
# Wastewater Treatment

## Application Note

## Introduction

Water which has been used to transport human and liquid wastes of residences, businesses and industries is defined as wastewater. The sewage system also transports the run-off surface water and storm water. Any wastewater that is potentially dangerous to humans or the environment because of its toxicity, flammability, corrosivity, chemical reactivity, etc. requires treatment before it is released back to the water system.

Wastewater Treatment Plants (WWTP) are facilities designed to prevent pollution and disease by treating wastewater before released to the environment.

### Market Segments

Municipal and industrial wastewater treatment plants

## Description of the Challenge

Typical gases to be monitored at a wastewater plant are: combustible gases (primarily Methane, $CH_4$), Hydrogen Sulfide ($H_2S$), Chlorine ($Cl_2$) and Oxygen ($O_2$). In addition, some plants may require Sulfur Dioxide ($SO_2$), Ammonia ($NH_3$), Ozone ($O_3$), Chlorine Dioxide ($ClO_2$) or Hydrogen Peroxide ($H_2O_2$) gas detection.

The terrain of the treatment plant site and the influent sanitary sewer system define the need for and location of in-plant and external (lift station) pumping facilities. In-plant pump stations are facilities that consist of pumps and service equipment designed to pump flows from lower to higher elevations to allow continuous and cost-effective treatment through unit processes within the plant. Gas detection for combustible gases and vapors may be required where surface and storm water might carry fuel oil, gasoline, or flammable solvent spills. If those pumping stations, lift stations, dry wells or wet wells are in an enclosed building or structure, additional to methane/combustibles monitoring, $H_2S$ and $O_2$ detectors might be needed.

### Primary Treatment

In Primary Treatment, during which much of the solids are removed, sanitary sewers carry wastewater from homes and businesses to the treatment plant. Bar screens let water pass through but filter out larger trash and debris, which is collected and disposed of later. A grit chamber slows down the flow of water, allowing sand, grit, and other heavy solids to settle out. A primary sedimentation tank collects the smaller particles. Lighter-than-water liquids, primarily oils and solvents, float on top. These “floaters” and “sinkers” are removed. Gas detection for combustible gases and vapors may be required where surface and storm water might carry fuel oil, gasoline, or flammable solvent spills.

### Digestion

In Secondary Treatment, which removes much of the remaining pollutants, an aeration tank supplies large amounts of air to a mixture of wastewater, bacteria, and microorganisms. Oxygen (aerobic process) speeds the growth of these helpful organisms which consume harmful organic matter. A secondary sedimentation tank (anaerobic breakdown) allows the microorganisms and solid waste to settle out. During the process of aerobic breakdown, especially when happening in enclosed buildings or structures, gas detection may be required for Carbon Dioxide ($CO_2$) and $O_2$ for depletion. In the process of anaerobic breakdown gas detection for $CH_4$ and $H_2S$ may be required.

The sludge collected at the bottom of the clarifier is recycled to the aeration tank to consume more organic material. The term “activated” sludge is used, because by the time the sludge is returned to the aeration tank, the microorganisms have been in an environment depleted of “food” for some time, and are in a “hungry”, or activated condition, eager to get busy biodegrading some more wastes. Since the amount of microorganisms, or biomass, increases as a result of this process, some must be removed on a regular basis for further treatment and disposal, adding to the solids produced in primary treatment.

One commonly used method of sludge treatment is digestion. Since the material is loaded with bacteria and organic matter; why not let the bacteria eat the biodegradable material? Digestion can be either aerobic or anaerobic. Aerobic digestion requires supplying oxygen to the sludge; it is similar to the activated sludge process, except no external “food” is provided. In anaerobic digestion, the sludge is fed into an air-free vessel; the digestion produces a gas which is mostly a mixture of methane and carbon dioxide. The gas has a fuel value, and can be burned to provide heat to the digester tank and even to run electric generators. Digestion can reduce the amount of organic matter significantly, greatly decrease the number of pathogens, and produce a liquid with an inoffensive, “earthy” odor. This makes the sludge safer to dispose of on land.

During the process of aerobic breakdown, especially when happening in enclosed buildings or structures, gas detection may be required for $CO_2$ and $O_2$ depletion. In the process of anaerobic breakdown gas detection for Methane ($CH_4$) and Hydrogen Sulfide ($H_2S$) may be required. The description herein is only meant for **monitoring of ambient air**.

For any in-line biogas monitoring see a separate application note since different measuring ranges and conditioning of the biogas is absolutely essential.

### Disinfection Process

Chlorine ($Cl_2$) is a widely used disinfectant for municipal wastewater because it destroys target organisms by oxidizing cellular material. After the disinfection the Chlorine residual has to be reduced to a level that is not toxic. Some processes use Sulfur Dioxide ($SO_2$) for the de-chlorination of the water. Some alternative disinfectants include ozonation ($O_3$), Chlorine Dioxide ($ClO_2$) or ultraviolet (UV) disinfection. The wastewater, now safe for the environment, flows as an effluent to a river, lake or the sea. Gas detection is needed for $Cl_2$ and $SO_2$, or whatever other gas is used as the disinfectant treatment.

OTHER POSSIBLE PROCESSES INCLUDE:

- Ammonia stripping is a simple desorption process used to lower the Ammonia ($NH_3$) content of a wastewater stream. In Ammonia stripping, lime or caustic is added to the wastewater which converts Ammonium Hydroxide ions to Ammonia gas.
- In some areas of the wastewater collection system, odors and corrosion within the wastewater system are controlled by direct oxidation of $H_2S$ with Hydrogen Peroxide $H_2O_2$. Typically, this is upstream of sensitive pump stations or before main discharges.

## Solutions from Dräger

### 1. Detection of gasoline and solvents (from surface and storm water):

**Dräger Polytron® 8700 or 5700 IR sensor monitor** for combustible hydrocarbon gas monitoring. Long life (>10 years) IR gas detector with aluminum or 316 stainless steel housing, sophisticated double compensated optics which ensures less than 2 %LEL signal drift over 24 month, wide temperature range covering all climates (-40 to +77°C) and beam block warning before failure to schedule maintenance from any build-up of deposits on the optics. Units can be cross-calibrated for solvent monitoring. Consult with Dräger Tech Support.

*Alternative:* **Dräger Polytron® 8200 or 5200 DD Catalytic sensor monitor** for total combustible gas monitoring. Robust, unique catalytic sensor technology with wire mesh flame arrestor for fastest response. Low drift and poison resistant design help reduce maintenance cost and provide reliability.

*Recommendation:* None of the monitors should be submerged in water or wastewater because of possible damage. The IR sensor (PIR 7000) for the Polytron® 8700 or 5700 can be remote mounted separate from the transmitter electronics in potential flooding areas and has IP 66 & IP 67 ingress protection. If immersed, it can be hosed off and be made fully operational again.

### 2. Detection of Methane (produced during bacterial breakdown of organic material)

**Dräger Polytron® 8700 or 5700** long life (>10 years) direct methane reading IR gas detector with SS 316 aluminum or stainless steel housing, sophisticated double compensated optics which ensures less than 2 %LEL signal drift over 24 month, wide temperature range covering all climates (-40 to +77°C) and beam block warning before failure to schedule maintenance from any build-up of deposits on the optics.

*Alternative:* **Dräger Polytron® 8200 or 5200** DD Catalytic sensor monitor for total combustible gas monitoring. Robust, unique catalytic sensor technology with wire mesh flame arrestor for fastest response. Low drift and poison resistant design help reduce maintenance cost and provide reliability.

*Complementary:* **Dräger Polytron® Pulsar 7000** open path IR monitor, often used outdoors where the detector will be subjected to exposure to the elements, vibration, sunlight (and other bright light sources) and longer beam distances. Fence line monitor ideal for applications in areas where there is a need for high sensitivity to flammable gas over longer operating distances.

*Recommendation:* Open path detectors should be used when a large area should be monitored, e.g. across basins or along piping or fences.

**Dräger Polytron® 8700, 5700, 8200, or 5200** are ideal as point detectors where a possible leak can occur at any time, e.g. areas with connectors, flanges or valves.

 

## 3. Detection of toxic gases and oxygen
### (covering all gases found in a WWTP)

Dräger Polytron® 3000, Polytron® 7000 and Polytron® 2 XP Tox are universal transmitters which accepts any DrägerSensor, downloads sensor-specific information from the embedded sensor EEPROM.

The sensor has an embedded temperature element which allows to compensates the sensor signal in the range of - 40 to + 65 °C.

## Restrictions

Catalytic bead detectors: - $H_2S$ might be poisoning the sensor

### ADVANTAGES OF THE DRÄGER SOLUTION

Catalytic bead detectors:
– Economical solution

IR detectors:
- Lower measuring ranges along with higher sensitivities result in larger monitoring areas
- Constant sensitivity over lifetime of the instrument
- Can be submersed without damage (IP 66 & IP 67)

Open Path:
- Monitoring of large areas
- Low cost of ownership
- Fast response time

DrägerSensor:
- Bigger sensor means bigger electrodes and more electrolyte, hence faster response, higher accuracy, more stability and longer life
- Embedded micro-chip and temperature element
- Sensor recognition, numerous self-test functions, remote calibration and signal compensation over the whole temperature range of typically - 40 to + 65 °C



**CORPORATE HEADQUARTERS**
Drägerwerk AG & Co. KGaA
Moislinger Allee 53–55
23558 Lübeck, Germany

www.draeger.com

**USA**
Draeger, Inc.
7256 S. Sam Houston Parkway W.,
Suite 100
Houston, TX 77085
1 800 4DRAGER
(1 800 437 2437)

**Locate your Regional Sales Representative at: www.draeger.com/contact**