Detecting Combustible Gases and Smoke

HERE'S SOME PRACTICAL ADVICE FOR WATER AND WASTEWATER TREATMENT PLANT OPERATORS FOR KEEPING THEIR DETECTION DEVICES WORKING PROPERLY

By Aaron Paterson

To make the best choices when replacing or upgrading smoke and gas detectors, plant operators should understand the basics of the fire safety equipment in hazardous areas of their facilities.

The design and installation of fire protection systems generally require the expertise of a fire and gas safety system integrator, but treatment plant operators are often responsible for upgrading or replacing components in their facilities' systems.

Over time, the demands of treatment plant applications can take their toll on combustible gas and smoke detectors, until the choice is to perform extensive maintenance or select replacement units. At this point, some basic knowledge can help operators choose robust new detectors that can meet the site's challenges while requiring minimal maintenance.

UNDERSTANDING RATINGS

Many combustible gas and smoke detectors in water and wastewater treatment plants are installed in what OSHA calls hazardous locations, defined as "areas where flammable liquids, gases or vapors or combustible dusts exist in sufficient quantities to produce an explosion or fire." These include wastewater collections systems and liquid wastewater treatment processes.

For detailed information, plant operators can refer to the National Fire Protection Association standard NFPA 820 (2016), a 65-page document published for wastewater treatment plants — the standard details for where and how gas and smoke detectors should be installed, along with required product performance attributes and certifications.

Figure 1, a process flow diagram created using NFPA 820 (www.nfpa.org) as a reference, can help users determine the type of hazard-detection equipment needed at various stages of a typical wastewater treatment facility. More information about hazardous locations can be found in Chapter 5 of NFPA 70: National Electrical Code, which establishes hazardous-area classifications specific to electrical equipment:

- **Class I:** Places where flammable gases, flammable liquid-produced vapors or combustible liquid-produced vapors may be present in the air in quantities sufficient to produce explosive or ignitable mixtures.
- **Division 1:** Places where combustible materials are routinely present in ignitable concentrations.
- **Division 2:** Places where the same materials are handled, processed or used but are normally confined and can escape only in case of accident, breakdown or ventilation equipment failure.

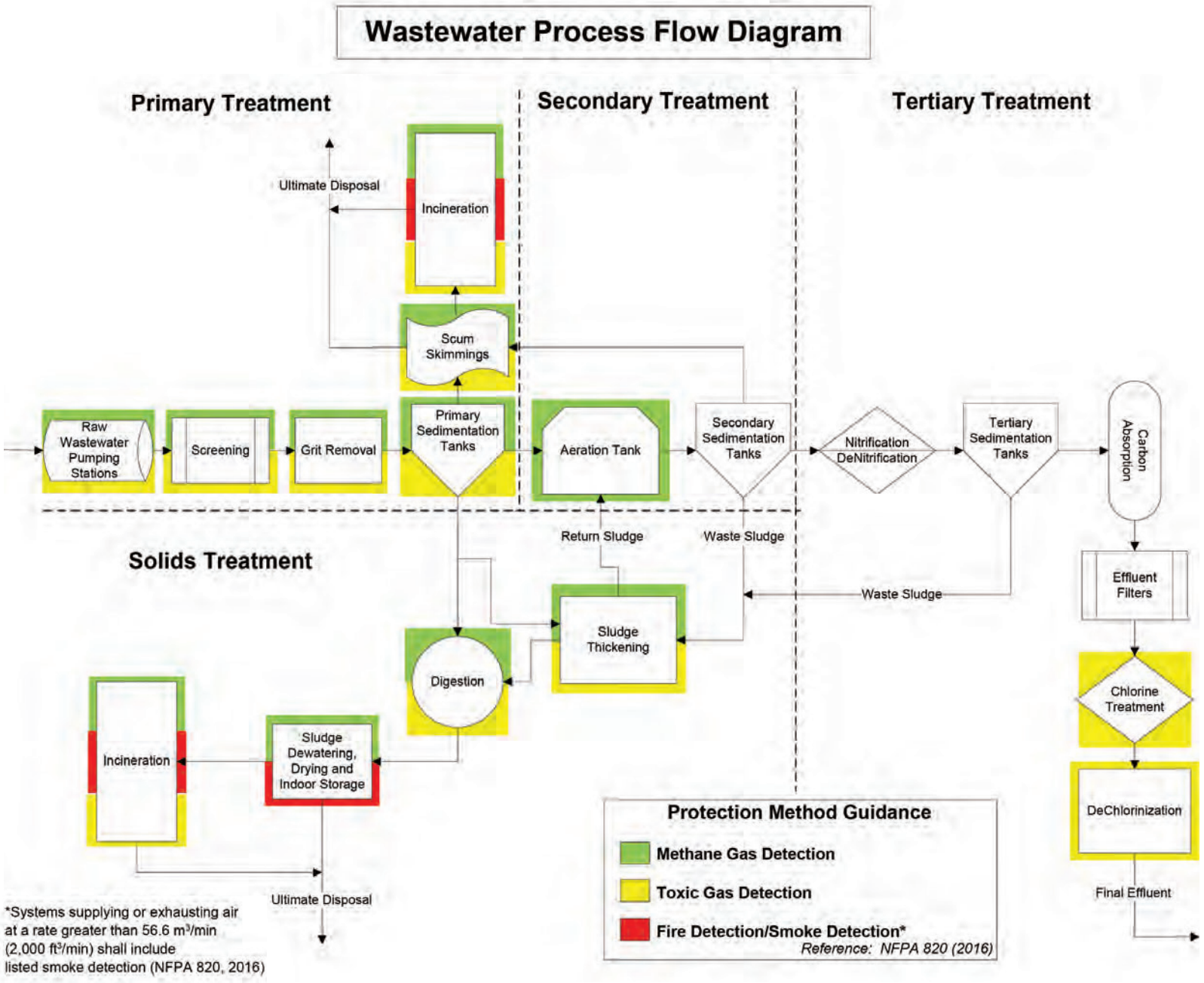
Biosolids dewatering is one wastewater treatment area specifically called out in NFPA 820 for fire protection that includes smoke detectors.

Such areas are common in treatment plants. Per NFPA, electrical equipment such as gas and smoke detectors in these areas must be designed to limit or isolate potential gas ignition sources. NFPA 70 Section 500.7 lists several protection options for electrical equipment in hazardous locations. For Class I Division 1 areas, these include:

- **Intrinsically safe (IS) equipment,** designed with special circuitry that maintains energy levels below that required to cause ignition.
- **Explosion-proof (XP) equipment,** designed so that sparks or explosions are contained within the housing, preventing these from becoming gas ignition sources. While XP detectors may cost more, IS devices are more difficult and costly to install and maintain, usually making XP detectors less expensive in the long run.

FIRST LINE OF DEFENSE

Combustible gas detection systems, which alert personnel to a leak before it ignites, constitute the first line of defense in a fire safety system. When used in treatment plants, they measure methane to determine whether it has



Based on NFPA 820 (2016), this diagram shows the stages in a typical wastewater treatment process and the types of detection needed at those stages.

DETECTOR CERTIFICATION

For use in hazardous-classified areas of water treatment plants, both combustible gas and smoke detectors must be Class I Division 1 hazardous-area certified to ensure explosion safety.

They must also be performance-certified for the specific attributes and functions required in hazardous areas. The performance, selection, use and location of gas and smoke detectors are covered in general terms in Chapter 17 of NFPA 72: National Fire Alarm and Signaling Code.

Performance testing and certification verifies that a device will operate as specified by the manufacturer under worst-case conditions. Some detector manufacturers self-certify product performance, meaning they rely solely on their own evaluation to certify that their products meet applicable standards.

Other detector manufacturers seek certification from accredited third-party testing organizations to get an independent evaluation of performance. A number of independent organizations have documented safety and performance criteria for gas detectors.

Certification information about a particular detector can be found on the device label and in its accompanying manual. If the manual or label states that the device is certified for Class I Division 1 areas, there are no restrictions on where it can be placed.

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reached a combustible level. These systems can also trigger alarms, record events, provide time for intervention or evacuation, activate ventilation, and release water mist or carbon dioxide to suppress ignition if a gas cloud is forming. Gas detector options suited to wastewater applications include:

- **Line-of-sight (or open-path) gas detection,** using laser, infrared or UV technology. These detectors, which monitor combustible gas levels between two points, are most often used to monitor open spaces above valves, tanks and pipelines.
- **Fixed-point gas detection** by electrochemical, catalytic or infrared technology. Detectors using these technologies activate when gases contact them. Typically installed in high-risk areas, these detectors also come in hand-held variations for spot-checking or for use by crews entering high-risk zones.

Each technology has benefits and limitations, so plant teams sometimes combine various technologies, placing detectors in locations that maximize their effectiveness.

PLACING SMOKE DETECTORS

In water and wastewater treatment plants, smoke detection is recommended for sludge-processing areas, incinerator buildings and underground tunnels. The detectors are usually hung on walls or ceilings. Like gas detectors, smoke detectors in hazardous areas must have hazardous-location approvals.

Smoke detectors sense particles produced by combustion, using technologies that include ionization, photoelectric light obscuration and video image detection. They should be located in anticipation of airflow from sources likely to present fire risks, but not where potentially costly or inconvenient false alarms are likely to be triggered.

To help treatment plants comply with the latest version of NFPA 820 (2016), which requires smoke monitoring in high-velocity ventilation ductwork, some smoke detectors are designed for mounting within ductwork.

To help treatment plants comply with the NFPA requirement for in-duct smoke monitoring, SmokeWatch U5015 (Det-Tronics) explosion-proof, self-monitoring smoke detectors are available with a duct-mount accessory.

When smoke is present, these detectors activate smoke dampers or fire dampers to protect personnel and help prevent the spread of fire through the HVAC system.

Some smoke detectors periodically self-test; the system controller informs users whether the devices are functioning properly. Still, plant personnel should test these devices regularly.

CONCLUSION

Water and wastewater treatment plants require an effective fire and gas safety system to protect personnel, equipment and structures from the risk of fire. Plant operators often leave the initial system selection and installation to a fire and gas safety specialist. However, as combustible gas and smoke detectors age, knowledge of detection equipment can help plant operators make decisions to keep their workplaces safer and maintenance easier.

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AR-1133

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