Thermochemical Processing of Digested Sewage Sludge and its Implications for the United States

Introduction:

- Sewage sludge (i.e., biosolids) is the solid organic byproduct of wastewater treatment.
- Across the U.S., this sludge is treated and disposed of in many different ways. • Many of these practices have a large environmental footprint and represent health risks to the public
- and ecosystems. Wastewater treatment plants that use anaerobic digester
- gas to meet their electricity and heating needs have been shown to increase plant efficiency and reduce emissions.

Location and Number of Anaerobic Digester Systems



• A potentially beneficial addition to these systems is thermochemical processing of digested sludge. This process can produce bio-oil (pyrolysis) or bio-syngas (gasification), both of which can be upgraded to fuels or used for power generation. Here we investigate the environmental, political and economic implications of widespread adoption of this technology.

Environmental Implications:

• Biosolids contain heavy metals and micropollutants detrimental to both human and environmental health.

Heavy Metal Concentrations in Sewage Sludge:

Metal	Dry sludge (mg/kg)	
	Range	Median
Arsenic	1.1-230	10
Cadmium	1-3.410	10
Chromium	10-990,000	500
Cobalt	11.3-2490	30
Copper	84-17,000	800
Iron	1000-154,000	17,000
Lead	13-26,000	500
Manganese	32-9870	260
Mercury	0.6-56	6
Molybdenum	0.1-214	4
Nickel	2-5300	80
Selenium	1.7-17.2	5
Tin	2.6-329	14
Zinc	101-49,000	1700

Chemicals Found in Corn Grown with Biosolid **Fertilizer:**

- DEET (mosquito repellent) Progesterone (birth control hormone)
- Glyburide (diabetes medication)
- Naproxen (pain killer)

Chemicals Found in Tomatoes, Potatoes, and **Carrots Grown with Biosolid Fertilizer:**

- Cocaine Benzoylecgonine (pain medication)
- Alenolol (blood pressure medication) Minocycline (broad spectrum antibiotic)
- Thermochemical Processing dramatically reduces the volume of sewage sludge, helping to mitigate methane emissions and to relieve pressure on landfills.

Methane Concentration in the Atmosphere



U.S. Landfill Distribution by Region



Number of Landfills











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Economic Factors:

Companies Investing in Thermochemical Processing:





processing technologies.

Companies that have banned buying products from famers who use biosolids as fertilizer:



Policy Factors:

Status Quo:

the exception of heavy metals."

health."

and respiratory tracts, including two who died."



An Overview of Municipal Wastewater

Contributions to Atmospheric Methane by Sector



Years Remaining of Landfill Capacity

Biofuels are renewable, cost competitive, applicable in diverse markets, and show reduced carbon emissions. Funding is available for thermochemical processing, and several companies are already investing in the technology.



As biosolids fertilizers lose their viability, major companies' bans on their use may help drive thermochemical



Investment on advanced Biofuels fluctuate depending on oil prices.

The State of Biosolids Fertilizer in California

Conclusion:

Barriers/drawbacks to widespread implementation: Great variability amongst wastewater treatment facilities (energy costs, size, biosolid load, transport cost, land constraints)

Increase in criteria emissions and associated regulation Currently in 'valley of death' in terms of funding and proof of feasibility

Public perception currently classifies thermal processing with incineration, particularly in potential early-adoption communities

Drivers to widespread implementation:

- Production of carbon-neutral fuels/energy
- Reduction of land-applied/landfilled sludge

Reduction of GHG emissions, may become more important with changes in policy





Dewatered biosolids being delivered to an application

Funding is needed to demonstrate this technology with a biosolid feedstock, and coalitions formed amongst water utilities (like BAB2EC) provide a way to garner funding, reduce individual financial risk, and work to sway public perception.

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Acknowledgements:

Bay Area Biosolids Coalition Berkeley Center for Green Chemistry EBMUD

Instructors: Joseph Guth, Sasha Harris-Lovett, Alastair Iles, Tom McKone, Martin Mulvihill, Chris Rosen, Megan

Schwarzman, Chris Vulpe