

FACULTY DEVELOPMENT ENDOWMENT FUNDS

Eleanor Lane Endowment
and
Nathan Deutsch Development Fund

Award Date: Fall 2023

Proposal Title: Solar-Powered Hydrothermal Treatment for Enhanced Biomethane Production
from Grain Processing Waste

Principal Investigator: Chiqian Zhang

ABSTRACT

Anaerobic digestion is promising to convert waste (such as grain processing waste) to renewable energy (i.e., biomethane). However, anaerobic digestion is limited by the slow hydrolysis of complex organic matter in the waste. Therefore, people developed various pretreatment methods to hydrolyze complex organic matter before anaerobic digestion so that biomethane production during anaerobic digestion can be maximized. Among those methods, hydrothermal treatment (heating the waste at a high temperature and pressure) is the most effective and convenient one. Nonetheless, hydrothermal treatment of waste consumes much energy (electricity or fossil fuels), which cannot be offset by the additional biomethane production during anaerobic digestion. Compared with a system with only anaerobic digestion, a system incorporating hydrothermal treatment and anaerobic digestion has a much lower net energy production. In this project, I propose to use direct solar energy (a “free,” renewable energy) to power the hydrothermal treatment of grain processing waste. I plan to use a solar evacuated tube collector to heat the grain processing waste with direct solar energy as the energy source. The hydrothermally treated waste will be anaerobically digested for biomethane production. The energy production from the system will be thoroughly analyzed. I will incorporate this proposed project into the Senior Design project. Also, relying on the project results, I plan to secure external funding from the NSF Research Advanced by Interdisciplinary Science and Engineering (RAISE) and Early-Concept Grants for Exploratory Research (EAGER) Program (specific area: industrial heat and energy efficiency technologies).