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REINVENTING FIRE DETECTION IN FOOD FACILITY COLD STORAGE

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Advanced fire sensing technology detects smoke at the earliest possible stage, while reducing false alarms and maintenance, even in refrigerated and frozen food storage

In the past year, online grocery and e-commerce shopping exceeded previous highs and it's estimated that online grocery shopping will surpass \$100 billion in 2021 (Chain Store Age, February 2021). The demand for increased refrigerated warehousing has been growing for several years, resulting in the development of new or expanded cold storage warehousing technology and structural improvements. The need for efficient, state-of-the-art cold storage development is driving warehouse refrigeration technology and logistics optimization.

Some trends driving change in the industry include:

- Designing taller, rather than wider, warehouses which creates greater refrigeration efficiency and accommodates newer high-capacity freezer heights;
- Expanding dedicated temporary storage areas with humidity flexibility to support a broad range of storage options that meet new product diversification demands; and
- Increasing adoption of micro-fulfillment centers to meet same-day delivery expectations; for cold storage, this often means an investment in automated workforce technology.

While the threat of a fire may seem minimal in subzero temperatures, serious risk factors exist in food industry cold storage facilities. Most stored goods and delivery materials (boxes, pallets, packaging) are combustible. The environment is dry with low humidity and contains multiple ignition sources. Additionally, the building's insulated walls and ceiling can retain a fire's heat, potentially furthering its spread, and high airflow can disperse smoke throughout the refrigerated space.

The cost of a fire goes far beyond the loss of the building structure and materials. The perishable nature of the goods, whether meat, produce or dairy, commonly stored in freezers or coolers, makes it essential to avoid any rise in temperature. Heat from a fire or a temperature rise due to refrigeration system downtime following a fire can result



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in significant stock spoilage and revenue loss. Even a spark or smoke from an emerging fire can lead to costly losses if not detected and managed early. Food products exposed to even low levels of smoke over time can be contaminated, and therefore, unusable.

Losses caused by downtime, operation interruption, business reputation and goodwill can be significant, and could even put significant portions of the country's refrigerated or frozen food supply chain at risk.

Fortunately, protecting life and inventory is much easier for even the largest food processing, cold storage facilities as aspirating smoke detection (ASD) technology becomes more widely adopted. Far from new, the core ASD technology has been used for decades in critical applications like data centers where early smoke detection is critical. The combination of programmable alarm threshold levels and the advantage of extracting the air sample out of harsh environment make ASD an ideal solution for these facilities.

Compared to traditional spot smoke detectors, aspirating smoke detectors can improve a warehouse by detecting smoke at the earliest possible stage via numerous sampling points, while reducing false alarms and maintenance.

Cold Storage Smoke Detection Challenges

Fire risks are present in refrigerated storage facilities despite their low temperature typically ranging from -40°C (-40°F) to 18°C (65°F) (coolers for foods). The leading causes of fire in cold storage facilities include problems with electrical distribution, lighting equipment, transport equipment faults (conveyors), maintenance operations (hot work) and arson.

Refrigerated storage facilities can present challenges in fire detection. The environmental conditions of operating temperatures, low humidity, high airflow conditions resulting in significant dilution of smoke, and the volume of high storage racking can affect airflow and impede the detection of a fire event with conventional smoke detection systems.

"Traditional spot detectors are not designed to operate in food industry, sub-zero temperatures," says Khaleel Rehman, director of development for the advanced detection fire team, Honeywell.

According to Rehman, the subzero temperatures and heavy icing associated with cold storage may degrade the performance and operation of conventional detection systems, particularly in large volume, high-ceiling cold storage settings.

He adds that in such settings, detection systems that rely on heat signatures passively wait for heat to rise to the ceiling. "High airflow conditions can dilute smoke, making it more difficult for traditional systems to detect so by the time sufficient heat reaches the detectors, the fire may already be well underway," he says. "Additionally, with cold storage, ice can build up on standard smoke detectors and compromise safety or create false alarms. Spot smoke detectors can also be damaged by forklifts or automated lifts during the loading and unloading of pallets," says Rehman.

Constant air movement in a high-rack storage facility would cause vertically released sprinkler water to swirl around as ice water. In such an environment, firefighters' ability to counter a potential fire would be virtually impossible. A dark, ice-cold warehouse environment with aisles approximately 482' long and 115' shelves, would push firefighters to their physical and technical limits.

The maintenance of spot smoke detectors presents major challenges since detectors installed in hard-to-reach places (high ceiling, in-between racks) are required to be physically accessed for service and maintenance. Such activities can be time consuming, disrupt operations on the floor, and present safety risks to service personnel.

Optimizing Cold Storage Smoke Detection

As an alternative, ASD technology is a more effective, early detection option that does not require physical maintenance to access cold storage facility ceiling areas above high bay racks.

According to Rehman, for food industry cold storage applications, the Honeywell VESDA VEU aspirating smoke detectors are well suited. The system draws air samples in a continuous process through holes in long runs of durable industrial pipe mounted along the walls and ceiling.

While some ASD products use an LED light source and one or more photo receivers, the Honeywell VESDA VEU detector uses a flair detection chamber that features a short wavelength laser, a CMOS imager and multiple photodiodes. Direct imaging of the sampled particles using the CMOS camera allows data to be derived regarding its size, color and shape. Additional data from five photodiodes allows measurement of light scatter in different directions.

With more detailed information to analyze, the unit is able to differentiate smoke from other factors that could cause disruptive false alarms. For cold storage environments where airborne dust particles may also be present, which can be confused as smoke by some systems, the unit's dust rejection and data analytics can minimize nuisance alarms by at least three times compared to similar technologies.

The detector's high sensitivity chambers and cumulative sampling can deliver the earliest possible warning of fires in large open spaces and in the presence of high airflows. The detector combines an intelligent filter with an advanced clean-air barrier for optics protection, providing very early warning detection and a long detection chamber life without the need for recalibration.

"Cold storage requires superior smoke and fire detection systems with a performance-based design approach like the VESDA VEU designed to reliably operate in adverse, sub-zero conditions. It can detect smoke at the very earliest stages when standard detection systems cannot. Compared to traditional detection systems using heat signatures, it can detect smoldering smoke significantly faster," says Rehman.

The system uses special techniques to help maximize its reliability in sub-zero temperatures. With the VESDA VEU, the sampling points are located inside the cold storage area of a facility while the detection system is installed outside of the sub-zero temperatures. This helps safeguard the system and enables fast access for personnel performing service or maintenance.

Recently, an East Coast food retailer successfully deployed the system in an approximately 100'x100'x50' freezer application involving perishable meat, vegetables and dairy products. The facility is located on a site with naturally occurring methane gas and ammonia emissions, creating a need for additional protections. The VESDA VEU was installed with a modular component, VESDA Sensepoint XCL Gas Detection, which can detect a variety of odorless gasses that pose significant safety and liability hazards, such as ammonia, chlorine, chloride, carbon dioxide and carbon monoxide.

Protecting the Bottom Line

Some managers of refrigerated and frozen food storage facilities may be inclined to use spot smoke detectors or other traditional devices because of their familiarity with such systems.

Those who take advantage of the capabilities of ASD systems will further protect lives and inventory in these challenging environments. This level of protection may even help prevent serious supply chain disruption.

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