Spark Detection and Extinguishment Systems

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Spark generation is a constant danger in those factories where combustible materials are being worked, transported, dried, filtered or exhausted. The statistics provided by insurance companies point out that silos, dust collection filters, bins, and even complete production lines are the areas at greatest risk.

Sparks are a very common danger. Although they may not be readily apparent, this does not mean that they do not exist. In most cases, close attention is focused on this problem only after it is too late, namely when there has been an explosion or fire. A dull tool, damaged fan bearing, an overhead motor or electric sparks, foreign bodies in the conveyed material, defective parts on the production line, and friction generating processes are causes of these events.

Several common spark-producing industries include:

Foundry, metal reclaim and processing - high temperature melt lines, shredding, grinding and polishing of metal parts.

Fiber and particleboard - processing of the fiber and the particleboard as well as the sawing and sanding of the finished board.

Chemical - spray dryers and the pneumatic conveying of the various dusts and powders.

Food processing - coffee, chocolate and tobacco drying, spice and seasoning grinding, and the pneumatic conveying of powders.

Baghouse Explosion

Why Is it So Dangerous?

A spark by itself is not dangerous. For a fire or explosion to occur, there must be three essential ingredients - a combustible material, oxygen, and an ignition source. If one of these three is eliminated, then so is the potential for fire or explosion.

In today's production plants, we often have to cope with all of the components that lead to a fire or cause an explosion. Dust extraction systems and pneumatic conveyors increase the danger of fire. Once sparks or glowing embers are created, the pneumatic extraction system conveys these hazards to other areas. At this point, two of the three ingredients for the creation of fires and/or explosions are transported. When this conveyed danger meets a supply of combustible materials (filter cloth, deposited dust or the material in the separator or silo) it becomes more likely that the feared reaction will occur.

Increased environmental protection measures regarding dust emissions and tightened regulations for air pollution have lead to the increased use of filter systems, and has increased the danger of dust explosions and fires due to the concentration of the combustible material at the filter.

Because of the high cost of heating and cooling plant buildings, many air systems return the clean air directly back into the production facility. This practice, although energy efficient, presents an additional hazard if the collector catches fire. This fire will be propagated via the return air duct into the plant structure with devastating consequences.

What Preventive Measures Can Be Taken?

To prevent such hazards, the extraction ducts, the ducts to silos and bins, and return air ducts, should all be protected with a comprehensive spark detection/extinguishment system.

By installing a modern spark detection/extinguishment system, sparks and glowing embers are detected and countermeasures are immediately actuated to eliminate the initial cause of fires and explosions. The major difference between fire extinguishment systems and a spark detection/extinguishment system is that the spark extinguishment system eliminates the early causes of the fire, not the fire itself.

Spark detection/extinguishment systems can detect even the smallest spark or hot particle in the transport system, and initiate countermeasures instantaneously. These countermeasures can be the activation of an extinguishment system, shutting off the means of transport, stopping the effected production area of the process, or a combination of any of these.

The detection is accomplished by sensors recognizing the infrared of the sparks and/or glowing particles. The spark sensors are capable of detecting sparks through layers of dust or through conveyed dense material flow. This alarm signal is transmitted to the control console, which processes the signal and automatically enacts the prescribed countermeasures.

The most common extinguishment relies on a water “mist” spray in the duct following the detection area. When the sparks are no longer detected, the extinguishment “mist” is automatically stopped. The extinguishment process most commonly takes place without the interruption of the production process and normally has no adverse effects on the filter media.

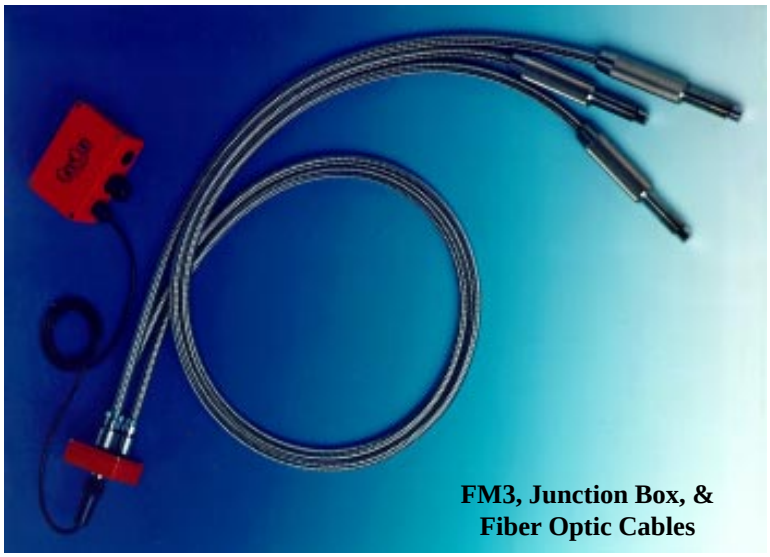
Due to these operational principles, spark detection/extinguishment systems need to be classified differently from sprinkler, deluge, or even explosion suppressions systems. Such types of fire protection measures are required for the protection of building and facilities and are in addition to a spark extinguishment system.

The Control Console

The centerpiece of the spark extinguishment system is the control console. All signals from the spark sensors in the various duct locations, or “zones”, are accumulated and processed by the microprocessor based control console. The control console activates the appropriate extinguishment devices, as well as any electromechanical safety measures. The use of the microprocessor results in enhanced safety for the protected zones. The microprocessor integrates spark counts, in respect to time, permitting the operator to program the various countermeasures in response to a single spark, a stream of sparks or a continuous alarm.

Thousands of events can be stored in the console’s memory. With the microprocessor based control console, the alarm messages are visually displayed with zone, time, date, duration of the event, and the countermeasures that have been initiated. The console’s automatic sensor tests, manual sensor/valve tests performed by in-house personnel, and any system troubles, are also logged into the event memory. These events can be displayed on the console screen or printed, via the serial port connection, for further evaluation.

GreCon BS704 Control Console



FM3, Junction Box, & Fiber Optic Cables

The Spark Sensor

The most important component of a spark detection/extinguishment system is the spark detector. Because of the wide variations and the severity of applications, different types of sensors have been developed. Low pressure pneumatic conveying systems with ambient air temperatures less than 150°F use a standard spark detector. This type of sensor mounts onto the duct and views the air stream directly.

For applications of high temperature or high pressure conveying, the detecting sensor has fiber optic cables connecting it to the duct's interior viewing area. These cables transmit the infrared energy to the detector's photo optic diode. Using the fiber optic cable protects the sensor electronics from the radiant heat of the transport duct. These cable-equipped sensors can detect sparks and embers in air stream temperatures between 150°F and 1,860°F. They are also applied on high pressure transport systems where material abrasion of the sensor lens may be a problem.

Special daylight sensors are used in applications where ambient light is present, such as chutes, hoppers or belt conveyors. This type of detector establishes a baseline of excitation caused by the surrounding ambient light conditions. If a radiating body spark or ember passes through the sensor's viewing area, the sensor will activate an alarm and associated countermeasures.

The Extinguishment Device

Water is the best extinguishment agent. Water has a strong cooling effect. Its excellent extinguishing efficiency is the result of its high heat absorption. Because of the cooling effect, the potential for re-ignition of the burning material is prevented. To obtain optimum extinguishing efficiency, the surface area covered by the water must be maximized. This is accomplished by the atomization of the water.

Atomization is achieved through a specially designed nozzle at a minimum required pressure. With the proper atomization of the water, a minimum amount is required to successfully extinguish the detected hazard. The amount of water introduced into the air stream for a single detection should be exhausted with the clean air, and not cause any caking or blinding of the filter media.

LS2 Extinguishment Assembly

In some industrial applications the introduction of water into the production stream is not an acceptable extinguishment agent. Protection in these applications can be accomplished using diversion or knife gates, flap gates, or actuation of a suitable inerting agent that is appropriate for the material being conveyed.

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