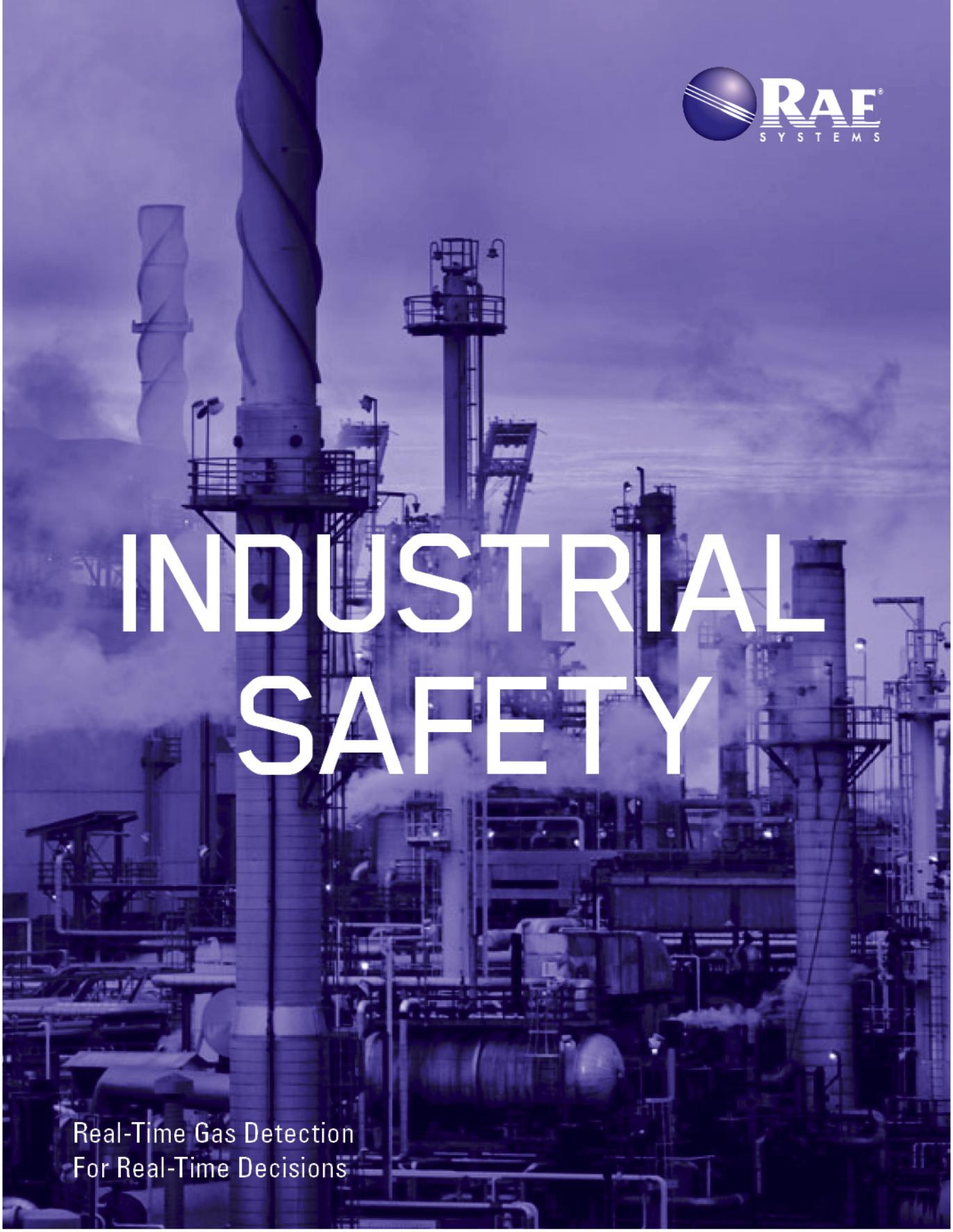


Effective Wireless and Fixed Gas Detection To Increase Safety at Wastewater Treatment Facilities

Rae Systems, Inc.

Introduction

Wastewater treatment facilities are an essential part of any industrialized nation's infrastructure. Also known as sewage treatment facilities, they allow a critical life-sustaining resource, water, to be reused without permanently damaging the ecosystems in which we live. Everyone generates wastewater, and typical daily residential water usage ranges from 50 to 100 gallons (189 to 378 liters) per person.

Wastewater treatment is accomplished by four basic methods: physical, mechanical, biological and chemical. Potentially harmful gases are generated during the various wastewater treatment processes. In order to ensure the safety of both the employees working at the treatment facility and the environment to which the treated wastewater is discharged, water treatment processes must be monitored.

Many of the processes involved in treating wastewater either use or produce toxic and flammable gases that create potentially hazardous environments. In addition, industrial facilities often have confined spaces where gases can displace ambient air and create oxygen-deficient environments. Because of these risks, gas detection is an essential part of any safety program at wastewater treatment facilities. Typical gases monitored at a wastewater treatment facility include methane, oxygen, chlorine, hydrogen sulfide, and ammonia.

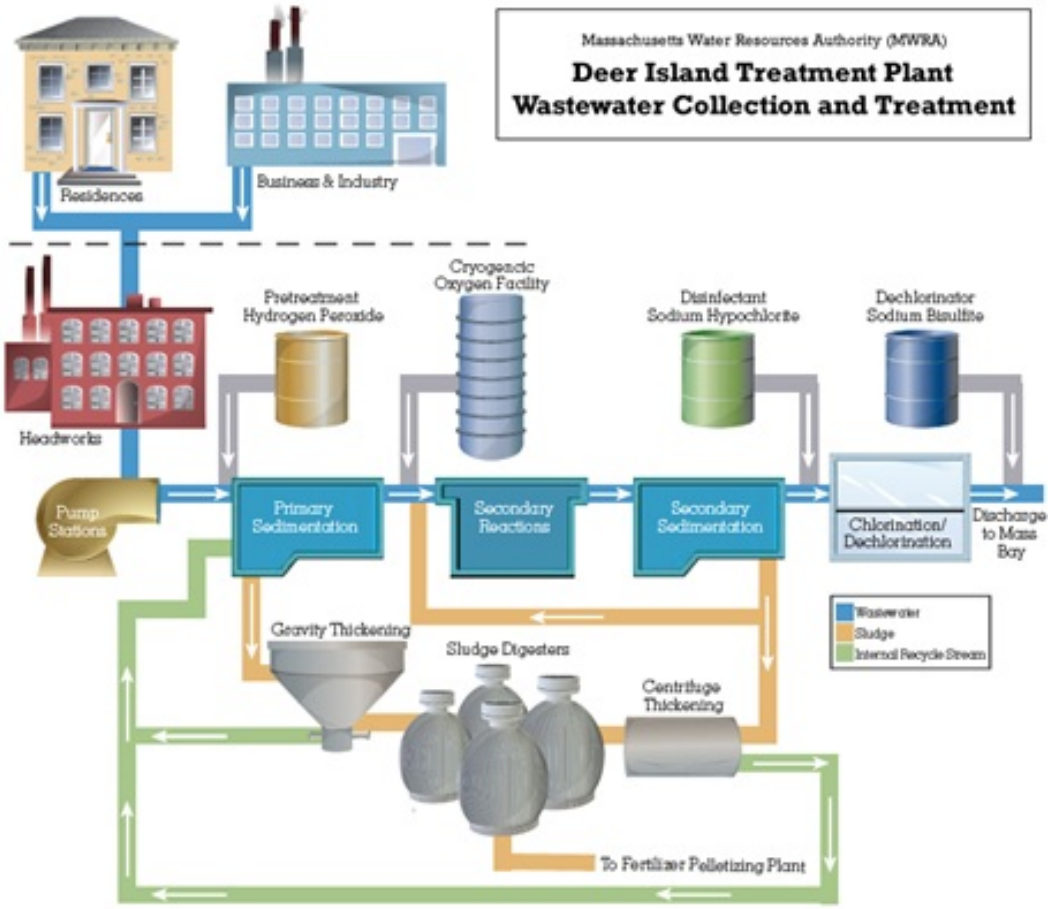
Most facilities utilize a combination of fixed-head gas detectors for area monitoring and portable gas detectors for personal protection.

Many facilities are also adopting semi-fixed gas detectors, such as the MeshGuard from RAE Systems, which offer the long-term monitoring of a fixed head as well as the flexibility of a portable monitor.

This paper reviews the use of gas detection equipment in wastewater treatment facilities and how different approaches to wastewater gas-detection systems are being adopted to perform a range of industrial applications – including fixed, portable, transportable and wireless.

Wastewater Treatment Processes

In order to understand the best practices for gas monitoring in wastewater treatment facilities, it is important to first understand the wastewater treatment process. The following example of a water treatment facility is intended as an overview. Processes and equipment vary by location.



Source: Massachusetts Water Resources Authority

Major Components of a Wastewater Treatment Plant

Pumping

Wastewater *influent* from communities arrives at the plant through underground tunnels. Water is temporarily stored in "wet wells" in the pumping station. Pumps then lift the influent to the head of the plant. The pumping stations contain multiple high-powered pumps to move the influent into the treatment facility. Pumping stations are often enclosed areas and are considered confined spaces for gas detection. In addition the influent can release methane and hydrogen sulfide, and displace enough oxygen to create a hazardous environment.

Primary Treatment

After pumping, flows pass through grit chambers that remove grit for disposal in an off-site landfill. Next, flows are routed to primary treatment clarifiers that remove about half of the pollutants brought to the plant in typical wastewater (50 to 60% of total suspended solids and up to 50% of pathogens and toxic contaminants are removed). At the water reclamation plant, long concrete tanks are used as clarifiers.

The heavier solids settle to the bottom and form sludge. Lighter materials, like plastic and grease, which float to the top, constitute what is called "scum" and are removed and returned to the sewers for further treatment. Then the remaining wastewater containing dissolved and suspended materials (mostly organic) moves to the second phase of treatment in aeration tanks and secondary settling basins. Some treatment facilities use hydrogen peroxide as a pre-treatment additive, so oxygen levels should be monitored closely. Also, if primary treatment is done in an indoor facility, methane, hydrogen sulfide, and oxygen levels must all be monitored closely to ensure safety for anyone entering the process facility.

Secondary Treatment

Secondary treatment mixers, reactors and clarifiers remove non-settleable solids through biological and gravity treatment. The biological process is an oxygen-activated sludge system, using microorganisms to consume organic matter that remains in the wastewater flow.

Secondary treatment raises the level of pollution removal to over 85%. In the secondary-treatment aeration tanks, air is either bubbled through the water to supply oxygen or oxygen may be directly added at the cryogenic facility. Microorganisms in the wastewater grow as they feed on the organic materials in these tanks.

In the secondary-treatment settling tanks, the microorganisms clump together and settle to the bottom, where they are removed and recycled back into the treatment process. Secondary treatment steps produce "off-gases" that include hydrogen sulfide, methane, and oxygen.

Sludge Digestion

Sludge and scum from primary treatment are thickened in gravity thickeners. Sludge and scum from secondary treatment are thickened in centrifuges. Digestion then occurs in large anaerobic digesters. Microorganisms naturally present in the sludge work to break down sludge and scum into methane gas, carbon dioxide, solid organic byproducts, and water. Digestion significantly reduces sludge quantity.

The byproduct of the digestion process is 70% methane gas, which can be captured and piped to boilers that generate enough heat to warm the buildings on the site, as well as for the heat-dependent treatment processes.

Odor Control

Air scrubbers and carbon absorbers remove odors and volatile organic compounds from treatment process off-gases. Odor control is used for primary and secondary treatment process facilities, as well as sludge processing, plant pumping, and grit removal facilities. Odor control performance is constantly monitored and is governed by local regulations. Hydrogen sulfide is typically the primary odor concern.

Disinfection

After passing through primary and secondary treatment, wastewater is disinfected with sodium hypochlorite or chlorine to kill bacteria. In subsequent steps, sodium bisulfite is sometimes added to dechlorinate the water, so that chlorine levels in the ultimate discharge will not threaten marine organisms. After disinfection and de-chlorination, the effluent is ready to be discharged back to natural water supplies.

Fixed-Head Gas Detection in Wastewater Treatment Plants

Fixed-head gas detectors are ideally suited to areas that need continuous monitoring. Fixed-head detectors are permanently mounted and hard-wired to provide data to a remotely located controller. Controllers can aggregate data from multiple fixed gas detectors and often contain configurable relays that can activate warning alarms or process controls to alert others of alarm conditions.

Fixed-head detectors are typically located in areas that are known to have potential risks. For example, chemical storage rooms, confined spaces, or any area that is in close proximity to processes that produce toxic and flammable gases are all potential locations for fixed-head gas detectors.

However, fixed-head gas detectors are difficult to install because they typically require an electrician, and are also expensive when the costs of safety conduit and cabling to the controller are factored in. In addition, fixed-head gas detectors are difficult to relocate should the water treatment processes or facility layout change over time.

Portable Gas Detection in Wastewater Treatment Plants

Portable gas detectors are ideally suited for personnel protection. They are battery operated and small enough to be worn by personnel who work in potentially hazardous environments.

Portable gas monitors can be either single-gas or multi-gas instruments, and offer superior personal protection, since they are worn directly by workers and travel with them throughout the water treatment facility. However, portable detectors have a limited battery life (often less than 24 hours), need frequent calibration and maintenance, and only provide local alarms for the worker who is wearing the instrument.

Most portable devices do not have the ability to transmit real-time readings and alarms to a central location that can alert other personnel to a potentially dangerous situation within the water treatment facility.

As a result, data collection, aggregation and alarm logging from multiple portable instruments can also create significant administrative burdens for wastewater treatment facilities.

Semi-Fixed Gas Detection in Wastewater Treatment Plants

With recent advancements in technology, some wastewater treatment facilities are beginning to use semi-fixed gas detectors in addition to traditional fixed head and portable gas monitors.

The portability of semi-fixed gas detectors allows treatment facilities to quickly deploy gas detection systems as needed. For example, gas detection systems are needed when facilities must shut down existing process equipment in order to perform routine maintenance.

Shutdowns, or turnarounds, may last anywhere from several hours to several months. Semi-fixed detectors, however, still need maintenance for battery replacement and sensor calibration, but the data aggregation and alarm logging are done automatically by the controller. Because of their usage flexibility, many wastewater treatment plants are using semi-fixed gas detectors in addition to their existing fixed-head and portable gas detectors.

By eliminating power and signal cabling requirements, semi-fixed gas detectors do not require an electrician for installation and can be easily moved around a wastewater facility as gas detection needs change over time.

Semi-fixed monitors, such as the MeshGuard detector, have the ability to provide the long-term monitoring of a fixed head, but offer the flexibility of a portable monitor. MeshGuard is a battery-operated wireless gas detection system. Detectors can operate continuously for up to 6 months on a single battery, eliminating the need to install power cabling.

MeshGuard detectors also wirelessly transmit real-time readings to a remotely located controller, eliminating the need to install expensive signal cabling and conduit. The remotely located controller wirelessly receives readings and alarm conditions from the detectors, and, like a fixed system controller, can use internal relays to trigger wider-area alarm notifications or process controls.

Summary

Wastewater treatment facilities, or sewage treatment facilities, are an essential part of any industrialized nation's infrastructure. During the various treatment processes of wastewater, toxic and flammable gases are produced. To ensure safety for treatment facility employees and the surrounding community, these gases must be monitored. Wastewater treatment plants use a combination of fixed, portable, and semi-fixed gas detectors to monitor gas readings throughout the facility.

The following chart provides an overview of some of the gases produced throughout the wastewater treatment process.

	Chlorine	Hydrogen Sulfide	Methane	Oxygen	Sulfur Dioxide
Pumping Stations / Wet Wells		X	X	X	
Primary Treatments					
Grit Chambers		X	X	X	
Primary Clarifiers		X		X	
Secondary Treatments					
Aeration		X	X	X	
Settling tanks		X	X	X	
Sludge Digestion		X	X	X	
Odor control		X			
Disinfection	X				X

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About RAE Systems Inc.

RAE Systems is at the forefront of hazardous-atmosphere detection-monitoring technology. The company develops and manufactures field-proven wireless systems that enable incident commanders, plant safety managers and industrial hygienists in a wide range of industries to easily and affordably extend their monitoring capabilities, integrate meaningful information and share critical data with a multitude of stakeholders in a situation-specific way – all in real time as emergencies unfold.

RAE Systems delivers a wide range of wireless functionality in our atmospheric-hazard detection-monitoring solutions. A global gas-detection and wireless-system innovator, RAE Systems develops a wide range of rugged yet easy-to-use detection instruments and systems simplify the job of plant safety managers and industrial hygienists with innovative product designs that help increase safety, improve incident-response times and reduce downtime.

With its proven technological leadership and more than 37 patents in the detection-sensor field, RAE Systems produces an extensive line of fixed, portable, hand-held and personal instruments that enable real-time safety-threat detection of chemicals, including volatile organic compounds (VOCs), and radiation for industrial and environmental safety applications worldwide. The company's reliable and cost-efficient products protect workers, contractors and the public from hazardous and potentially deadly exposures from radiation, gases such as hydrogen sulfide (H_2S), and hundreds of VOCs, including benzene, toluene and formaldehyde.

RAE Systems' solutions are:

- **Versatile**. RAE Systems' easily deployable fixed and portable monitors placed in sensitive areas transmit sensor information in real-time to a central location for quick interpretation, analysis and action.
- **Wireless**. Atmospheric monitoring that utilizes cost-effective wireless equipment that is easy to install and operate can assist event officials and first responders with real-time information on potential hazards.
- **Proven**. With more than 20 years of experience, RAE Systems has a verified track record of producing innovative fixed, portable, transportable and wireless solutions.

For more information, contact RAE Systems **HERE.**