Biomass Industry & Dust Safety

CV TECHNOLOGY®
FIRE AND EXPLOSION PROTECTION

Biomass Industry

Approximately 2.3% of total U.S. annual energy consumption comes from wood and wood pieces—bark, sawdust, wood chips, wood scrap, and paper mill residues.

Biomass in bulk is a dangerous material that can ignite and lead to combustion events. Fine wood particles that are generated during the transport or handling of wood materials behaves as a combustible dust. A growing number of loss history events have occurred in biomass and wood pellet manufacturing and handling facilities.

Using Wood as Biomass Fuel

Wood has been used as fuel for centuries, and today it is most often burned in biomass power plants.

Burning wood provides a low-carbon alternative to using traditional fossil fuels. Wood bioenergy or wood pellets can reduce greenhouse gas emissions while providing a sustainable supply chain for energy production. Responsible forestry practices and sourcing wood material from waste streams of other wood production facilities keeps this important biomass source sustainable. Wood pellets provide a safe, reliable, and affordable power source.

Wood pellets are created when wood material is compressed into a pellet form. Biomass materials are dried and reduced in particle size prior to be compressed. Manufacturing processes to prepare the biomass materials produce combustible dust hazards.

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Wood Pellet Manufacturing Process Risks

Wood pellets are designed to burn as they are made from combustible dust that is pressed into a pellet. Combustible dusts are fine particles that present an explosion hazard when suspended in air at certain concentrations.

There are many important factors when considering the explosivity of combustible dust including size, shape, moisture, and environment. The industry refers to the dust explosion pentagon when illustrating the mix of components that need to be present to cause explosions or fires. The five elements of the pentagon include fuel, ignition source, dispersion, confinement, and oxygen. Removing any one of these elements can prevent an explosion, but not necessarily fire.

Dust is present with other elements of explosions in every stage of the pellet-making process in both internal systems and external environments. Although wood pellet producers can not see what happens in the pipes and machines of the internal system, it is clear that the internal systems have four elements of that explosion pentagon present. In the process of a pellet production system, at any given time, the only element that is missing is an ignition source.

Equipment involved in the process of wood production should be thoroughly evaluated and reviewed to ensure safety standards are met. Wood manufacturers use the following common appliances or equipment in the process: silos, filters, conveyor systems, screens, dryers, mills, classifiers, cyclones, and elevators.

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What Causes Wood Dust Fires and Explosions?

Wood dust fires can be caused by an electric spark, flame, heat from friction, or other ignition sources. Fine wood dust (less than 5 millimeters) will ignite when dispersed in the air.

Wood dust explosions are usually caused by confined materials such as within drums or pipes being agitated by machinery and shaking up wood particles which then ignite. Fine wood dust may also explode if ignited while inside flammable gas such as propane tanks or vessels of liquid combustible material like alcohols.

Wood dust explosions occur in enclosed process equipment when wood particles ignite. Fires and flash fires can occur both inside process equipment, or externally in building compartments and occupied areas. One of the most common oversights in the biomass energy industry is the failure to distinguish fire and explosion scenarios from one another. Thus, protection against only one or the other is deployed in at-risk process areas, rather than both.

Wood pellet plants have an inherent risk of combustion events due to the nature of the process to create pellets. After all, they are creating a fuel source. Drying, milling, and handling of wood dust produces dust accumulations. Additionally, many of these processes can generate sparks. Ignition sources can take the form of electrostatic discharges, friction, mechanical sparks, heated surfaces, and even spontaneous combustion.

Combustion can occur from many sources, such as electrostatic charge, friction, heating or even spontaneously while in storage.

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Danger Zones Involved in Pellet Production

- ✓ Drying
- ✓ Pellet Milling
- ✓ Milling
- ✓ Load Out

In many production areas, from the hammer mill via drying to the pellet press, there are danger zones where dust explosion can occur.

Due to the fast-running machines, the high press-pressure and the high temperatures, sparks or glowing particles can easily lead to fire and dust explosions in the production of wood pellets.

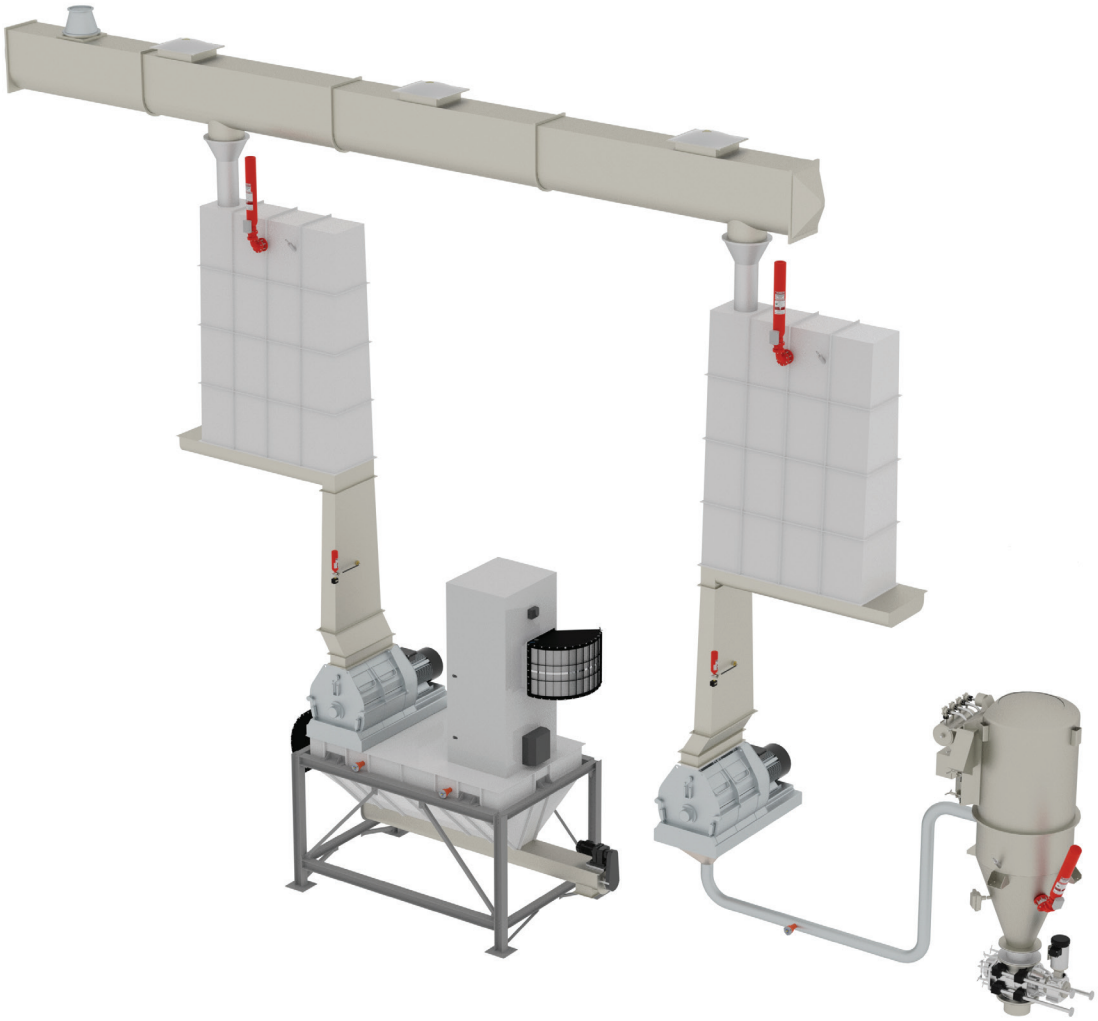
Drying

One of the most potentially dangerous areas of a pellet plant is near the dryer. This area is introduces a lot of kinetic energy into the process and, therefore, are lots of dangerous sparks and combustible materials. To prevent an explosion, make sure you clean up all debris from around your dryer, such as stray sawdust or wood chips. Additionally, ensure protection measures are included to measure whether the dryer is running as designed. One of the most dangerous situations is when a dryer is run outside of it's intended design parameters. For instance, if a dryer is designed for a 20% moisture content raw material but is instead fed with 5% moisture content material, this incongruous can create a deflagration in and of itself.

It is also imperative that down stream air material separators are properly protected as ignition sources can be generated in the dryer and then conveyed to the downstream pneumatic equipment where the elevated level of dust and oxygen is present

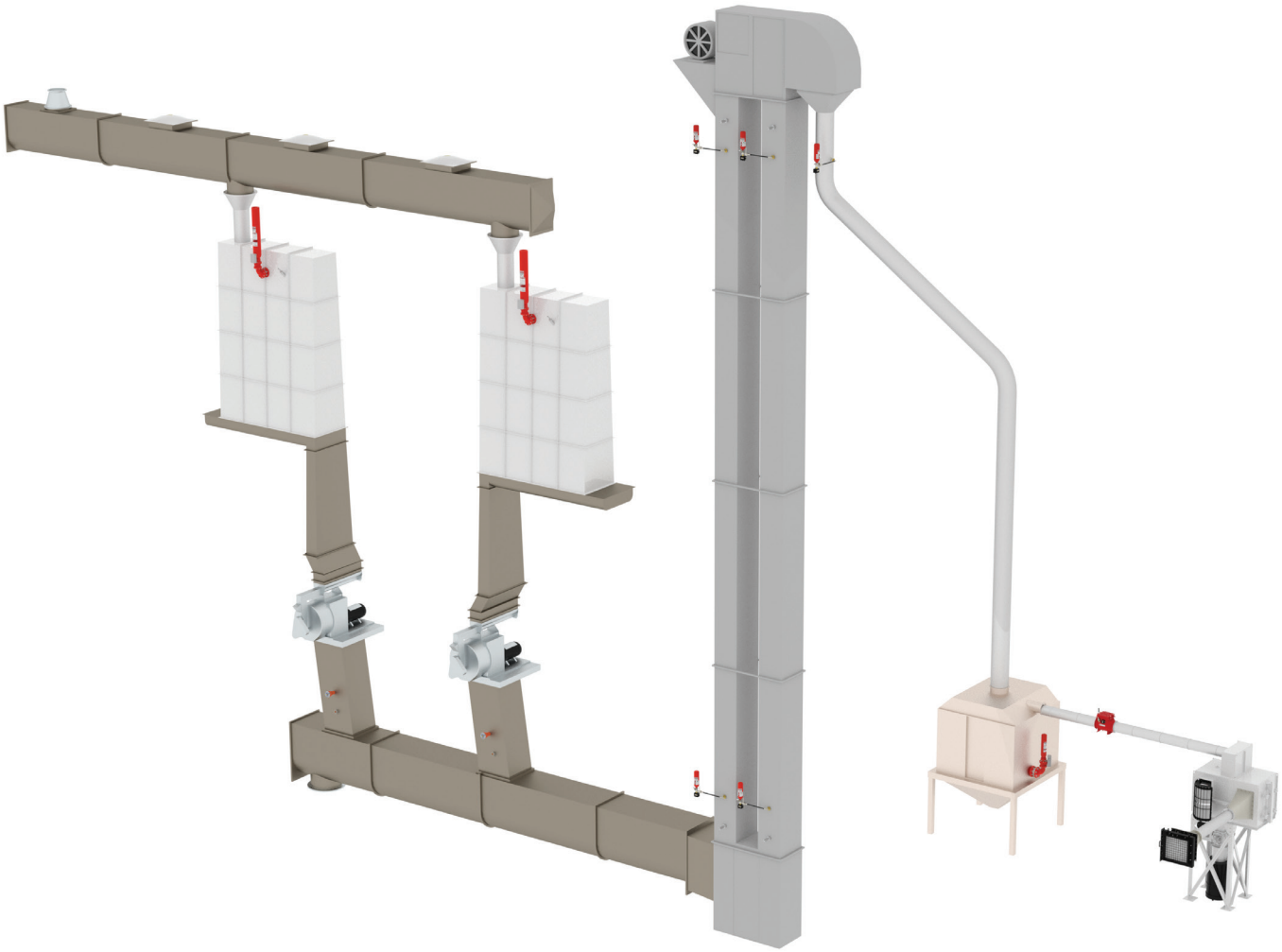
Milling

Hammer mills are operated at high speed to reduce the particle size. This generates an enormous amount of heat and kinetic energy. Internals of the mill must be maintained and lubricated to prevent overheating and spark generation. Wood powder produced in this area provides the greatest risk due to lower moisture content and smaller particle sizes.



Pellet Milling

Since small, hot sparks can ignite dust and cause an explosion, pellet mills need to be equipped with NFPA compliant solutions. These include may include explosion vents, chemical suppression, a valve for the pipeline, a flameless vent, and isolation devices to squelch an explosion.



Load Out

The final product load out of a Biomass plant typically consists of Bucket Elevators, horizontal mechanical conveyors and storage silo(s).

Although this is the finished product and therefore a less-dusty environment, protection measures should still be considered.

If the load out portion of a pellet plant is down due to a fire or explosion, the entire operation is down because the product cannot be shipped. This is often overlooked but can generate massive supply chain issues. So although viewed as a lower threat due to the material properties, the business interruption that can occur often counterbalances the risk profile. protection panels.

NFPA and OSHA Requirements

Engineering design rules apply for mitigating the risk of fires and explosions in manufacturing, handling and storage facilities.

In North America guidelines are published by NFPA (National Fire Protection Association), FM (Factory Mutual Insurance Company), OHS OSHA (Occupational Health and Safety), local fire codes, etc., some of which are voluntary and others are mandatory. In Europe, ATEX (Atmospheres Explosives) is universally accepted as the guideline mitigation of risk of explosions.

NFPA provides guidance on combustible wood dust while OSHA provides regulations with deadlines for compliance specifically focused on fires in industrial settings related to fuels like biomass or bioenergy.

The NFPA standards are documents that the biomass industry can use for guidance on combustible wood dust, but that may not be clear as there aren't a lot of biomass - or bioenergy - specific requirements in them. NFPA 664 provides guidance for facilities handling wood materials.

OSHA offers clear guidelines and regulations, to help reduce the risk. A September 2020 deadline for biomass and bioenergy facilities to complete a dust hazard assessment was implemented.

Rather than looking at it as meeting a regulatory requirement facilities use the document as a tool for plant personnel to use to educate themselves of the potential risks at their individual facility. For biomass and bioenergy facilities, a dust hazard analysis (DHA) is extremely valuable in learning about a facility's risks and what's needed to adequately protect assets and employees. It's not uncommon to realize there are areas of the plant at risk that weren't considered before. Something as simple as maintenance work may change once it's understood there's a hazard in that piece of equipment—for example, properly cleaning out a piece of equipment before doing any welding.

The more an operator knows about their own facility, where fire can ignite, how fast it spreads and how difficult to put out – such as equipment around high-risk materials like rubber mats - without understanding one could lead to disaster.

Ideal Safety Strategy to Prevent Fires & Explosions

Dust explosions and fires aren't uncommon at biomass plants, but the right protection equipment can make a world of difference in reducing risk and changing the outcome of a fire or explosion event.

Typically, the most common hazards in the biomass industry relate to particle size reduction areas. The hammermill system and what's downstream are high-risk areas. A layered approach of spark detection and explosion protection in these areas is how an acceptable level of safety is achieved.

In many process areas where the material is conveyed, some plants employ only a spark detection system or an explosion venting system; however, these systems should really be used in conjunction with each other. A spark detection system is meant to lower the likelihood or frequency of an explosion of a fire occurring but can also protect against fire, whereas an explosion vent is really just for explosion protection. A combination of systems, fire prevention and explosion prevention ensures true safety from risk.

Infrared spark detection offers a significant advantage to fire prevention. While ultraviolet spark detection systems on hammer mills can see light and sparks, they can't detect the really low-energy particles that may pose a threat. Infrared technology is a game-changer in those areas when used in combination with explosion protection.

Since the dust that biomass produces is explosive, it's important to control any explosion and to ensure that it doesn't spread quickly through a facility by igniting these dust clouds. So, explosion suppression and venting will control any ignition, and explosion isolation will ensure it does not spread.

Solutions

CV Technology prides itself on tailor-made dust explosion and fire protection solutions, as proper strategies are unique to each factory, process and company. Listed below by solution are common methods we employ to protect people, processes, and plants from fire and explosion hazards.

Explosion venting

A simple solution for explosion protection, explosion vents both relieve the pressure and exhaust flame during a deflagration. The burst pressure can be custom designed to handle different process parameters. Integration with flameless vents or vent ducts allows them to be used indoors or outdoors in an occupied area.

Explosion Isolation

Isolation systems can come in the form of passive or active solutions. Passive isolation systems tend to be triggered by the pressure-flow associated with a deflagration to be activated. Active isolation systems use pressure or optical sensors to continually monitor process areas then react by activating an isolation device. Typical isolation locations include material or air pathways both upstream and downstream from process vessels like dust collectors, conveyors, dryers, and storage vessels.

Fire Prevention

Our spark detection system features the most advanced detection, controls, and extinguishing technology in the world. By utilizing infrared sensing elements the detectors an insensitive to daylight and capable of detecting black body particles, glowing embers, sparks, and flames.

By addressing each hazard proactively, addressing risks through a dust hazard analysis, employing OSHA regulations and the NFPA's best practices, and ensuring both fire and explosion custom engineered solutions are up to date and current, plant safety managers can reset assured that the threat of combustible dust hazards is removed. Ensuring these safety strategies ensures that "Safety is Job One" is more than a slogan but truly an integrated and intentional approach to protecting a plant, people and process from disaster.

Investing in combustible dust mitigation and fire protection systems is essential since dust is a natural and unavoidable by-product produced during processing. This wood dust is highly combustible, and a solid fire and explosion protection strategy must be in place to prevent flash fires as well as explosions.

Biomass Fire Protection & Prevention Strategies

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