



## SYSTEM FAILURE CASE STUDIES

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# Dust to Dust

*On February 7, 2008, a series of violent explosions devastated a sugar refinery in Port Wentworth, Georgia (Figure 1). Workers inside had little time to escape as pressure waves heaved concrete floors, blasted brick walls, and collapsed stairwells. Combustible sugar dust, along with sugar that had spilled from packing and processing machinery, fueled fires that burned up to seven days after the initial blast. The explosions claimed the lives of 14 workers and critically injured 36 others. The blaze ravaged storehouses, packaging buildings, and processing areas that had been operating for more than eighty years. The U.S. Chemical Safety Board deemed it the most devastating dust explosion in decades.*

### BACKGROUND

#### Combustible Dust Explosions

Many industries generate fine dust particles when their products pass through processing areas and machinery. Common combustible dusts come from coal, wood, rubber, plastics, chemicals, metals, and food products. According to the Occupational Safety and Health Administration (OSHA), particles with a diameter of 420 microns or less become explosive when dispersed in a confined space. Suspended particles burn rapidly, and when airborne dust meets an ignition source, a deflagration may occur. A deflagration is an exothermic reaction that propagates to unreacted material at a rate that is slower than the speed of sound. If a deflagration occurs in a confined space, gas pressure from the combustion reaction could exceed the strength of the container, resulting in an explosion. Often, machines containing potentially explosive atmospheres use mechanisms that vent overpressure to the exterior, a tactic that preserves the structural capability of the container should a deflagration occur.

An explosion that takes place in an unvented enclosure can quickly become catastrophic. If combustible dust has accumulated in other areas of the facility, shock waves from the initial explosion can dislodge it, and the fireball can ignite the falling dust. This triggers a chain reaction of secondary explosions. Because of the increased concentration and quantity of airborne particles, secondary explosions can be more powerful and destructive than primary explosions. According to the National Fire Protection Agency (NFPA), when 5% of the



**Figure 1: Imperial Sugar Company's refinery in Port Wentworth, GA, suffered catastrophic damage when combustible sugar dust exploded.**

surfaces in a facility are covered with 1/32 of an inch of combustible dust, that facility faces high risk of suffering a serious dust explosion chain reaction.

#### Imperial Sugar Company

Savannah Food and Industries built the Port Wentworth sugar refinery in 1917 and sold it to Imperial Sugar Company in 1997. The facility converted raw cane sugar into granulated sugar, then packaged or refined it into specialty sugar products. In 2007, the plant produced 2.6 billion pounds of sugar, making it the second largest sugar refinery in the nation.

### Sugar Refinery Explosion Kills 14, Injures 36.

#### Proximate Causes:

- Combustible dust accumulates in confined space
- Dust ignites, resulting in primary explosion
- Explosion disturbs accumulated dust in other areas of refinery
- Dislodged dust ignites, fuels further explosions

#### Underlying Issues:

- Absence of risk management
- Lack of operator training
- Normalization of Deviance





