Identifying and Controlling Odor in the Municipal Wastewater Environment: Phase 2

Biosolids odor emissions can affect the ability of wastewater utilities to implement beneficial biosolids processing and reuse programs. In fact, odor is the number one issue that WERF subscriberscite regarding problems with biosolids disposal in their communities. Citizens often become more sensitized and vocal about biosolids once they experience odors emanating from a nearby facility, according to this report.

The literature review performed in the first phase of this project concluded that the wastewater treatment industry has an incomplete understanding of the in-plant operations and treatment parameters that influence biosolids odor emissions. In the report, the project team identified more than 25 research project ideas that could fill in this knowledge gap (stock no. 00HHE5a). Without a better understanding of these factors, wastewater treatment plants (WWTPs) often have little control over biosolids odor quality.

This project assesses what is known about odors—sources, generation and dispersion processes, human perceptions and responses—and their control. The study also identifies critical odor control points in the wastewater treatment process and appropriate control technologies; characterizes malodorous compounds, their sources, generation, and dispersal; and identifies future analytical needs, such as detectors and detector systems. In the third phase of this research (project no. 03-CTS-9), researchers are working to determine the mechanisms that reduce biosolids cake odors on a laboratory scale and then test those mechanisms full-scale at selected WWTPs.

Problems with Proteins

Many WWTPs have decided that anaerobic digestion will produce the least odorous biosolids product. Relatively little odor data, however, currently exists to support this belief, and there is insufficient data to show how anaerobic digestion system design and operating parameters can influence biosolids odor quality.

This research demonstrates the influence of anaerobic solids digestion system design and operating parameters on odor quality of biosolids.

In this report, produced as part of the second phase of the project, the project team collected data from 11 wastewater treatment plants ranging in size from 13 million gallons-per-day (mgd) of influent flow to 350 mgd. Field analysis performed included pH, temperature, oxidation-reduction potential (ORP), and headspace concentrations for hydrogen sulfide and ammonia. The project team then drew correlations to demonstrate the influence of anaerobic solids digestion system design and operating parameters on the odor quality of the final biosolids product.

The project team determined that biologically available protein was the main contributor to the odor potential of biosolids. As a result of biological activity

BENEFITS

- Helps the wastewater treatment industry understand and manage biosolids odor and its impacts on surrounding communities, by better understanding the events involved in the generation of biosolids odors.
- Identifies gaps in scientific knowledge regarding mechanisms of odor generation in WWTP biosolids.
- Shows that biosolids stability parameters may be misleading with respect to their impact on odors produced from biosolids.
- Provides a reference guide and a starting point in identifying the causes of biosolids odors.
- Emphasizes the importance of whole plant management for reduction and control of biosolids odors.

RELATED PRODUCTS

A Critical Review of Odor Control Equipment for Toxic Air Emissions (D53010)

Biofiltration: Controlling Air Emissions Through Innovative Technology (D53015)

Controlling Odor and VOCs with Bioreactors (D13007)

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in the anaerobic digesters, proteins are broken down into amino acids and are consumed as substrate by specialized microbial groups, releasing sulfur and nitrogen-bearing compounds that are the main source of odors associated with biosolids.

Longer SRTs Are No Solution

In the United States, the 503 Rule regulates production of biosolids and their beneficial use. The 503 Rule governs treatment, disposal, and use of biosolids, based on compliance with pollutant limits and the degree of pathogen reduction (Class A or Class B). The rule also requires stabilization of treated biosolids, defined in the regulation as "vector attraction reduction" (VAR). The main goal of VAR is to achieve an acceptable degree of biological stability in biosolids by one of 12 VAR options recommended in Rule 503.

Although odors from biosolids are not specifically regulated by the 503 Rule, it is a generally accepted belief that efficient anaerobic digestion and stabilization of biosolids in accordance with the 503 Rule also should lead to reduction of biosolids odors after digestion. A comparison in this study of classical digestion parameters, such as volatile solids destruction or residual biological activity (RBA), with odors from the dewatered biosolids cake, however, did not reveal any conclusive results. Though the 38% volatile solids (VS) destruction requirement of vector attraction reduction Option 1 was exceeded at all test sites (VS reduction varied between 42% and 67%), the treated biosolids still produced high odors and volatile sulfur compound emissions after centrifugal dewatering.

The project team found long digester solids retention times (SRTs) at many of the WWTPs, with 75% of the WWTPs having digester SRTs greater than 20 days. Yet, when examined in conjunction with volatile solids destruction and dewatered cake odor emissions, the project team concluded that further study will be necessary to determine if any relationships exist between digester solids retention time, volatile solids destruction, and biosolids odor emissions. Mechanistic studies should be undertaken to better understand the link between classical digestion parameters in terms of their contributions to odors in the final biosolids product from WWTPs.

Conclusions

The study findings indicate that the anaerobic digestion process is not well understood regarding its affect on odors from digested biosolids, especially odors in biosolids cake after centrifugal dewatering. The project team also determined that there is no conclusive evidence that more effective anaerobic digestion, leading to more complete digestion of complex organics, can result in lower odors in digested, dewatered biosolids cake, though there is evidence that every step in a biosolids handling process has some effect on odor production. In other words, efficient digestion alone is not sufficient to maintain low odors when the upstream conditions or downstream processing equipment imposes conditions that increase the potential for odor generation. Recognizing that a clear and conclusive relationship between bioavailable protein and biosolids odor production exists, it follows that destroying more releasable proteins during digestion will result in lower odor production.

The project team suggests a variety of pre-digestion processes for cell lysis, sonication, or pasteurization should be investigated for the enhancement of digestion efficiency. Also, appropriate processes need to be paired to investigate biosolids processing and handling combinations downstream of digestion, which should result in less odorous biosolids product.

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