenance workers, the dust gradually built up to a thickness of one-quarter to one-half inch on ceiling tiles, beams, conduits, and light fixtures. As much as a ton of combustible powder could have accumulated in the area above the ceiling, just a few feet over the heads of production workers.

Engineering Practices

Good engineering practice calls for consulting available codes and standards during project design. West was well-positioned to understand its own rubber process and the materials in use. The company hired outside engineering contractors, however, to design and install the process in Kinston. That process was not suitable for handling combustible powders, such as polyethylene or zinc stearate, the CSB determined. For example, the use of fans to dry the coated rubber dispersed dust throughout the work area. The unsealed acoustic tile ceiling allowed large amounts of dust to accumulate in concealed areas that were difficult to clean. The electrical fixtures and wiring in the production area were general-purpose and not rated for use around combustible dust.

Animation still from the CSB's Safety Video ***Combustible Dust: An Insidious Hazard***

NFPA Standard 654 includes a variety of good practices to prevent dust explosions. The standard states that dust accumulations of just 1/32 of an inch thick create conditions for a dangerous explosion and must be removed. Specific NFPA provisions that would likely have prevented the tragedy include: segregating dust-producing operations; sealing off walls, ceilings, and partitions to prevent intrusion and accumulation of dust; installing electric equipment suitable for explosive atmospheres; and regularly training employees on combustible dust hazards.

Combustible Dust

Combustible dust is any finely divided solid, such as flour, wood dust, or coal dust, that will burn when dispersed in air and ignited. When dispersed in a confined space, combustible dust can explode. Once an initial explosion occurs, the pressure from the blast can disturb dust that has accumulated on other surfaces, often leading to secondary explosions that can spread through a facility. Combustible dust is a serious hazard because it can accumulate in hidden areas and remain there undetected for years. The keys to avoiding catastrophic dust explosions are: recognizing the hazard; designing facilities and work practices to prevent the spread of dust; instituting effective housekeeping programs to remove dust accumulations; and controlling possible ignition sources.