# Defusing the Tinderbox

Cost-effective techniques to mitigate dust- related risks are available to less sophisticated wood pellet mills, where a lack of capital, education, code knowledge, and proper cleaning and maintenance protocols may exist.

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Under the right substandard conditions at a wood pellet mill, the creation of a spark is like throwing a match into a dynamite factory. "Wood is about

like gunpowder, and it's as explosive in the right scenario," says Justin Price, principal at Ever-green Engineering Inc. The risks are the same at small and large mills alike. The difference is that smaller plants typically don't have the dust hazard analysis (DHA) expertise found in larger, more sophisticated facilities, Price says, and therefore they don't realize the risks and dangers facing them. "The bigger facilities have a larger staff and greater expertise," he says. "It's an educational issue."

Smaller-scale pellet mills could be at greater risk for dust-related safety incidents because they may have less knowledge of the codes and risks, less capital to invest in fire detection and explosion suppression and prevention technologies, less operating capital to rotate staff for proper cleaning and maintenance, and insufficient training. "Housekeeping should be a primary concern to these folks," says David Grandaw, vice president of sales at IEP Technologies. These plants should at least prioritize keeping residual dust to a minimum, he says.

Price says preventive maintenance programs around cleaning are more vigorous in larger mills. "Smaller facilities generally have fewer hands on deck to do this, and it's a harder challenge to justify hiring two guys to sweep the floor and clean the building," he says, whereas a larger plant with larger volumes can rotate those responsibilities out to take care of some housekeeping. "The other thing is process expectations," Price continues. "Smaller plants realize fires are common. They will happen. It's a cost of doing business. They have fire protection systems in place to fight fires, but larger facilities implement measures to prevent fires. If I'm walking through a smaller operation, I look up when I see a charred bin and they say, 'Yeah, we had another fire there,' or 'Yeah, fire happens routinely.' That's just part of operating to them. In reality, that's not necessarily true. It's an educational standpoint some operations just don't have." Price says this is becoming less the issue as the pellet industry matures.

Experts say keeping residual dust to a minimum is extremely important because of how the dynamics of an explosion work. Explosions send shock waves at the speed of sound, faster than the flame behind it, which can rattle dust built up on conveyors, pulleys and rafters into suspension. Then, the lagging fireball catches up and finds the dust cloud, turning the room into a secondary explosion. "That's what blows up the building and kills people," Grandaw says.

When improperly maintained or installed outside a sound management-of-change program, some devices intended to mitigate dust-related risks, such as dust collectors, can constitute a big safety threat. Dust collectors are often a first line of equipment defense to keep residual dust down at a pellet mill. "Dust collectors in general are probably one of the most dangerous vessels for an explosion in a facility," Grandaw says.

Dust collectors contain the finest dust in the plant captured from vents, separated from the air and collected in a filter medium or bag periodically cleaned pneumatically or mechanically, which reintroduces fine dust to the air. "Having the finest dust means having the most aggressive explosion characteristics," Grandaw says. Furthermore, the finest dust requires less ignition energy to light, so it ignites easier. Finally, dust collectors are often connected to multiple vessels within the facility, especially in smaller operations that rely on one or two central collectors as they lack capital for multiple units. When an explosion occurs, the flame propagation travels upstream to the main duct and out to various parts of the facility from where the dust was extracted, exposing multiple areas to danger, Grandaw says.

## Repeat Offenders

In 2012, the U.S. Department of Labor's Occupational Safety and Health Administration cited New England Wood Pellet LLC for serious repeat violations of workplace safety standards at its wood pellet plant in Jaffrey, New Hampshire, proposing fines of $147,000 for fire and explosion hazards in the aftermath of an Oct.

20, 2011, fire at the facility. According to OSHA, the fire started in the pellet mill and was transported through several conveying systems to a pellet cooler and then to a dust collector, and caused several other flash fires. Shortly thereafter, explosions occurred in the dust collector and an exhaust muffler. The explosions sent fireballs outside of the building and likely ignited materials in two silos.

The 2012 OSHA inspection found numerous fire and explosion hazards stemming from the absence of protective devices in the transport system, dust collection duct and conveyor systems that would prevent sparks, embers and fires from spreading throughout the system, as well as a lack of effective explosion protection due to the construction or location of dust collection ducts. The hazards were exacerbated by a buildup of combustible wood dust on surfaces throughout the plant and from the use of unsafe equipment to vacuum combustible dust.

In 2013, OSHA cited the company again, this time for violations following inspections of its New York mills in Schuyler and Deposit. The violations found at the Schuyler plant included failing to isolate the conveying systems to prevent fire and rapid combustion from spreading both upstream and downstream in critical process equipment. In addition, the process equipment, such as indoor cyclones, pellet coolers and silos, lacked containment, explosion venting and suppression to mitigate the hazards of rapid and explosive combustion. At the Deposit plant, the violations include inadequate ventilation, lack of isolation devices and lack of spark detection and extinguishing systems in the wood pellet processing system.

"We thought we were in good shape," says Mark Wilson, CEO of New England Wood Pellet. "We thought we knew a lot, but we didn't know much at all. None of us had any background on National Fire Protection Association codes. We knew parts."

Unfortunately, this mentality exemplified through incidents and OSHA citations is not uncommon in the pellet industry. In 2013, a combustible wood dust explosion and fire occurred at Inferno Wood Pellet Inc. in East Providence, Rhode Island, injuring a worker and partially demolishing the building. The ignition of wood dust in the plant's production room migrated to a retention bin, resulting in an explosion that spread through the building. OSHA found that the retention bin lacked spark detection, explosion suppression, fire and explosion isolation and explosion venting devices; conveyor systems carrying combustible wood products lacked spark detection, fire suppression or fire isolation devices; dust collection systems and dust segregation barriers were not maintained to minimize fire sources; and an opening in the fire wall between the plant's production and chip rooms allowed a fireball to enter the chip room and spread the fire. OSHA cited Inferno for 11 serious violations of workplace safety standards and proposed $43,400 in fines. The mill has since been shut down.

## Solutions

After dust collectors, other areas where Grandaw says pellet mills should consider implementing explosion protection systems are cyclones (a different type of airmaterial separator), hammer mills or other particle-size reducers, which are active ignition sources, and equipment associated with hammer mills that are exposed to the threats. In addition, pellet coolers, storage vessels such as bins, hoppers and silos, bucket elevators, which have ignition potential between bearings, belt rubs and static discharge, not to mention drag conveyors—"a beautiful conduit,"

*THREAT CONTAINED: After a 2011 fire at New England Wood Pellet LLC's manufacturing plant in Jaffrey, New Hampshire, and multiple repeat citations on safety violations from OSHA, the company invested $2 million in fire and explosion safety equipment at its facilities, and implemented several new risk-mitigation programs.*

Grandaw says—and rotary dryers should all be evaluated. "You take a small operation vs. a big company," Grandaw says, "and they're looking at all these vessels but can't afford to protect them all. That's why it's so important to do a process hazard analysis (PHA), to determine where the risks are and what can be done to minimize the risks. And then they have to make choices."

A thorough analysis may determine that, in certain parts of the process, the risk of fire or explosion in a particular vessel is less than another near an active ignition source. Also, a mill may choose to protect equipment that, if lost to a fire, would cause the entire operation to cease.

Another obvious consideration is protecting equipment that would endanger life without protection. Companies operating on a budget must prioritize what to protect in terms of ignition potential and risk to human health and business continuity, Grandaw says.

Mitigating the presence of dust through suppressors, like Dust Solutions Inc.'s Dry Fog system, can reduce dust suspension and aid housekeeping. The technology creates droplets smaller than 10 microns that agglomerate to dust at points of transfer, such as truck tippers, hopper loaders and conveyor transfers, says Richard Posner, president of Dust Solutions. "At conveyance transfer points, there are two areas of dust generation," Posner says. "That's discharging from one conveyor to another, and the biggest is when wood impacts the belt below and plumes out." Dry Fog nozzles are positioned at the discharge area to knock dust down and at the impact point to help drop the dust into the pile. The system adds less than 0.1 percent moisture by volume, Posner says.

Spark detection and suppression systems are another line of defense. Though IEP Technologies does not offer these systems in the U.S., Grandaw says it does overseas. "Spark detection systems are looking for burning embers or hot spots traveling through the duct," he says. Based on airflow rates and the system's response time, X amount of feet downstream a water nozzle activates to suppress the ember. "It's a very effective explosion prevention means for pneumatic conveyance," Grandaw says. "It only takes care of one type of ignition source, an ember that's conveyed. It does not protect against static discharge or frictional heating."

Explosion protection comes in passive and active systems. A passive system provides protection based on pressure waves through an explosion rupture panel or an isolation valve in ductwork, Grandaw says. "It's the least expensive, so if passive can be used, that's going to be the No. 1 choice," he tells Biomass Magazine. Explosion vent panels must be placed to direct fireballs to a safe area outside the plant. If that's not possible, a flameless explosion vent is an option, albeit perhaps more expensive. Grandaw says these are vent panels with a metal mesh housing that act as a heat sink. An isolation valve, on the other hand, can passively protect against an explosion that occurs in a vented dust collector from traveling upstream. "The pressure wave that precedes the flame closes the valve," he says.

Price says the No. 1 move for a pellet mill on a tight budget looking to mitigate risks, especially a new facility scaled at 50,000 tons or less, is getting a DHA. "The second part is there are some basic minimums you need to address, such as knowing that when you're conveying material down an air system pneumatically, look for capital improvements through spark detection and deluging," he says. "Third string is to look at rotating machinery systems. Address anything you can't do in housecleaning, such as deluge and suppression. If you roll all those together, you end up with a really good system. The fourth tier is housecleaning, misters and other equipment to knock down dust, fans—low capital items—things that will help in housecleaning. A $2,000 fan is going to save you time and expense in keeping dust from the rafters and ceiling. If you do a DHA properly, lower-cost capital expenses can prevent you from having issues with dust accumulation."

For cost-conscious facilities, knowledge of codes and best practices can come through a variety of resources, Price says. "Look to traditional wood processing industries and see what they're doing," Price says. "There'll be some great learning there that'll save you tremendous amounts of time and energy." Canada-based FPInnovations and Work-Safe BC have invaluable assessments and best practices of sawmills. FM Global also has best practices to glean information from. Also, the American Industrial Hygiene Association's annual event is worth attending. All of these are great resources, Price says, adding that the biggest educational component has been through OSHA's combustible dust initiative. "The larger facilities have engineers and designers, expertise in code compliance," he says. "The small guys tend to not afford hiring code-specific people, so they put it together the best they can with the local jurisdiction—it's more compliance-based."

OSHA's role as a regulatory body in mitigating risk may seem heavy-handed, but Wilson says New England Wood Pellet's experiences with the agency vastly improved safety at its mills. "We have a great relationship with OSHA," Wilson says. "They recommend experts to bring in and we ultimately made a number of changes to our equipment, putting in certain fire and explosion mitigation systems."

After its 2011 fire and numerous citations, the company invested more than $2 million in safety equipment and implemented a combustible dust and housekeeping safety program formalized with training. "We were cleaning with Shop-Vacs," Wilson says. "That's not allowed, so we purchased Class 1 vacuum systems, expensive ones that you can use in hazardous environments. We formalized a management-of-change program, so we are not allowed to change equipment and processes until we conduct reviews on what could happen. And we also implemented a formal preventative maintenance program."

The company's hammer mills and dryers are indoors, which Wilson says adds another layer of protection. "We also implemented top-of-the-line Firefly spark detection and suppression systems on our pellet mills, coolers, baghouses, dryers, cyclones and hammer mills," he says. "We also had to do a lot of work in our bucket systems. We had to have the correct air locks in place, and put in explosion vents on our silos, cyclones, and baghouses, and a properly designed explosion protection system on our hammer mills, baghouses, certain conveyors, and on our dryers and cyclones. We did a lot of work. And we spent a lot of time reading NFPA codes over and over and over again. We overdid it. For instance, we did not have to put in an explosion suppression system on our dryer, but we wanted to do the right thing. The only thing incumbent upon us now is following through on our housekeeping, preventative maintenance and management of change. If we do all those, OSHA tells us we can't do any more to protect our workers."


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