Executive Summary

Is it possible to control foaming in anaerobic digesters?

Wastewater Treatment Anaerobic Digester Foaming Prevention and Control Methods (INFR1SG10)

An example of an extreme case of anaerobic digestion foaming that runs into roadway, parking lot, and walkway.

The Central Issue

Digester foaming can compromise treatment efficiency and can lead to other problems including significant economic impact to a water resource recovery facility (WRRF). This research identifies gaps in existing knowledge on the causes, measurement methods, effects, prevention, and control of foaming in WRRFs.

Context and Background

An increasing number of WRRFs already have, or are considering implementing anaerobic digesters (AD) as part of their treatment process. ADs produce methane gas and energy from the wastewater. However, many plants are experiencing problems with digester foaming. Additionally, the implementation of more advanced treatment processes including biological nutrient removal (BNR) has also appeared to increase the incidence of anaerobic digestion foaming in WRRFs. This research includes a literature search and a survey of 77 utilities in the U.S. and Spain. Those results are presented in this report. Based on the survey results, the researchers conducted five full-scale plant studies.

A case study report of AD foaming causes, methods of foam detection, control and mitigation methods was developed for each full-scale plant studied. The full-scale studies included:

- Marquette, Michigan – Investigation of an activated sludge system with Bio-P removal that exhibits no biological foaming, but has consistent AD foaming.
- Elmhurst, Illinois – Investigation of organic loading rate and mixing effects on AD foaming.
- Crystal Lake, Illinois – Investigation of primary sludge to waste activated sludge (WAS) solids ratio modification in the digester feed.
- San Francisco, California – Investigation of AD foaming in egg-shaped digesters.
- Bronx, New York – Investigation at Hunts Point on defoamant addition to control foaming.

The full-scale studies were compiled into one report and a synthesis of all of these findings was conducted and is presented in an accompanying Guidance Document (Project No. INFR1SG10a).

Findings and Conclusions

Filamentous bacteria were found to be the most common cause of foaming among the survey respondents. Most of the causes and control strategies reported by them were in agreement with published literature. The full-scale studies confirmed the existence of filaments *M. parvicella* and *G. amarae* in most of the WRRFs. Both types of filamentous bacteria have been linked to AD foaming. Prevention and control options were identified and include:

- Minimizing foam-causing materials (including filamentous bacteria) in the feed sludge.
- Reduced mixing.
- AD process control to operate in steady state mode.

Defoamers, uniform loading, "optimum mixing," WAS chlorination, and thickening are the most popularly implemented prevention/control/mitigation methods.

Management and Policy Implications

This research project's findings should be taken into consideration during the design phase of implementation of anaerobic digestion as part of a facility's treatment process to produce methane gas and energy from wastewater. Further, process modifications suggested should be considered if foaming is causing problems at facilities currently using anaerobic digestion to produce methane gas and energy from wastewater.

Executive Summary

WERF

Wastewater Treatment Anaerobic Digester Foaming Prevention and Control Methods

Related WERF Research

Project Title	Research Focus
Develop and Demonstrate Fundamental Basis for Selectors to Improve Activated Sludge Settleability (01CTS4)	Investigates growth and control of specific filamentous organisms at benchscale and includes a database of selector design and operating data from full-scale facilities. Examines the relationship between process parameters and settleability control and identifies significant process variables affecting settleability control in three plant types.
Developing Solutions to Operational Side-Effects Associated by Co-Digestion of High-Strength Organic Wastes (ENER8R13)	Offers a systematic evaluation of feedstocks available for use in co-digestion and co-fermentation processes by surveying household solid wastes (HSWs), particularly those available in New York State and provides a comprehensive, easy-to-understand compendium of operational solutions, or best management practices, to challenges encountered during the co-digestion of HSWs. The report also 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 Waste – Addressing Operational Side Effects (ENER9C13)	Compiles and summarizes performance, operations, and maintenance experience of full-scale co-digestion facilities for owners and engineers considering, planning, or designing this technology. The treatment facilities participating in this project represent a range of treatment capacities between 10 and 88 mgd and reflect a variety of supplemental organic wastes co-digested with municipal wastewater treatment plant sludge, including fats, oils, and grease (FOG); acid whey from Greek yogurt manufacturing; cheese whey; food processing waste; and animal blood.
Co-Digestion of Organic Waste Products with Wastewater Solids (OWSO5R07)	Evaluates co-digestion of organic wastes such as food waste with wastewater solids in anaerobic digesters at lab, pilot, and full-scale to increase biogas production at wastewater treatment facilities. This project includes: ■ A plan for identification of potential organic wastes (including fats and grease). ■ Parameters to assess co-digestion operational stability. ■ An economic model of co-digestion.

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