Disinfecting and Stabilizing Biosolids Using E-Beam and Chemical Oxidants

WERF's research project, *Disinfecting and Stabilizing Biosolids Using E-Beam and Chemical Oxidants* (U4R06), has taken a significant step toward validating innovative technologies that can cost effectively disinfect and stabilize municipal biosolids.

More than seven million dry tons of biosolids generated from municipal wastewater treatment facilities are beneficially land applied each year. The research team examined the capability of high-energy (10 million electron volts – 10 MeV)) electron beam technology to disinfect and stabilize municipal biosolids. Used alone or coupled with chemical oxidants such as chlorine dioxide and ferrate, the researchers found E-beam effective as a disinfection technology with significant reductions of a variety of target bacterial and viral pathogens.

This research can help wastewater treatment plants on their path to becoming high value resource recovery operations, in addition to treating and disposing of municipal wastes.

E-Beam Irradiation – A Future Disinfection Contender

High energy E-beam is effective as a disinfection technology. Significant reductions of all target organisms can be achieved in municipal biosolids, depending on the dose that is employed. The engineering specifications of a high-energy E-beam treatment system capable of delivering the required E-beam doses were developed, modelled, and empirically validated utilizing 15kGy beam dose. Based on these engineering design considerations, E-beam treatment was shown to be highly effective by itself as a disinfection technology with significant reductions of a variety of target bacterial and viral pathogens. The results indicate that doses between 8 and 15 kGy (kilogray) destroyed > 99.9999% of bacterial and viral pathogens. Studies confirmed there was no pathogen regrowth in the E-beam treated biosolids samples. The Monte Carlo simulations and empirical tests confirmed that it is technically feasible and cost effective to deliver uniform E-beam doses to biosolids streams of varying solids concentrations and water quality at approximately 1500 cubic m^3/day throughput. In addition to the technical feasibility, preliminary cost-estimate analyses indicated that high-energy E-beam based disinfection can be cost effective compared to some of the current treatments, such as heat drying, composting, and lime stabilization.

Combining E-Beam and Chemical Oxidants for Biosolids Treatment

The researchers observed synergistic disinfection of pathogens when combining E-beam with chemical oxidants such as chlorine dioxide and ferrate. The combination of E-beam and ferrate treatments was effective at disinfecting microbial pathogens, destroying estrogenic activity, and stabilizing the biosolids. Combining E-beam with ferrate for producing Class A biosolids will cost approximately $70/dry ton, which is significantly lower than other contemporary technologies, such as Thermophilic aerobic digestion, which costs $180/dry ton (Fitzmorris et al., 2004). Decisions about whether this technology should be deployed at the front or towards the end of a wastewater treatment plant

BENEFITS

- Demonstrates that 10 MeV E-beam is highly effective at disinfecting aerobic and anaerobically digested biosolids and that 10 MeV E-beam treated biosolids do not exhibit any pathogen re-growth.
- Illustrates that 10 MeV E-beam destroys estrogenic compounds in wastewater effluents.
- Shows that sludge disinfection, estrogenic compound destruction, and enhanced stabilization of municipal biosolids are achievable when 10 MeV E-beam is combined with an oxidant such as ferrate.

RELATED PRODUCTS

Identifying Technologies and Communicating the Benefits and Risks of Disinfecting Wet Weather Flows (00HHE6)

Secondary Wastewater Effluent Disinfection Using Tin Oxide Anode Technology (02CTS6)

Examination of Reactivation and Regrowth of Fecal Coliforms in Centrifuge Dewatered, Anaerobically Digested Sludges (03CTS13T)

Fate of Estrogenic Compounds During Municipal Sludge Stabilization and Dewatering (04HHE6)

RELATED ONGOING RESEARCH

Categorizing Wastewater Treatment Processes by Their Efficacy in Reduction of a Suite of Indicator TOrC (CEC4R08)

State of the Science Review of Occurrence and Physical, Chemical, and Biological Processes Affecting Biosolids-Borne Trace Organic Chemicals in Soils (SRSK5T09)

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require careful analysis and evaluation. The ability to disinfect and stabilize municipal biosolids by combining E-beam and chemical oxidants opens up a number of opportunities for biosolids re-use and resource recovery. The research team is currently seeking industrial partners to commercialize this technology.

In conclusion, when high energy (10 MeV) E-beam is combined with ferrate, biosolid stabilization and significant reductions in microbial pathogens and estrogenic compounds can be achieved.

WERF is constantly looking and exploring innovative technologies that advance the science and understanding of various disinfection technologies. WERF is committed to providing its subscribers and the water quality community with information that helps managers make the best and most appropriate treatment decisions.

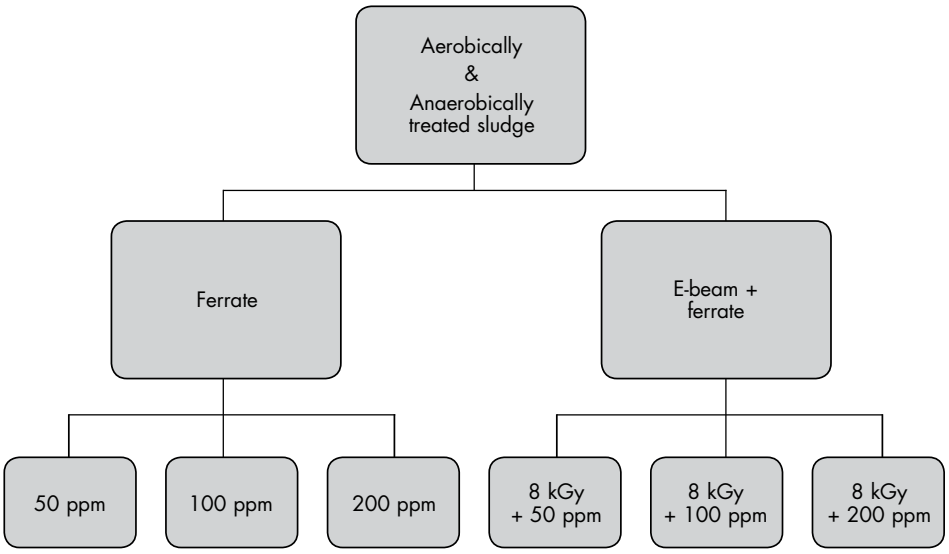

Figure 1. Schematic Representation of the Experimental Design Involving Ferrate and Ferrate Combined with E-beam.

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