APPLICATION NOTE A2.5:
Measuring GHGs from Wastewater Treatment Plants

INTRODUCTION

Greenhouse gases (GHGs) are gases that trap heat in the atmosphere and contribute to climate change. These include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases. While naturally occuring, human activities have increased the rate at which GHGs are released into the atmosphere and the natural removal process is unable to keep pace. As a result, mitigating GHG emissions is a key step in fighting climate change.

Some of the largest global GHG emitters are wastewater treatment plants (WWTPs), and there are several steps in the process that can lead to GHG emissions. By ensuring accurate measurements at these locations, WWTPs can enact steps to prevent leakage and reduce their environmental footprint.

WASTEWATER TREATMENT PLANTS

WWTP are important pieces of infrastructure in any community, but they are also a significant contributor of anthropogenic GHG emissions. Wastewater can enter treatment plants from a variety of sources such as municipal, commercial, or industrial sources, and are treated differently depending on the individual treatment plant. Generally in WWTP, direct GHGs are generated during the wastewater and sludge treatment process. However, it is important to note that only CH_4 and N_2O are of major concern here since CO_2 is considered carbon neutral because of its biogenic nature. Indirect GHG sources, such as energy consumption, do include CO_2 though. The majority of WWTPs are actively working towards mitigating GHG emissions, however this is complicated by the fact that CH_4 is ebullitive in nature. Thus, having an accurate method to measure GHGs, and enact management protocols as needed, is essential.

SOURCES OF GHGs IN WASTEWATER TREATMENT SYSTEMS

Leakage of GHGs in WWTP can occur at several points along the treatment process:

- Pre-entry to the plant at pumping stations and manholes/ sewers
- The point of entry into the plant (influent location)
- The various treatment stages: primary settling, aeration, secondary settling, anaerobic digestors, sludge treatment/ disposal
- The point of exit from the plant (effluent location)

Figure 1. An example of a wastewater treatment plant (right). Image from: https://evreka.co/blog/how-to-handle-wastewater-treatment-and-disposal/

PRO OCEANUS

Dissolved Gas Sensors

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MEASUREMENT OF DISSOLVED GHGs

Measurement of dissolved gases is essential to ensure that emissions are accounted for appropriately. Each wastewater treatment plant is unique, making the measurement of the greenhouse gas emissions a key element in any operation.

Dissolved CH_4 and CO_2 can be measured in a number of ways, including head-space equilibration with gas chromatography, chemical laboratory analysis of water samples, and in situ measurement via diffusion across a membrane into an infrared gaseous CH_4 or CO_2 detector. Head-space equilibration with gas chromatography and analysis of water samples are time consuming, creating a time lag between sample collection and measurement results. Pro-Oceanus' pCH_4 and pCO_2 sensors utilize infrared detection to provide continuous long-term in situ measurements that allow for real-time data to support WWTP monitoring.

DISSOLVED GAS SENSORS

Pro-Oceanus offers several models of dissovled gas sensors for monitoring WWTP, including the CO_2-Pro CV, the Mini CH_4 and CO_2, and the Solu-Blu CH_4 and CO_2. Pro-Oceanus sensors utilize an advanced flat membrane technology that allows for the sensors to be continously deployed for long periods of time. This leads to less equipment downtime and less maintenance, resulting in better reliability and lower cost of ownership.

These sensors can be standalone with internal logging and battery power, or can be easily integrated into automated systems with feedback control with 4-20 mA, 0-5 V and RS-232 outputs. The right equipment choice to monitor GHGs is easy with a consultation from the Pro-Oceanus Scientific Team.

Figure 2. Pro-Oceanus' Mini CH_4 sensor

PRO OCEANUS Dissolved Gas Sensors

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