True Infrared vs. Spark Detection

Although superficially similar, the technologies are quite different

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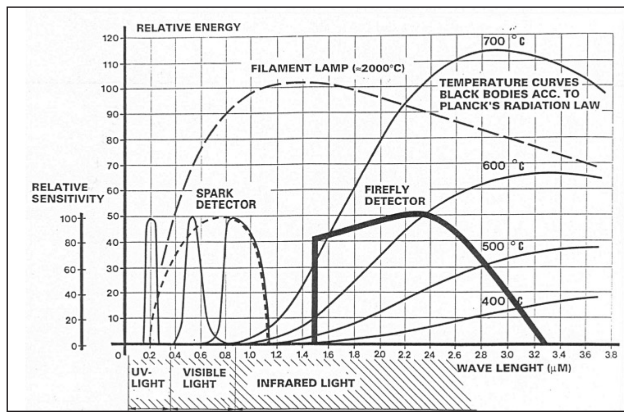
Both true infrared and spark detection systems can be useful tools. So it is important to understand the principle differences as well as some important limitations of each technology before making a decision about which to select for any given application. Both technologies have a place in the well integrated protection scheme for companies that want to have highly protected risks.

Principle of Operation

1. Spark detection operates on the principle of detection of energy wave lengths that are near infrared in the visible light spectrum. Basically, a light sensitive silicon photocell is used in the detector that has useful sensitivity in approximately the 0.3-μM to 1.1-μM range (see graph). The idea is to insert the detector into a process flow stream, detect sparks or flame and inject water-spray into the line immediately downstream to extinguish. While this technology does not prevent ignition, it does provide early detection and fast response to minimize the potential consequences.

2. True infrared detection systems operate on the principle of detection of energy wave lengths that are actually in the infrared light spectrum (i.e. not in the visible light spectrum). Two heat sensitive lead-sulfite photocells are used that have a useful sensitivity in approximately the 1.5-μM to 2.8-μM range (see graph). Like a spark detector system, the detector is inserted into a process flow stream. Unlike a spark detector, however, a true infrared unit will detect hot particles at pre-ignition temperatures, as well as sparks, glowing embers or flames. In addition to water spray, there are a variety of other response mechanisms available, including valves (stop and diverter types), steam and inerting gases. The most important distinction is that because of the longer wavelengths involved, true infrared systems are suitable for detection of hot particles before ignition as well as for sparks or flame



Practical Considerations

In practical terms, the two technologies, although superficially similar, are quite different. Each has both important applications and limitations. In many complex industrial systems there could be applications for both. Consider the case of a dryer that is adding heat to drive off moisture from the product. It is not uncommon for there to be sparks entering a dryer from an air heater. The reason sparks might not pose a risk in this situation is that they are very low in thermal mass relative to the much larger mass of wet product being fed into a dryer. In a situation of this kind a spark detector would not be particularly useful as it would be susceptible to be constantly detecting sparks and triggering water-spray.

The situation could change in a dryer, however, and a risk for fire or explosion develop if, for example, the feed to the dryer stopped, or the material inside the dryer chamber could not be removed and it became overheated. A true infrared detector, however, monitoring the output from the dryer would provide early warning of a thermal excursion. In this situation true IR is the best option. There is any number of types of equipment where this important characteristic difference is meaningful. Examples include the outlet from a mill, the outlet from a vibratory sieve, or the inlet and outlet from a bucket elevator.

Since a spark detector is operating in the visible light spectrum it is going to respond to light. For this reason light leaks can cause false triggers and can be an expensive nuisance.

True infrared can be too sensitive in some situations and can trigger at thresholds well below any that pose a real risk to the process. Any material that has a high minimum ignition temperature and has a low K_{st} would be a good candidate for spark detector protection. Examples include intermediate chemicals such as acetates and stearates, activated carbon and melamines. It is quite important to understand the process and the risks before selecting either technology at any given point in the process. Spark detectors should prove more reliable in high ambient temperature locations where spark detectors can be separated to a certain extent by using fiber-optic cables.

Risk Analysis

All spark detectors respond to sparks, glowing embers, and flames at threshold temperatures of approximately 7000˚C. True infrared detectors respond to the longer wave lengths of heat energy being emitted from hot bodies at threshold temperatures of 1500˚C (Type LD), 2500˚C, (Type TD), or 4000˚C, (Type GD). In plain English, true IR can be used in all applications where spark detection can, but the reverse is not true.

Two aspects of the material being handled are important in the choice between spark detection systems and true infrared detection systems: What is the minimum ignition temperature of the material? At the location being monitored, is the dust dispersed or layered?

There is usually any number of specific locations in a typical process system where either a fire or an explosion could erupt. When these events occur there is always an interest in finding the root cause and of course there is no such thing. In every case that I am aware of, the fire or explosion was the result of a weird sequence of events that were abnormal. Generally equipment types at risk include those that add heat to a process either thermally (i.e., dryers, presses etc.) or kinetically (i.e. mills, fans, sanders, elevators etc.). Vessels that collect and hold bulk products in large quantities (i.e. silos, dust collectors, hoppers, and bins) are also at risk.

It is essential to perform a risk analysis of each process to determine if explosion and fire are possible. Knowing the characteristics of the materials, the types of equipment employed and the options for protection can make for the most effective protection solution.

Spark detector systems are relatively inexpensive and are widely distributed. They are neither difficult to install nor, with the exception of the light leak problem, overly burdensome to maintain. Because they respond in the visible light spectrum, and because they are not able to distinguish between a small spark and a much larger ignited mass, spark detector systems do tend to trigger and spray water fairly frequently. This in turn can plug lines, filters or other equipment, and require production interruptions to clean up. Since spark detectors are widely used in some industries, and since they trigger frequently, this factor is often accepted as normal and no big deal. Depending on frequency of occurrence, however, frequent triggering and consequences can be an expensive proposition.

As companies look for ways to improve profitability, the cost for frequent production stoppage to clean equipment from water mixed with product plugging is becoming an impetus for re-evaluation. A move toward true infrared and away from spark detection often accompanies this process where economic factors are great enough to warrant the additional investment in protection equipment.

Conclusion

As stated earlier, fundamental to the use of spark detection is the understanding that they are fast responders after ignition and they help to mitigate the consequences of ignition, but they do not prevent ignition. Remember, too, that they are confined to applications where the detector lens can be shielded from light. Frequent triggering should be accounted for and be deemed tolerable.

Fundamental to true infrared is that it can respond to heat prior to ignition. As such, it offers the possibility to prevent ignition in a protected process. True infrared systems are generally more expensive to buy than spark detection systems, although that cost can be more than offset by their greater immunity to unnecessary triggers. Since they are not light sensitive, they can be used over the full energy spectrum, which offers far greater flexibility in application. Additionally, the broad range of response options such as water spray, water mist, steam, inert gases and the use of valves of various types enhance the greater applicability of this emerging technology. There is a clear reduction in frequency of detection and action with true infrared systems. In highly efficient and profitable operations this factor can be a very important consideration.

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