CRITICAL EVALUATION OF THE EFFECTIVENESS OF SEWAGE SLUDGE DISINFECTION AND VECTOR ATTRACTION REDUCTION PROCESSES

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BOSC WATER QUALITY REVIEW
CINCINNATI, OHIO JANUARY 2006

LTG 4 Poster 03

Science Questions

MYP Science Question:
What is the current state of management practices for biosolids production and application, and how can those be made more effective?

Research Questions:

- How effective are Class B disinfection and vector attraction reduction (VAR) processes, and public access and harvesting restrictions at reducing the public's exposure to pathogens? Can the processes be made more effective?
- How can the operation of existing sewage sludge treatment facilities and the design of new ones maximally reduce the risk to public health through the issuance of guidance for utilities, consultants, regulators and manufacturers based on best sludge management practices and recent and ongoing research?

How Research Addresses the Water Quality MYP Goals

This research responds directly to the recommendations of the July 2002 National Research Council (NRC) Report, *Biosolids Applied to Land: Advancing Standards and Practices* and U.S. EPA's Dec. 31, 2003 response by studying the efficacy of current pathogen reduction, vector attraction reduction, and site restriction practices. In addition it is evaluating ways to improve the effectiveness and optimize the combination of these practices to minimize potential health risks by:

- Evaluating the performance of anaerobic digesters at three different facilities within Ohio for their pathogen reduction efficiency and the stability (vector attraction potential) of their product.
- Studying and comparing air emissions and pathogen transport and die-off when biosolids are applied to the land's surface as a liquid/slurry in one instance and as a dewatered material (~25 % solids) in the other instances. This work is in part a follow-up to work described in LTG 4 Poster 01. The tools developed in that project will be used to complete these studies.
- Making research results and best management practice information/data available via research reports and guidance documents.

Research Objectives

1. Determine the effectiveness of different anaerobic digestion facilities at reducing indicator organisms and pathogens and reducing the attractiveness of vectors to processed sludge.
2. Evaluate the potential of new and existing options for assessing vector attraction reduction in anaerobically digested sludges.
3. Assess the fate and transport of microbial indicators following anaerobic digestion, during and subsequent to the surface application of biosolids.
4. Evaluate and assemble the most current information regarding the treatment, use, and disposal of sewage sludge and ways to optimize alkaline treatment.

Research Methods & Collaboration

Fairfield, Ohio's Wastewater Treatment Plant:

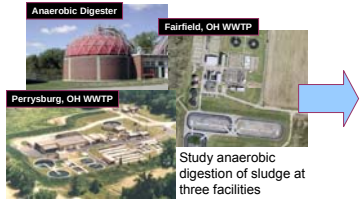
- Digestion occurs in four stages that are connected in series. Measurements will include total and volatile solids, alkalinity, pH, volatile acids, nutrients, gas production, fecal coliform, Salmonella sp., and FAME analysis. Air emissions will be sampled in the sludge dewatering building and around biosolids stockpiles for endotoxins, particulates, and selected bacteria and viruses. VAR will be measured by the conventional method of volatile solids reduction and developmental methods that utilize enzyme activity and oxygen uptake.

Joint effort with the University of Toledo, Bowling Green State University, and the Medical University of Ohio:

- Studies will be at Perrysburg and North Baltimore and include a detailed engineering evaluation of each wastewater treatment plant's performance with emphasis on the sludge processing portion. Thus the reductions of the organic and microbial contaminants through sludge processing will be known. Air emissions will be sampled around biosolids stockpiles, during surface application, and proximal to the application sites for varying periods of time (30 days or more) for endotoxins, particulates, and selected bacteria and viruses. Samples will also be taken of the biosolids-soil mixtures for various periods of time (up to a year) to determine reductions of organic and microbial contaminants over time.

Comprehensive Guidance Documents:

- ***Alkaline Treatment of Sewage Sludge***. When properly executed, alkaline treatment can provide a well disinfected sludge and one which neither attracts vectors nor emits unpleasant odors. Unfortunately this seldom happens. This guidance will be based on material developed at two major workshops on alkaline treatment of sludge, information and data collected by states, manufacturers' case studies, work on mixing and necessary moisture completed and underway at the DC Water and Sewer Authority, work being funded in Pennsylvania by Region 3, and the expertise of the National Lime Association.
- NRMRL is collaborating with the Water Environment Federation (WEF) and Water Environment Research Foundation (WERF) and their membership to ***update and revise the publication, Process Design Manual for Sludge Treatment and Disposal EPA/625/1-79-011***, USEPA, Cincinnati, OH, October 1979. Materials will be assembled from recent and ongoing research at NRMRL as well as the efforts of its collaborators (WEF and WERF). The new manual will provide the latest design information on all applicable technologies available for treatment, use, and disposal of municipal wastewater solids including grit, scum, screenings, primary sludges, biological sludges, chemical sludges, and septage. It will be maximally useful to permit writers and decision makers at the federal, state, and local levels as they confront wastewater treatment and water reclamation and reuse issues. It is intended that the new manual be kept current and made available on the Worldwide Web by WEF.



Study anaerobic digestion of sludge at three facilities

Study air emissions occurring prior to, during, and following surface application of treated sludge (biosolids) as:
- Liquid/Slurry
- Dewatered Material

Prepare comprehensive reports/guidance documents

Research Results

Research reports and peer-reviewed journal articles will be made available to federal, state, and local regulators; utilities; academia and others on:

- Kinetics of degradation of biodegradable organic matter, reduction of fecal coliform, Salmonella sp., and other organisms during the anaerobic digestion of sludge.
- Kinetics of degradation of biodegradable organic matter, reduction of fecal coliform, Salmonella sp., and other organisms present in anaerobically digested sludge applied to land as a function of climatic conditions.
- Relationship of innovative and alternative methods for measuring VAR like biochemical oxygen demand and the presence of certain enzymes to the currently employed method of volatile solids reduction.
- Air emission of endotoxins, particulates, and microbial contaminants occurring during the surface application of sludge as a liquid/slurry or dewatered material.

Comprehensive Guidance Documents or Manuals:

- ***Alkaline Treatment of Sewage Sludge.***
  - First draft has been completed.
  - Revisions are underway incorporating research conducted by the DC Waster and Sewer Authority showing that optimum lime mixing is influenced by the method of sludge conveyance prior to mixing, solids content of the sludge, and gradation of the lime. Mixer performance can be determined by examining the distribution of calcium in the mix. As standard deviation of the calcium levels throughout the mix approaches a minimum, so does the total reduced sulfur and the fecal coliform counts; thus maximizing control of both pathogens and odors. Selection of the polymer for conditioning of the sludge prior to dewatering is also critical in controlling odor.
  - Report will be completed in 2006.
- ***Process Design Manual for Sludge Treatment, Use, and Disposal***.
  - Report will be completed in 2008.
  - Report will be kept up to date by WEF and made available to all via the Worldwide Web.

Research Conclusions & Future Directions

- Anaerobic digestion is an excellent technology for significantly reducing the quantities of biodegradable organics and microbial contaminants in sludge while also producing usable energy.
  - From the studies at these three facilities a model will be developed that gives the necessary time of digestion to maximize destruction of organic and microbial contaminants.
- Degradation of organic and microbial contaminants on land will be modeled as a function of climatic conditions.
- Alkaline stabilization of sludge is a very good way of preparing the sludge for land application when following the guidance to be issued in 2006. An easy to handle granular and non-smelly product is produced for surface application.
- NRMRL, WERF, and WEF are preparing a comprehensive sludge management document which will be made available to all interested parties on the Worldwide Web and will be kept up to date by WEF for users.

Interactions with Customers

The principal customers of the products developed out of this research include:

- OW,
- Regional, state, and local regulators,
- Regulated community (e.g., utilities),
- Those potentially impacted by pollutant releases from biosolids, and
- Treatment process developers.

Working closely with the regulated community in doing plant-scale and field studies, products will be developed that will assist federal, state, and local regulatory authorities in updating sludge management guidance and regulations to ensure that public health concerns are minimized. Use of the worldwide web and peer reviewed reports and journal articles will ensure a wide distribution of the products developed.

How Research Contributes to Outcomes

The Office of Water, States and other regulatory authorities will have updated technical information for promulgating more effective sludge treatment guidance and regulations, and utilities will have more technically sound information for their implementation. The public will have state of the art information on the effectiveness of various treatment options to further their understanding these process and their environmental risks. Treatment process developers will have an improved understanding of conventional process operation and process evaluation techniques to use in developing more cost-effective sludge treatment options. As a result, there will be more technically sound (and potentially more cost-effective) decisions regarding sewage sludge treatment that should lead to further reductions of any potential health risks.