Executive **Summary**

Using High Strength Organic Waste to Increase Energy Recovery

Co-Digestion of Organic Waste Addressing Operational Side Effects (ENER9C13)

The Central Issue

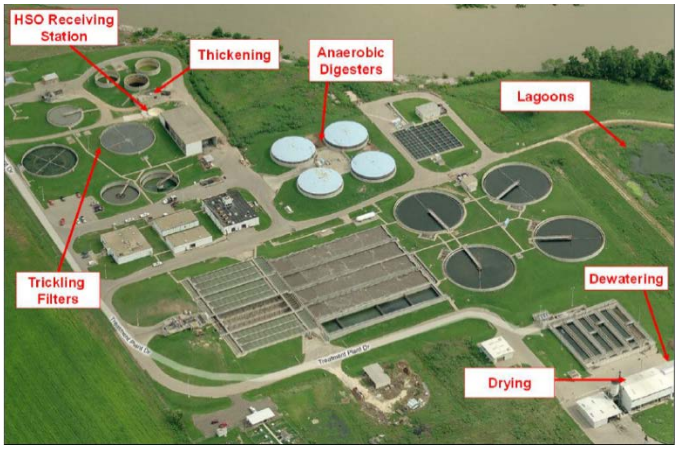
Co-digestion is a beneficial option for water resource recovery facilities (WRRFs) to improve the methane yield of anaerobic digestion. High strength organic waste (HSW) co-digestion is used to increase energy recovery through combined heat and power systems. However, HSW co-digestion can present challenges to WRRF operations and maintenance staff because data does not exist for implementers to use to understand challenges they may encounter.

Context and Background

This research sought to provide an analysis of co-digestion data and assess the variability of HSW co-digester performance that facilities can anticipate. It was designed to expand on existing information for WRRFs evaluating co-digestion as an option for increased energy recovery. Five facilities in New York, Texas, and California were selected for study due to their experience with HSW co-digestion beyond fats, oils, and grease (FOG), but also with acid whey from Greek yogurt manufacturing, flotated dairy wastewater solids, packaged drink manufacturing waste, and others. The project was divided into two phases. The first phase evaluated five WRRFs and focused on co-digestion facility design, performance data, operation, and maintenance issues. The second phase included bench-scale anaerobic treatment of HSW, thickened primary sludge, and thickened waste activated sludge. The goal was to understand the impacts of HSW co-digestion on methane production and nitrogen and phosphorus concentrations in recycle streams.

Findings and Conclusions

Facilities use different types of organic waste with varying results and processes. As more WRRFs implement HSW co-digestion, conventional operating parameters may not be sufficient to characterize co-digestion operation. HSW loading rates depend on the character of HSW and rate consistency, the volatile solids loading rate may not be the best control parameter. Volatile solids simply represent the organic fraction of the total solids – it does not provide any insight into the characteristics of organic solids



Site plan at a WWTP in Waco, TX that implements a high strength waste receiving program.

comprising the anaerobic digester feed. Chemical oxygen demand (COD) is an alternate anaerobic digester control parameter with several advantages over a volatile solids-based loading rate. While volatile solids and COD are surrogate parameters for the organic fraction of the digester feed sludge, the COD concentration enables a direct check on methane production.

The facilities in the case studies implemented HSW co-digestion to reduce dependence on purchased electrical power and/or natural gas. As early adopters, these facilities face particular challenges such as producing a consistent fuel supply with periodic HSW deliveries, uncertain energy production and extended payback times, supply variability, uncertain tipping fees, and operation and maintenance costs.

Management and Policy Implications

Because the specific energy yield is approximately 40% greater with co-digestion of HSW than digestion of conventional wastewater solids alone at an equivalent volatile solids loading rate, HSW do-digestion results in more biogas generation for renewable energy. Yet, practitioners need better process control parameters. A better understanding of the science of co-digestion alongside science-based research on anaerobic digestion operations when organic waste is added to wastewater solids is needed.

Related WE&RF Research

Project Title	Research Focus
Utilities of the Future Energy Findings (ENER6C13)	Estimates the energy embedded in domestic wastewater in the U.S. relative to the energy required to accomplish treatment to understand how to manage operations more efficiently.
Developing Solutions to Operational Side Effects Associated with Co-Digestion of Organic High Strength Wastes (ENER8R13)	Identifies and quantifies implications of co-digestion with high strength waste (HSW), from all facets of the operations, including receiving, pre-treatment, digestion, and post-digestion treatment and handling.
Co-Digestion Experience in Central Europe and Case Study Analysis (ENER9C13a)	Evaluates operational side effects associated with co-digestion of high strength waste (HSW) and wastewater solids at water resource recovery facilities (WRRFs).
Understanding Impacts of Co-Digestion: Digester Chemistry, Gas Production, Dewaterability, Solids Production, Cake Quality, and Economics (ENER12R13)	Develops a fundamental analytical approach to understand and predict the broad array of impacts of co-digestion, including effects of digester chemistry, digestate rheology, dewatering, and cake quality.
Co-Digestion of Organic Waste Products with Wastewater Solids (OWSO5R07)	Examines waste characterization of six types of high strength waste (HSW) and analyzes the feedstock for specific parameters to determine the level of gas production.

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