Waste Embraced 2.0: A Novel Study of the Effects of Optimized Struvite Precipitation on Biogas Production and Resource Recovery from Municipal Landfill Leachate and Wastewater Centrate

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My research this year aimed to design a novel process to utilize landfill leachate and wastewater centrate, two highly prevalent forms of waste around the world, to recover valuable nutrients and to increase methane gas production. Leachate is a dangerous waste product that forms from rainwater in landfills around the world. Without proper application, leachate can contaminate groundwater, posing health risks. However, in several countries, leachate is proving to be a viable source of methane gas production to generate fuel. Raw leachate is fed to digesters in order to produce methane, but resources are not recovered. Leachate contains ammonia, phosphorus, and heavy metals, which can all be repurposed as sustainable fertilizers. In my research, I tested the efficiency of resource recovery via chemical precipitation at 5 different pH levels with either Magnesium Chloride and Calcium Chloride. After determining the optimal pH and salt for precipitation, two batch anaerobic digesters were built. One was fed raw leachate/centrate, while the other was fed precipitated leachate/centrate. The methane gas production was measured over the course of 4 weeks. It was found that a pH level of 9 with Magnesium Chloride were the best pH and salt for resource recovery. More than 76% of phosphorus was recovered, which is 30% higher than the industry standard. Anaerobic digestion with a precipitated mixture of leachate and centrate produced over 40% methane composition, compared to only 15% methane composition through anaerobic digestion with raw leachate/centrate. The findings, which have a worldwide application, will allow leachate and centrate to be recycled in a highly sustainable manner, increasing methane gas production for use as fuel while also recovering profitable materials.

Awards Won:

Fourth Award of $500