

Engineering Ethics: Combustible Dust Explosion at Georgia Imperial Sugar Plant

An Online Continuing Education Course for Engineers

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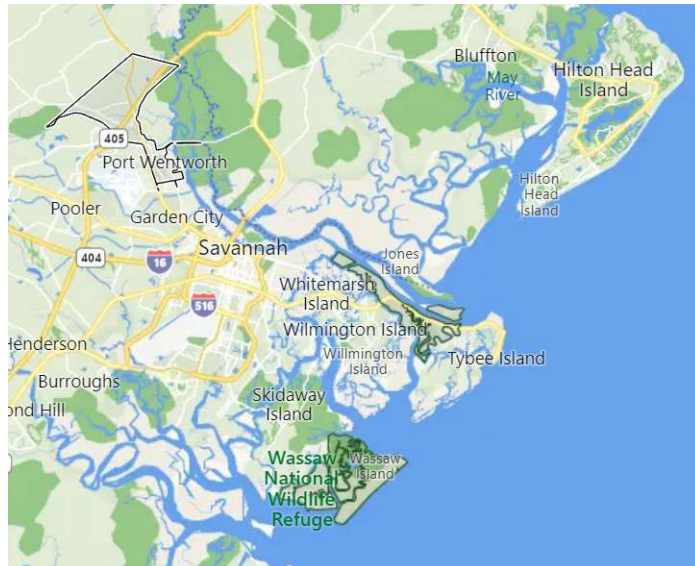
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Engineering Ethics: Combustible Dust Explosion at Georgia Imperial Sugar Plant

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Background

Port Wentworth, Georgia, is located near the Atlantic Ocean just Northwest of Savannah and Southwest of Hilton Head, South Carolina. With shipping access to the Atlantic, this small town in Georgia has less than ten thousand residents. The Imperial Sugar plant is one of the city's larger employers and provides above-average living wages to many of the residents in Port Wentworth.



When a large business resides in such a small, close-knit community, an accident or injury impacts the entire community. On February 7, 2008, this community would be rocked by several explosions at the Imperial Sugar Company plant. The result of these catastrophic events left 14-people lifeless and another 36 injured.

More than 350 employees and contractors worked at Imperial Sugar Company, where annual average sugar production exceeds 700,000 tons. There were approximately 112 persons on site when the explosion occurred around 7:00 pm. Contractors and most office staff had gone home by the time the explosion transpired. This, in some respects, proved to be a small blessing in disguise.

Why should Professional Engineers be concerned or interested in Combustible Dust Explosions at a sugar refiner? For the same reasons, they should be interested in the City of Lemoore Raw Water Tank Explosion. These events have taken place in locations and plants that no one

expected them to. The Professional Engineer is a scientist, risk manager, and designer and wears many other hats that civilians not in the profession may realize.

Learning from these tragic events opens our eyes and removes the blinders to what we perceive as normal and acceptable. Professional Engineers are obligated to see beyond scope, schedule, budget, quality, and profit. One of the most disheartening things that professional incident investigators hear from employees after a catastrophic event is, “I thought we were safe, I never thought that could happen here, no one told us it was unsafe to run like this; this is normally how we run.”

This should send chills up your spine. Many of the people that the hourly employees rely on to keep them safe are Professional Engineers. We often end up in leadership and management roles. However, we can never allow our creeds, oaths, and ethics to be compromised by business obligations as long as we carry the “PE” after our names.

The Chemical Safety Board (CSB) has a comprehensive investigation report and video detailing the Imperial Sugar Dust Explosion incident (Report No. 2008-05-I-GA) on its webpage. Not necessary to complete this training module; some information to construct this training was obtained from this report. Other readings of newspaper articles were also utilized to learn the history of this tragedy, along with the author's own accounts from resources known to him.

There were several aspects at play that led to this incident. The key issues were:

- Hazard recognition
- Normalization of Deviance
- Combustible Dust Accumulation
- Equipment Design
- Acceptable Routine Maintenance Practices
- General Housekeeping

We hope you will purchase this module. Our thoughts are that even though this incident may not be even remotely similar to your work situation, understanding how to envision hidden dangers no one else can see will be. This module will train your eyes and mind on how to go beyond the day-to-day. Our goal is not to allow you to become normalized into less than adequate production, operation, and engineering design practices that foster catastrophic failures.

Incident Review

The Event

In the evening hours of February 7, 2008, just after 7:15 pm, Imperial Sugar CEO began a tour of the facility at Port Wentworth with three other employees. As they trekked through the refinery, they made their way towards the south packing building. Surprised by a loud noise and a slight ground vibration, the men paused. Having felt and heard similar coincidences when a heavy roll of the packing material is dropped from a forklift, their first thought was not of alarm.

Initially not concerned, a few seconds later, they were dismayed when a louder explosion knocked them backward. Shocked and trying to discern what was going on, debris blew through the packing building doorway. The explosion rang out through the entire plant. Just inside the south packing building, three-inch-thick concrete floors rose up, buckling from the stress.

Employees working inside the packaging buildings had no prior warning of the eminent dangers and were completely caught by surprise. The walls of the packing building, furniture, and equipment were tossed about. Exposed skin was scorched by superheated air propagated by the blast wave. Debris was scattered throughout walkways and pathways that led to exits. Collapsed brick walls blocked some exits and made others nearly impassable. Smoke and dust filled the air making visibility in some areas very difficult. The sprinkler systems failed due to ruptured water lines as the explosion progressed through the plant.

Eyewitnesses stated that intense fireballs advanced through the entire north and south packing buildings as well as the palletizer building. Sugar dust, shaken loose from surfaces, ignited like fuel vapors. Some of the concrete floors opened to lower levels igniting piles of granulated and powdered sugar that had accumulated around equipment, raining down and intensifying fires already burning. The fireballs continued to prorogate through an enclosed screw conveyor, igniting additional fires in the refinery and bulk sugar building hundreds of yards away from where the incident began. Dozens of eruptions continued inside the facility for more than 15 minutes as spilled sugar and accumulated sugar dust continued fueling fires.

The author recalls the dangers of dust explosions in high school chemistry class. An instructor, the school's swimming coach, would conduct experiments on Fridays. This broke up the long

week into a more relaxed and fun learning atmosphere. He had contracted the shop class to construct a one and one-half cubic-foot plexiglass square. The bottom was constructed of sturdy plywood, with plexiglass walls and top. An opening on the top of the container allowed access through a removable plastic lid. A brass coupling was attached near the floor on one side that allowed an air hose to be attached.

The instructor would take us to a parking lot and clear a space about 50-feet in all directions. He would have a plate with ordinary baking flour inserted into the box next to the air hose opening. A lit candle would also be placed inside the box. The lid, with a few small air holes, would then be placed on the box. A lucky student would be selected on his command to depress the hand air pump a couple of times. The air would suspend the flour, and the flame from the candle would ignite it. Sometimes the plastic lid would fly off from the explosion. We performed the experiment several times with other items like confectionary sugar, baking soda, sawdust, coffee grounds, powdered coffee creamer, and whatever else he could collect. Some would explode, and some would not. We scientifically noted our experiment results.

The point of this monologue is that Professional Engineers have privileged knowledge by formal education and experience many businessmen, hourly, and laypersons may not possess. We are not saying that it was the fault of an engineer in this case. We are educating you that your role may place you in a position at a company similar to this.

Within companies like Imperial Sugar, the maintenance and facilities department managers are held by Mechanical, Civil, or Manufacturing Engineers. The same is similar to the engineering department manager role. During our formative years, we learn many things like the flour experiment above. So, were the managers at this facility aware that this could happen? Did they understand that poor housekeeping could lead to a tragedy that was completely avoidable? These questions will be answered as we continue with the investigation review.

The Emergency Response

Port Wentworth and nearby Garden City fire and rescue teams arrived within 10 minutes of the initial blast. Confronted with chaos, dense smoke, intense heat, ruptured water lines, debris, and continued fires, they attempted to reach the injured employees. Surviving employees had already

begun rescuing co-workers, staging them near the main guardhouse. Rescue and recovery took several hours. As the rescue continued and word spread to other communities, over a dozen nearby rescue teams arrived to assist with the emergency efforts.

Building fires were brought under control by the next morning. However, storage silo fires burned for another seven days. Thirty-six employees survived their injuries, with fourteen succumbing to them. Another seventy employees walked away from the accident with little or no injuries but were left with emotional scars.

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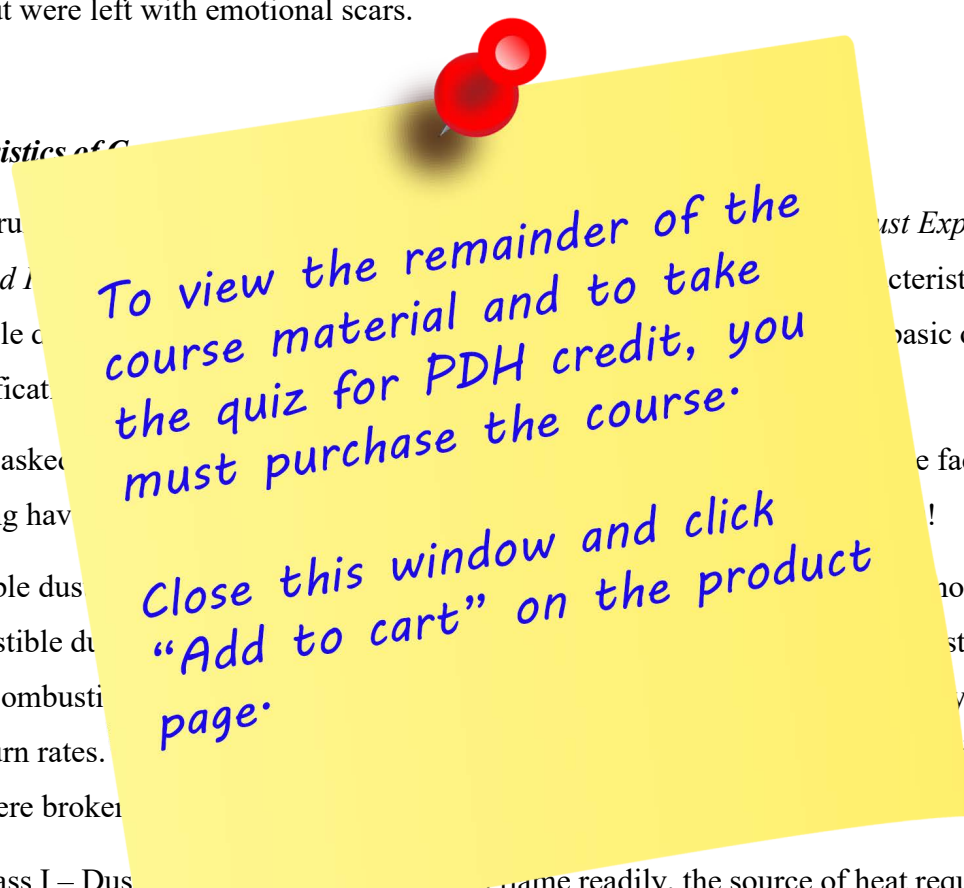
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- Class I – Dust that is readily ignited and which, for the propagation of flame, requires a heat source of large size or high temperature.
- Class II – Dust that is readily ignited and which, for the propagation of flame, requires a heat source of large size or high temperature.
- Class III – Dust that does not appear to be capable of propagating flame.

Other scientists followed, expanding on Wheeler’s initial research. Their examination corroborated that sugar, dextrin, starch, and cocoa are the most dangerous, with sugar being one of the most dangerous. Sugar ignites when aspirated as a dust cloud against a heating source just



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