Executive **Summary**

Analytical Framework to Identify the Economic Benefits of Co-Digestion Generation Revenue from Biogas

Understanding Impacts of Co-Digestion: Digester Chemistry, Gas Production, Dewaterability, Solids Production, Cake Quality, and Economics (ENER12R13)

The Central Issue

Utilities have looked for ways to increase their energy balance and attain energy self-sufficiency. Co-digestion of organic wastes with wastewater solids is an emerging practice, but there is not much guidance for water resource recovery facilities (WRRFs) that want to implement it for energy recovery.

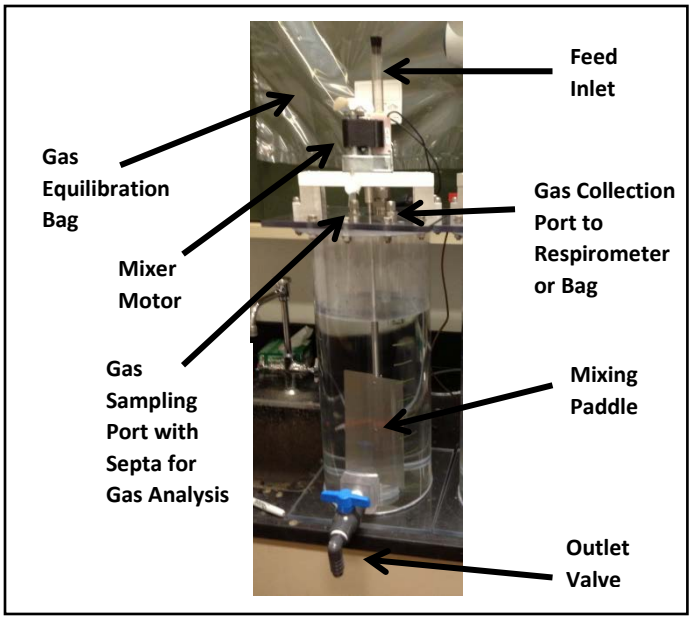
Context and Background

Utilities considering co-digestion need guidance on operations such as mixing, foaming, dewatering, and cake quality. Previous research on this subject has focused on increased biogas production and typical digester parameters, but few have discussed potential side effects of co-waste addition to anaerobic digestion. This report is one of three complementary projects to better understand best practices for advancing co-digestion (see related research on next page). The long-term project goal is to increase the number of facilities practicing co-digestion.

The research team developed an analytical approach to understand and predict the broad impacts of co-digestion using samples from 12 full-scale plants, including several that had a control digester with no high strength waste (HSW) added. The guidance from this research can help increase the number of facilities performing co-digestion by providing tools that enable them to understand the implications of implementing co-digestion at their facility.

Findings and Conclusions

Facilities can use the stoichiometric analysis developed to predict the impacts of co-digestion on digester chemistry, gas production, and nutrient concentration. The notion that co-digestion increased the amount of solids for disposal requiring more expenses has been disproven for more organic wastes. The research team learned that the net amount of wet solids leaving the plant is often lower with HSW added.



Anaerobic digester at the Bucknell University anaerobic digestion laboratory.

Facilities that have implemented co-digestion successfully have increased revenue by anaerobically co-digesting alternative feedstocks with sludge to increase biogas production. The average overall project cost was found to be sensitive to both the price of electricity and tipping fees. The addition of HSWs increased gas production by one and a half to three times, relative to gas production in the control. Facilities can sell the excess biogas offsite as electricity or as vehicle fuel.

Management and Policy Implications

Several factors had a direct impact on the costs of running and starting co-digestion plants, including, the cost of capital investment to perform co-digestion, the type and amount of HSW used, and the size of the facility. In all cases, the revenue from biogas and tipping fees outweighed the cost of infrastructure installation for co-digestion. The report examples and guidance can help utilities evaluate the overall costs and benefits of a co-digestion program through analyzing changes to digester operational parameters, changes to gas production, and reasonable tipping fees.

Related WE&RF Research

Project Title	Research Focus
Developing Solutions to Operational Side Effects Associated with Co-Digestion of Organic High Strength Wastes (ENER8R13)	Identifies and quantifies implications of co-digestion with HSWs, from all facets of the operations, including receiving, pre-treatment, digestion, and post-digestion treatment and handling.
Co-Digestion of Organic Wastes – Addressing Operational Side Effects (ENER9C13)	Evaluates co-digestion facility design, performance data, and operation and maintenance issues to examine the impacts of co-digestion on methane production, sludge production, and nitrogen and phosphorus concentrations in recycle streams.
Co-Digestion Experience in Central Europe and Case Study Analysis (ENER9C13a)	Provides a summary of the extensive German-language literature on the science and practice of co-digestion in Germany and Switzerland.
Renewable Energy Production from DOD Installation Solid Wastes by Anaerobic Digestion (ENER14R14)	Demonstrates anaerobic digestion of U.S. Department of Defense wastes including pre- and post-consumer food waste, waste cooking oil, and grease trap waste as a viable means to renewable energy generation. The project also studied biogas treatment to produce treated product gas suitable for end use applications.
Co-Digestion of Organic Waste Products with Wastewater Solids (OWSO5R07)	Examines waste characterization of six types of HSW and analyzes the feedstock for specific parameters to determine the level of gas production.

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