

Evaluation of Bacterial Pathogen and Indicator Densities After Dewatering of Anaerobically Digested Biosolids: Phases II & III

This research verified the occurrence of increases in organisms which are indicators of pathogens following digestion and dewatering. It also determined that there is no evidence of a corresponding increase in *Salmonella* in anaerobically digested biosolids following dewatering. *Salmonella* are the most reliably measured pathogenic bacteria in biosolids.

WERF researchers tested nine facilities, and obtained data from a number of other facilities that did their own testing. In all, 30 of 35 plants that had a combination of digestion and centrifugation showed increases in indicator organisms after dewatering. By comparison, only one of eight plants with belt filters following digestion showed increases in indicator organisms following dewatering.

This research helps our understanding of why these increases in indicator organisms are occurring at some facilities. The increase in fecal coliforms and other indicator organisms immediately following dewatering has been termed “sudden increase” for the purposes of this research.

Study Provides Reliable Assessments of Digester/Dewatering Combinations

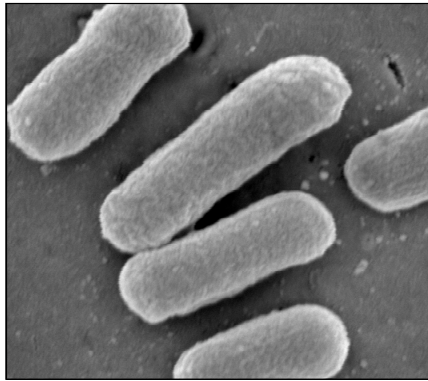
WERF and its research partners initially undertook this study in response to reports of unexpected increases of fecal coliform counts following high-temperature anaerobic digestion and dewatering at a few wastewater treatment facilities. Fecal coliforms and other selected bacteria provide an indication of pathogenic organisms in wastewater and residuals. Indicator bacteria are used to measure treatment efficacy and are used for regulatory compliance.

A number of utilities (including the District of Columbia Water and Sewer Authority, the utility research partner in this study) are in the process of making important design decisions which involve the types of processes studied here and will directly benefit from having reliable information on the performance of various digester/dewatering combinations.

Initial Findings Lead to Expanded Research

A number of enteric viral, bacterial, and other pathogens can be present in wastewaters, and one important goal of wastewater treatment is to reduce the potential pathogenic activity of the wastewater. The “indicator organisms” that wastewater treatment plants most often employ are fecal coliforms and *E. coli*, bacteria found abundantly in the intestines of warm-blooded animals and in municipal wastewaters. Previous research by WERF and others reported that significant increases in indicator organism densities can be measured after dewatering of anaerobically digested biosolids compared to densities just prior to dewatering.

Of 10 pathogenic bacteria potentially found in wastewater solids and for which test



Increase in pathogen indicators is not necessarily evidence of corresponding increase in pathogenic bacteria following dewatering.

BENEFITS

- Demonstrates the occurrence of a “sudden increase” of indicator densities at certain utilities.
- Provides a database of utilities with and without fecal coliform increases which can be used to evaluate this phenomenon.
- Demonstrates that *Salmonella* do not increase after dewatering of Class A biosolids and Class B thermophilically digested biosolids.
- Provides a standardized protocol to evaluate increases in indicator bacteria after dewatering.
- Developed measuring approaches—using a combination of quantitative polymerase chain reaction (qPCR) and culturing methods—for enumerating indicator bacteria.
- Evaluates process parameters.

RELATED PRODUCTS

Reactivation & Regrowth of Fecal Coliforms in Centrifuge Dewatered Anaerobically Digested Sludges (O3CTS13T)

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Biosolids Research Challenge (SRSK1R07)

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WERF's commitment to this latest phase of research, in conjunction with related efforts by others in the nation's wastewater community, helps to ensure that biosolids management practices continue to be scientifically sound and environmentally safe.

methods are available, nine were found to have sufficient data for follow-up testing. These included: *Salmonella*, *E. coli* 0157:H7, *Enterococci*, *Shigella*, *Aeromonas*, aerobic spore formers, *Listeria monocytogenes*, *Campylobacter*, and *Clostridium*. The type of sudden increase in indicator organisms observed in WERF's research has been described extensively for bacteria, but not for viruses and protozoa. Therefore, WERF expanded its research to determine if there were increases in pathogens that correspond to those increases observed for indicators organisms focused on bacteria.

Results Provide Clarity

Bacterial pathogens in wastewater solids entering digestion are generally low in numbers. The most consistently measured pathogen was *Salmonella*, which can be used in addition to fecal coliforms and *E. coli* to determine compliance with the Part 503 Sewage Sludge Use and Disposal regulations. *Salmonella* were not detected in biosolids following thermophilic digestion (used to produce both Class A and B biosolids) or dewatering by either centrifugation or filter pressing. Likewise, in cases where other bacterial pathogens could be quantified, pathogens were not measured following either thermophilic digestion or dewatering.

For some pathogenic bacteria, only qualitative test methods are available to determine possible presence or absence of these organisms. In almost all cases, test results indicated these other pathogens were not present in either thermophilically digested or dewatered biosolids.

There were a few instances where test results showed that some pathogens could possibly be present following thermophilic digestion, but confirmatory testing was negative.

Mesophilic digestion processes used to produce Class B biosolids are not designed to destroy all pathogens. Accordingly, regrowth of *Salmonella* observed in mesophilically digested biosolids was not unexpected.

Research Also Examines "Sudden Increase" Phenomenon

These latest phases of research verified the occurrence of increases in fecal coliform and *E. coli* density after dewatering of anaerobically digested biosolids. This study confirms that these increases are much more prevalent with centrifuge dewatering compared to belt filter press dewatering. The preponderance of the evidence indicates this phenomenon is due to "reactivation" of non-culturable organisms.

Researchers suspect that certain configurations of anaerobic digestion processes lead to conditions which inhibit the ability of indicator organisms to grow and be measured by standard culture methods. "Reactivation" refers to the renewed ability of these organisms to be measured by culture methods. However, shearing of the biosolids particles during centrifugation, resulting in "releases" of bacteria, has not been completely ruled out as a possible explanation for these increases in indicator organisms.

Additional growth of fecal coliforms and *E. coli* can occur during biosolids cake storage (regrowth). Regrowth can occur without reactivation.

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