

Fighting Fire

How to protect product, a storage facility, and its systems







Introduction

Preventing fire in bulk storage is one of the most important steps to protecting product, a storage facility, and its systems. Customers can proactively protect their investment by considering the qualities of various bulk-storage options, executing routine maintenance on facilities and equipment, and utilizing innovative monitoring systems that analyze the stability of stored materials and moving parts within and outside the structure.

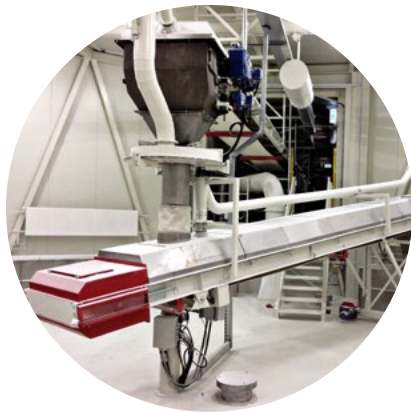
The strength of the dome allows for unique explosion prevention and mitigation methods. One example are the explosion vents visible on the coal-storage domes above.

How a dome wards off fire naturally

One way to minimize the likelihood of fire is to select a bulk-storage option that inherently resists deflagration, and certain dome characteristics make fire less likely than in other storage facilities. A dome's shotcrete shell is non-combustible and has low thermal conductivity, performing better in large fires than wood or even steel counterparts.

The insulated nature of the shell, composed of layers of polyurethane foam insulation and shotcrete, moderates externally generated temperature fluctuations, and the more constant an environment, the more stable otherwise volatile products will be.

The PVC airform covering the entire dome structure keeps it waterproof, an important feature since, for some products, the process of moisture-content changes will



Reclaim systems play a significant role in explosion prevention. The systems shown above for wood pellet (top) and sugar (bottom) take special care to reduce the accumulation of combustible dust.

produce heat, with either the drying effect or the hydrating effect causing self-heating. The dome's insulated nature also reduces heating and cooling of the walls and air inside, thus preventing condensation from forming and introducing moisture to the product.

The dome is airtight except wherever penetrations are made, aiding in the containment of inert gases pumped inside to deter fires and to minimize available oxygen for supporting fires. The truss-free structure discourages dust build-up, and the double curvature has proven in real-world examples that a dome is structurally stable under extreme fire and heat conditions; with a fire rating of at least two hours, the structure itself can survive a disaster that other types of storage might not and will likely reward customers with insurance-premium savings.

The most important steps to fire prevention

The two most important items in a fire-prevention system are housekeeping and maintenance, neither of which can be engineered into the system. When equipment is well maintained, it is less likely to fail or cause sparks and heat. When the facility is kept clean and free of considerable dust buildup, the potential for fire spread or secondary deflagrations is greatly reduced.

Customers can make the most of fire prevention in several ways:

- For facilities with combustible materials, have a plan for circulating product, especially in summer months. Be cognizant of dwell time and know how often product needs to be moved to reduce hot spots and aging in pile, particularly for wood pellets and coal.
- Check temperature on shipments into and out of the facility, ensuring all product is on spec all the time. It is also important to have the ability to reject off-spec product before it enters the storage facility.
- Develop a schedule for cleaning; some customers opt for a full system clean after every shipment, from the top of the dome to the bottom of the tunnel, and a similar full clean of the entire outbound and inbound systems after truck, train, or ship departs.



- Perform regular maintenance on all moving parts, including lubrication following manufacturer recommendations. As part of this maintenance, keep up with bearings on idlers and other equipment.
- Replace worn items when they are spent, rather than trying to eke out a little more production before discarding. Keep spares on hand so that when parts need to be replaced, extras are available; this allows production to continue without using materials defective or hazardous.
- Train employees on the importance of housekeeping. Not all employees adopt the same level of cleanliness in their own lives, so clear explanation and expectations regarding the worksite are essential. Teach them how cleanliness correlates with safety.
- Address areas of concern like horizontal surfaces, especially in warehouses or process buildings. Make sure to address hard-to-reach areas, and use a vacuum with a long wand to remove excess dust—never use a blower. Better yet, when in the planning stages of a project, request that engineers design as few horizontal surfaces as possible, or select a truss-free dome.



Available fire-monitoring systems

Fire prevention starts with a well-thought-out design. Each type of stored material requires its own considerations. To determine the necessary systems, engineers create plans that meet specific needs based on product characteristics, projected daily operations, and future business goals and needs.

Bulk-storage facilities designed and built by Dome Technology's team include innovative features aiding in fire protection. Some systems are preventative, providing feedback that can help customers avoid a disaster. But some are shutdown systems, alerting customers to halt operations to avoid damage to or loss of equipment or product.

The most commonly recommended fire-prevention features for any type of bulk storage are detailed here:

Equipment monitoring, maintenance, and cleanliness play a vital role in eliminating the source and fuel for explosions.



- Temperature- and humidity-cables monitoring; a cable array hung from the roof monitors both, alerting customers when the environment ceases to be ideal.
- Multiple-gas detection systems monitor off gasses from biological products. This system provides customers with information about an impending problem; by acting quickly, a fire can be avoided. These systems tell customers how aged some types of product are by analyzing off-gas composition and quantities, and watching those levels provides clues that fire could soon be possible.
- Point-level monitors identify the height of the product in the dome, and more specialized 3D monitors chart the surface of the pile and its shape—information crucial for inventory management and knowing how much product is being stored and is aging.
- Heat detectors sense surface heat.
- Moisture meters can be installed on the inbound feed to detect if the product is off spec, failing to meet requirements for heat or moisture. Customers are alerted if they are bringing in something too hot, too dry, or too wet and can reject the product.
- Spark detection recognizes sparks when product is moved into the dome, and metal detectors detect ferrous or non-ferrous tramp metal that could produce an ignition source.
- Systems that monitor conveyors are especially important because many fires in bulk-storage facilities are caused by the idlers on the belt conveyor not being properly maintained. If idler bearings begin to fail and the belt continues moving anyway, the system can take fire, with the conveyor carrying the flames right into the dome.
- Bearing-temperature monitors analyze specific bearings to make sure operation is optimal.
- Dust collectors or misting stations can be included to control fugitive dust.

Monitoring the climate and state of a product can both eliminate the occurrence of fires within a structure and reduce the damage caused, should they occur.



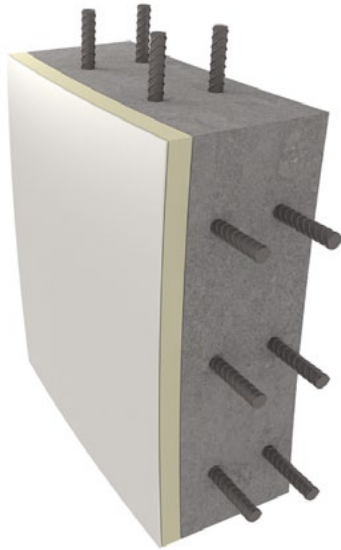
Explosion containment and domes

When storing wood pellets and coal, there's always the possibility of spontaneous combustion and explosion. Dust collects on horizontal surfaces like ledges or shelves and builds into a thick layer if not cleaned regularly, which is difficult when the facility is full of product and the beams are up so high.

Fire and explosion begin with a primary explosion that may be fairly small in magnitude but will shake the structure; that shaking action rattles loose the dust built up on the horizontal surfaces. With the dust airborne and in a high concentration in the air, the heat and flames from the primary explosion ignite the dust, causing a secondary explosion often more dangerous than the first. A tertiary explosion is even possible after a secondary explosion shakes the building and more dust is airborne.

A dome is less likely to experience fires like these because the interior is truss and support free with no areas for dust to accumulate. Even so, domes storing explosive materials are built with explosion panels at the apex; these panels are sealed to prevent moisture from entering the structure but are rated to release in an explosion event or when internal air pressure is excessive. When the explosion panel is loosed, the shape of the structure channels energy through the openings, reducing the chance of the dome

A traditional silo side-by-side with a more modern dome structure.



being compromised should an explosion occur. Other types of bulk storage can be built with relief panels too.

Dome Technology's team of engineers also has the ability to do in-depth explosion analyses on domes, optimizing the cost of explosion panels. Since the dome is inherently strong, it can withstand more pressure than warehouses. Engineers draw on this strength to minimize explosion vent requirements, allowing them to forego canned equations that don't apply to a dome because the structure's strength is beyond parameters identified as standard. Engineers use specialized modeling to calculate pressure and vent area necessary to prevent the structure from being overstressed by possible pressure.

An illustration of the layered composition of the dome's wall. The waterproofing, thermal insulation, and concrete layer contribute to the temperature stability inside a dome, which can make fire prevention easier.



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