How to Select a Flame Detector

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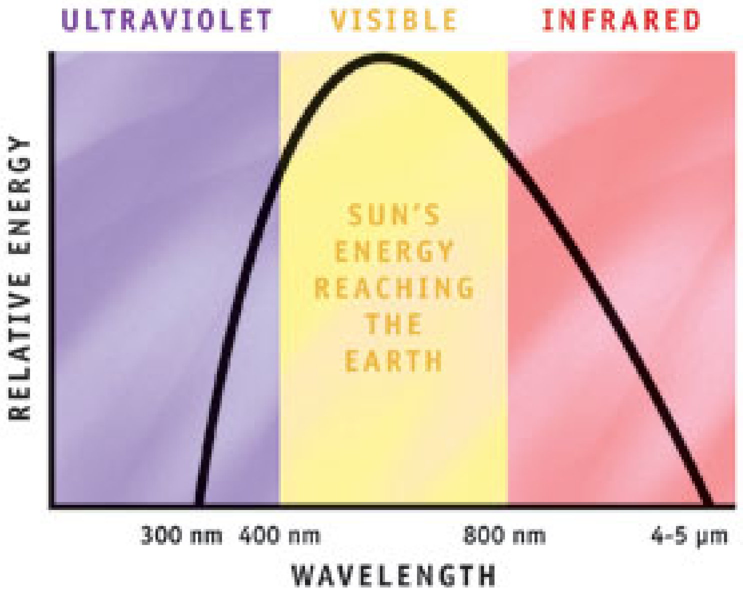

Hazardous industries require continuous flame-monitoring equipment to prevent catastrophic fires. To select such equipment, you should understand the principles of flame detection and review the types of detectors available. Armed with this knowledge, you can match the appropriate flame detector to process and site performance requirements, and the type of hazards of which the consequences the instrument is designed to mitigate.

The range of potential flammable hazards is expansive and growing as materials and processes become more complex. Increasingly sophisticated flame-sensing technologies with embedded intelligence are required to detect the most common industrial fuels, including, but not limited to alcohol, diesel, gasoline, kerosene, jet fuel, ethylene, LNG/LPG, hydrogen, paper, wood, textiles, solvents and sulfur.

Most flame detectors identify flames by so-called optical methods like ultraviolet (UV) and infrared (IR) spectroscopy, and visual flame imaging. Flames are generally fueled by hydrocarbons, which when supplied with oxygen and an ignition source, produce heat, carbon dioxide and other products of combustion. The reaction is characterized by the emission of visible, UV and IR radiation. Flame detectors are designed to detect the absorption of light at specific wavelengths, allowing them to discriminate between real flames and false alarms.

There are four primary optical flame-sensing technologies in use today—UV, UV/IR, multi-spectrum infrared and visual flame imaging. They are all based on line-of-sight detection of the radiation emitted in the UV, visible and IR spectral bands by flames. Technologies may be selected to suit the requirements of flame-monitoring applications, including detection range, field of view, response time and particular immunity against certain false alarm sources.

UV detectors respond to radiation in the spectral range of approximately 180 to 260 nanometers. They offer quick response and quality sensitivity at comparatively short ranges (0 to 50 feet). Because they are susceptible to arc welding, halogen lamps and electrical discharges like lightning, they tend to be sited indoors. Thick smoke can also cause failures due to attenuation of the incident UV radiation.

When a UV optical sensor is integrated with an IR sensor, a dual-band detector is created that is sensitive to UV and IR radiation. The combined UV/IR flame detector offers increased immunity over the UV detector, operates at moderate response speeds, and is suited for both indoor and outdoor use. As with UV detectors, however, their detection range may be reduced by heavy smoke.
Multi-spectrum IR flame detectors use multiple infrared spectral regions to further improve differentiation of flame sources from non-flame background radiation. These detectors are well-suited for locations where combustion sources produce smoky fires. They operate at moderate speed with a range of up to 200 feet from the flame source—indoors and outdoors. They also exhibit relatively high immunity to infrared radiation produced by arc welding, sunlight and other hot objects that may be encountered in industrial backgrounds.

Visual flame detectors employ standard charged couple device (CCD) image sensors, commonly used in closed-circuit television cameras, and flame detection algorithms to establish the presence of fires. The imaging algorithms process the live video image from the CCD array, and analyze the shape and progression of would-be fires to better discriminate between flame and non-flame sources. CCTV visual flame detectors do not depend on emissions from carbon dioxide, water and other products of combustion to detect fires, nor are they influenced by a fire’s radiant intensity. As a result, they are commonly found in installations where flame detectors are required to discriminate between process fires and fires resulting from an accidental release of combustible material.
Despite their advantages, visual flame detectors cannot detect flames that are invisible to the naked eye, such as hydrogen flames. Heavy smoke also impairs the detector’s capacity to detect fire, since visible radiation from the fire is one of its fundamental parameters.

When configuring a flame detection system and evaluating various technology alternatives, consider the following performance criteria:
False alarm rejection. False alarms are more than a nuisance—they hamper productivity and escalate costs. Therefore, it is essential that flame detectors discriminate between actual flames and radiation from sunlight, lightning, hot objects and other non-flame sources.

Detection range and response time. Depending on the plant environment, each alternative flame detection technology recognizes a flame within a certain distance and a distribution of response times. Typically, the greater the distance and shorter the time that a technology requires to detect a flame, the more effective it is at

supplying early warnings against fires and detonations.
Detection range and field of view. These criteria define area coverage per device. Like a wide-angle lens, a flame detector with a large field of view can take in a broader scene, which may help reduce the number of detectors required for certain installations. Most of today's flame detectors offer fields of view of about 90? to 120?.

To meet the highest reliability standards, continuous optical path-monitoring diagnostics are often built into optical flame detectors. The self-check procedure ensures that the optical path is clear, the detectors are functioning and the electronic circuitry is operational. Self-check routines are programmed into the flame detector's control circuitry to activate about once every minute. If the same fault occurs twice in a row, then it is indicated via a 0- to 20-mA output, or a digital communications protocol like HART or Modbus.

After gaining more perspective on potential flame hazards, and flame detection principles and technologies, you are in a better position to select a flame detector. Defining the requirements for an application is essential, taking into account the type of fuel, minimum fire size to be detected, and configuration of the space to be monitored.

For more information, please visit www.generalmonitors.com [1].

Links:
[1] http://www.generalmonitors.com/