



## TECHNICAL BULLETIN: Wastewater

### ***Production of Volatile Sulfur Compounds During Anaerobic Digestion***

Anaerobic digestion decomposes the biodegradable, concentrated portion of wastewater treatment plant solids. The resulting biosolids are relatively inert and have historically been used for a number of beneficial applications. In addition to producing nutrient-rich biosolids, anaerobic digestion produces Volatile Sulfur Compounds (VSCs) that can result in odor concerns.

In the first stage of anaerobic digestion, hydrolytic reactions and fermentative enzymes break down complex organic matter into sugars and proteins. In the second stage, acetogenic bacteria break down these sugars and proteins into organic acids (acetate), hydrogen and carbon dioxide. In the final stage, methanogenic bacteria convert acetate, hydrogen and carbon dioxide into methane gas. VSC production occurs during this process.

Municipal and industrial wastewater treatment plant managers prefer to use the biosolids from the anaerobic digesters for land applications. These biosolids, after dewatering, nutritionally benefit the receiving soils and help to minimize landfill costs. However, the odors associated with the biosolids frequently result in a negative public perception of land application.

A recent plant survey conducted by the Water Environment Research Foundation analyzed a number of different factors that

impact the operation of anaerobic digesters, to determine their effects on odors associated with the produced biosolids (Reference 1). One of the factors investigated was sulfate ( $\text{SO}_4$ ), a negatively charged ion found in natural waters, drinking water, and wastewater. The research studied the relationship between the influent sulfate levels and the levels of odiferous VSCs produced in the digested biosolids cake. "Past experience indicates that there is a positive correlation between high influent sulfate concentrations and odors in biosolids cake. The study found no relationship between influent sulfate concentrations and odor production in biosolids cake" (Reference 1). Another study suggested that naturally occurring amino acid proteins are the primary contributors of methanethiol (MT) and  $\text{H}_2\text{S}$ , both volatile sulfur compounds. "The results of this research demonstrated that amino acid degradation, especially methionine and to a lesser extent cysteine, are the primary substrate for MT and  $\text{H}_2\text{S}$  production, respectively" (Reference 2).

Naturally occurring amino acids, rather than sulfate contributors, are much more important in predicting the formation of odiferous VSCs during anaerobic digestion. On a mass basis, far more available sulfur comes from degrading organic matter than from residual sulfates contributed by either iron sulfates or aluminum sulfate.

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### References

1. *WERF: Reducing Digested Biosolids Odors in Plant*, WEFTEC 2003 Pre-Conference Workshop No. W123, G. Adams, R. Hargreaves, J. Witherspoon, B. Forbes, D. McEwen, Z. Erdal, L. Hentz, S. Murthy, T. Card, D. Glindermann, M. Higgins.
2. *Mechanisms of Volatile Sulfur Compound and Odor Production in Digested Biosolids*, 2003 Residuals and Biosolids, Matthew Higgins, Douglas Yarosz, Yen-Chih Chen, Sudhir Murthy, N.A. Mass, J.R. Cooney.

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