Optimizing anaerobic digesters through co-digestion and mathematical modelling in selected South African wastewater treatment plants

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Abstract

Wastewater treatment plants have been viewed primarily as sites for domestic and industrial wastewater treatment in South Africa, without considering the potential added benefit of onsite renewable energy production. Wastewater treatment plants consume large amounts of energy by virtue of the continuous processes such as pumping and aeration which occur throughout the water treatment process. Most wastewater treatment plants in South Africa have anaerobic digesters installed to stabilize sludge but they do not have combined heat and power (CHP)/ co-generation technologies as extensions to the anaerobic digesters. The resultant disadvantage is that some of the wastewater treatment plants the that have anaerobic digesters installed, do not flare the methane gas produced and this has a negative impact on the environment by contributing to greenhouse gas emissions. Energy audits of the respective wastewater treatment plants that where involved in the study were conducted. Raw sludge and co-substrates that were considered for co-digestion in the study were selected from industrial (high COD paper mill and brewery effluent waste) and non-industrial (municipal food waste and agricultural waste). Bio-methane potential tests were conducted in triplicate in order to validate the experimental results. The bio-methane potential curves were plotted as a result of the experimental data. The curves were used to calibrate the mathematical model. The software to utilized to simulate the model was SIMBA and DYNACHEM which are both dynamic models as a result a pilot scale anaerobic digester experiment was set up, where the daily biogas production per unit digester active volume was measured. The experiment involved placing 1200 L of full scale digester effluent sludge in each digester and purging the headspace with nitrogen gas. Each day 60 L of the digested sludge would be withdrawn and replaced with an equal volume of sludge and a mixture of the co-substrate. The results of the pilot plant were used to validate the model.

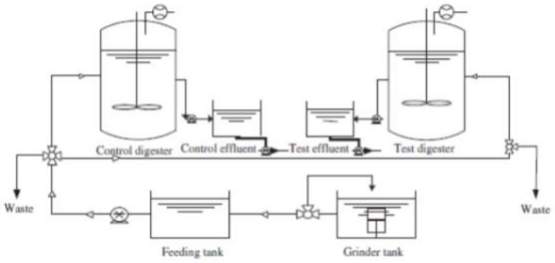


Figure 1Schematic of the pilot scale anaerobic digester set-up

References

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Nonhlanhla P Radebe has her expertise in water engineering and has a passion for renewable energy production in wastewater treatment plants. Her interdisciplinary training in the natural sciences and in engineering allows her to have a holistic view on the current issues surrounding renewable energy. Having worked in consulting within the contaminated site management team of a large multinational company such as Environmental Resources Management, she has some experience in the oil and gas sector. International experience in Egypt in the Red Sea region exposed her to solar and wind energy technologies widely practiced in the MENA region.

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Notes/Comments:

I am currently working on getting my work published.