BIOGAS

Metros, where are YOUR DIGESTERS?

Load-shedding, rising energy costs, limited landfill space and pressure to reduce carbon emissions should be enough reasons for municipalities to consider biogas.

Rosan van Wyngaard, tender manager, Veolia Services Southern Africa

While biogas alone will never solve the energy crisis, it can assist as a supplement in turning South Africa's waste problem into an energy solution," says Rosan van Wyngaard, manager: OSS Tendering, Veolia Services Southern Africa.

Water and wastewater infrastructure is among the major consumers of energy within municipal operations and service delivery. According to a Sustainable Energy Africa report, water and wastewater accounts for approximately 17% of energy consumption in a South African metro.

"A large-sized wastewater treatment plant (WWTP) can reduce a decent amount of that energy cost by using biogas that is generated on-site. That is a massive saving, and it provides capacity for the rest of the country while reducing carbon emissions," adds Van Wyngaard.

Veolia has created a tool called Greenpath that provides a simple and rapid diagnosis of carbon emissions from drinking water and wastewater treatment plants. Greenpath analysis was done on some of Veolia's operational sites (outside of South Africa), and it was found that the addition of a digester resulted in the reduction or avoidance of up to 40% of the carbon emissions.

Furthermore, biogas production can reduce the pollution potential in wastewater by reducing the oxygen levels required by the organic matter. Nutrients like nitrogen and phosphorous are conserved in the digestate, which is the material remaining after the anaerobic digestion. This can then be used to displace fertilisers in crop production and can also be turned into compost.

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How biogas works

Organic matter or biomass like sludge is added to an anaerobic digester that produces biogas – a mixture of mainly methane and carbon dioxide (CO_2).

The anaerobic digester breaks down the chemical oxygen demand (COD) in the biomass into smaller molecules that can be digested by methanogenic bacteria. From there, the COD is converted into biogas.

The raw biogas needs to be dried and hydrogen sulfide (H_2S) and other trace substances removed in order to obtain a good combustible gas and avoid corrosion or unwanted deposition in the combustion equipment. Particular attention must be paid to the concentration of siloxanes, which can lead to deposits in combustion equipment and deterioration of performance. Generally, the removal of siloxanes is done by adsorption on activated carbon, while H_2S is removed either with a scrubber or biological process.

The CO_2 and methane will have varying concentrations, depending on the feed. The methane contains the energy. This energy can be used on-site with these three technology options:

- combined heat and power (CHP) system where the excess heat can also be used to heat digesters or in a composting process
- gas engine to produce electricity only
- boiler (steam boiler or hot water boiler).

"It is important to consider conversion efficiencies. Boilers usually have 85% to 90% efficiency on energy recovery. But CHPs and engines have roughly 39% energy recovery," states Van Wyngaard.

Veolia is passionate about taking a waste product and turning it into a resource and has successfully implemented many biogas projects worldwide

Important considerations

Knowing the quantity and composition of the biomass entering the digester is central to the success of any biogas project. "Are there seasonal fluctuations? Will there be any changes in capacity in the foreseeable future (specifically considering the COD load)? Will there be any significant changes in the composition of the biomass? An anaerobic digester is robust, but may negatively react to massive fluctuations in the quantity and composition of biomass. Understanding and knowing what is fed into an anaerobic digester ensures the correct design specification, and makes the system easy to operate. There needs to be an understanding of important parameters (such as flow, pressure, siloxanes, COD, H_2S) and how to react should anything happen in the system. It is easy to make interventions if an operator is aware that the biomass coming into the system is not within certain parameters," she explains.

Furthermore, it should be noted that bacteria within the digester is sensitive to biocides, and these compounds may impede biogas production. Another important consideration is that biogas is flammable, and various safety measures must be put in place.

Size matters

Unfortunately, generating biogas is not always economically feasible for smaller WWTPs in municipalities or on the industrial side. However, there is still an opportunity to combine waste streams with other entities and generate biogas as a combined effort. The more biogas generated, the more cost-effective it is.

"To generate biogas, the sludge needs a high COD loading. As a rule of thumb, approximately 0.35 m^3 of biogas is generated from 1 kg of COD. Every plant is unique, and many other parameters need to be factored in when deciding if biogas is a viable option – such as wastewater discharge tariffs and landfill tariffs, cost of electricity, water or steam (if biogas will be used to provide steam), as well as the potential of biogas generation from the sludge," adds Van Wyngaard.

Misconceptions

While the benefits of biogas are obvious, the 'yuck factor' is a hindrance to the public acceptance of biogas. Extensive communication campaigns

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that encourage people to trust in the treatment process should be undertaken.

Another misconception is that biogas is difficult to design and operate, and that it does not work. Biogas technology has been around for decades. It is a proven technology.

"Some WWTPs in South Africa have digesters that are inactive. This is heart-breaking because it is infrastructure that can be put to use. There is this misconception that biogas did not work. But why did it not work? It is likely that the wastewater composition changed over the years and the operations side did not react accordingly. Perhaps the WWTP was not operating as it should or the operators of the biogas digester were not adequately trained," says Van Wyngaard.

With its entire business focused around water, energy and waste, Veolia Services Southern Africa have extensive knowledge of biogas technology. The company builds and operates the entire supply chain – from the whole WWTP to the actual digester – and understands limitations of the pumps and boilers.

"We are passionate about taking a waste product and turning it into a resource. Veolia has successfully implemented many biogas projects worldwide, including biogas projects in South Africa for industrial clients. We can also benchmark the characteristics of sludges and other biomass streams with facilities around the world," she adds.

"There is a promising future for biogas technology. Suppliers of the engines, boilers and CHPs are progressively manufacturing more efficient, cost-effective equipment and, as a result, the technology is becoming more accessible and the entire biogas process is constantly improving. There are huge incentives for biogas in the European market, where CO_2 is removed from biogas; the methane can even be pumped directly into the national gas grid for compensation. However, load-shedding, rising energy costs, limited landfill space and pressure to reduce carbon emissions are still clear drivers for the South African market," Van Wyngaard concludes. 3S