SLUDGE & BIOSOLIDS

The role of wastewater treatment plants toward decarbonization

Plants have the opportunity to upgrade anaerobic digestion with biological hydrolysis, maximizing biogas output and establishing a long-term revenue stream.

Dave Swerdlyk

April 5, 2023

Climate change resulting from increasing atmospheric greenhouse gas (GHG) concentrations is one of the foremost challenges facing society today.

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Wastewater

U.S. EPA, municipal solid waste landfills are the third-largest source of human-related methane emissions in the nation.

Additionally, wastewater treatment plants (WWTPs) — consumers of over three percent of all electricity in the U.S. — also contribute to the amount of GHG emissions released globally. WWTP operations produce direct emissions from biological treatment processes and indirect emissions result from the generation of energy that is required to run the plants.

While carbon dioxide generated from human-related activities represents the largest contributor to climate change, EPA characterizes methane, a short-lived climate pollutant, as more than 25 times as potent as carbon dioxide at trapping heat in the atmosphere.

With atmospheric methane concentrations having more than doubled over the last two centuries, capturing and utilizing GHGs to the greatest extent possible before these gases can be released to the environment is critical for addressing the challenge of a warming planet.

Reducing emissions

One of the most beneficial opportunities for reducing GHG emissions from landfills and WWTPs is to divert the organic waste to treatment processes that combine anaerobic digestion (AD) treatment with biological hydrolysis. Together, these advanced wastewater treatment processes can deliver significant GHG reductions by efficiently digesting sludge and capturing the GHG output.

In addition to the climate benefits these technologies offer, AD and biological hydrolysis offer WWTPs a substantial financial incentive due to the renewable energy that can be harnessed and resold.

electricity and thermal energy for powering plant equipment like the boiler.

However, from a financial perspective, municipalities can realize greater returns by upgrading all the biogas they generate into renewable natural gas (RNG) and injecting it into a commercial natural gas pipeline for sale on the RNG market.

In addition to receiving the commodity value of the RNG, municipalities can qualify for renewable identification number (RIN) credits under the Federal Renewable Fuel Standard Program, creating a revenue stream. Market participants can trade RINs and the credits are ultimately bought by obligated parties — such as petroleum refiners and refined fuel importers.

RINs function as the currency in the Renewable Fuel Standard Program. They receive different classifications depending on the feedstock source that was processed. For example, RNG produced using biogas from municipal wastewater treatment facility digestors, landfills and other cellulosic biofuel sources will generate a D3 RIN code that is currently valued at about $42 per MMBTU.

Comparatively, RNG derived from biogas produced from organic food waste including fats, oils, sugars, and starches fall into the D5 category and, at about $20/MMBTU currently, are valued significantly less than D3 feedstocks.

Since any food waste added to a WWTP's anaerobic digestor will automatically trigger the produced biogas to default to the lower D5 RIN rating, municipalities are currently disincentivized to pursue true co-digestion projects.

RNG as a climate strategy

decarbonization measure and a key strategy for achieving long-term climate goals.

Governments and policy makers, in their efforts to target short-lived climate pollutants and curb GHG emissions, are introducing renewable gas mandates that require natural gas distributors to gradually use RNG in place of conventional natural gas.

For example, to reduce fossil fuel consumption and meet its GHG emission reduction goals, the Government of Québec in 2019 initiated the Québec Renewable Natural Gas Mandate. The mandate requires natural gas suppliers in the province to incorporate a minimum of 5% RNG as the total amount of gas distributed in the system by 2025. This proportion could be increased to 10% by 2030.

In the U.S., California's Renewable Natural Gas Standard was recently adopted by the California Public Utilities Commission in February 2022. It requires the state's natural gas utilities to supply 12.2% RNG as the total amount of traditional gas delivered to customers by 2030. The standard makes California the first state in the U.S. to adopt a renewable gas standard.

According to the National Law Review, other states, including New York, New Jersey, Nevada, New Hampshire, Colorado, and Washington, have included RNG as an option for complying with their respective regulatory mandates to increase production of energy from renewable resources or are contemplating the adoption of RNG-related policies.

Optimizing AD with biological hydrolysis

Biological hydrolysis brings a key enhancement to the AD treatment process.

sludge so that it can be digested in the ensuing AD process at a shorter hydraulic retention time (HRT).

Compared to conventional mesophilic digestion, where the sludge is typically held for 20 to 30 days to achieve a reasonable amount of solids reduction and stabilization, adding biological hydrolysis will effectively cut that time in half — producing a stabilized biosolid in just 15 days of total retention time.

Importantly, the reduced HRT does not sacrifice biogas productivity. By controlling conditions through a series of six plug flow tanks ahead of the digester, which creates an optimal environment for hydrolysis and acidification, the digestor in turn is fed with volatile fatty acids. This allows the digestor to be dedicated to methanogenesis, resulting in a 25% boost in biogas production while also increasing the capacity of the digester.

By more than doubling sludge throughput using the same digester infrastructure, WWTPs have the option to supplement their digestor loading with an additional waste input.

Conventionally, the biological hydrolysis solution is designed to be integrated at the front of an existing AD process and can be commissioned in place without taking downstream digestion out of service.

As an added benefit, conditions can be tailored in the six-tank, biological hydrolysis flow reactors to both reduce the volume of resultant biosolids and enhance quality for producing a pathogen-free, Class A biosolid.

The higher quality biosolid product provides the opportunity for beneficial reuse by maintaining valuable nutrients to sell as

AD and biological hydrolysis upgrades that efficiently capture GHGs and maximize biogas output for conversion to RNG provide WWTPs with the benefit of long-term revenue streams while simultaneously enabling municipalities to play a larger role in the fight against a changing climate.

About the Author

Dave Swerdlyk