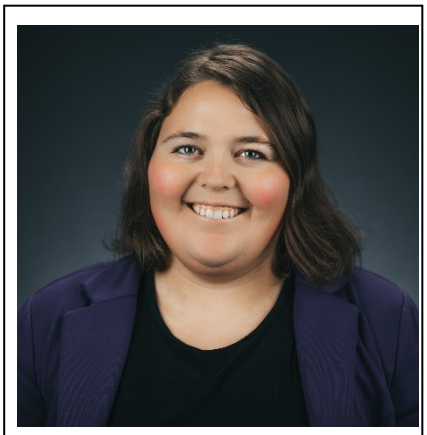

Emma Brace is from Topeka, Kansas, and as a first-generation college student completed her B.S. in Biological Systems Engineering with a minor in Chemistry at Kansas State University in 2014. She then joined the Laboratory of Renewable Resources Engineering (LORRE) and the Engelberth Research Group in Purdue ABE, earning her M.S. in 2016 and continuing on for her doctoral degree. Emma is interested in bioseparations, sustainability, and STEM education. At Purdue, she has been an officer for ABE-GSA and member of the Graduate Symposium planning committees, and worked three years on the leadership team for the Women in Engineering Program. She is a past recipient of the Purdue Doctoral Fellowship, Bilsland Dissertation Fellowship, 2019 Emily M. Wadsworth Graduate Mentoring Award, and the 2019 Outstanding Service Award in ABE. After graduation Emma plans to pursue an academic career. Emma is grateful that fate (or the powers-that-be) assigned her to the desk next to Antonio Santos in 2014. In her free time, she enjoys reading, crafting, playing tennis, and spending time with friends, family, and her cat: Podcat.

Agricultural & Biological ENGINEERING

Dissertation Defense

Speaker: Emma C. Brace

Title: Investigation of High-Oleic Soybean Oil as an Extraction Solvent to Remove Hydrogen Sulfide from Natural Gas

Major Professor(s): Abigail S. Engelberth

Date: Monday, June 22, 2020

Time: 1:00 pm

Link to join: Webex

Abstract:

Natural gas is often rendered sour by high concentrations of hydrogen sulfide (H_2S), a toxic and corrosive impurity. The present work evaluates the viability of using soybean oils as bio-solvents for removing gaseous H_2S. The Conductor-like Screening Model for Real Solvents (COSMO-RS) was used to predict the partition coefficient (*K*) of H_2S in a liquid-vapor system consisting of soybean oil fatty acids and methane gas. Predicted *K* values for H_2S were below 0.0005 at temperatures from 10 - 100°C at atmospheric pressure; *K* values near zero indicate near-complete removal of H_2S from the gas phase. Equilibrium extraction experiments resulted in *K* values below 0.1 for H_2S in soybean oil and high oleic soybean oil at 25°C. Greater than 90% of H_2S was removed from the gas phase within 15 minutes using 2:1 gas:oil ratios. Isotherm models determined the capacity of the oils for sorbing H_2S. Techno-economic analysis included design of an extraction column for removing 99.9% of H_2S from feed gas ranging from 40 – 400 ppm H_2S. Capital costs, operating costs, and revenues to be gained from methane and recovered elemental sulfur were estimated. Sensitivity analysis concluded solvent regeneration would need to exceed 98% to keep the cost of treating a unit of natural gas equal to or less than existing industrial methods.

Application:

Conventional soybean oil and high oleic soybean oil offer opportunities as bio-based solvents for sweetening sour natural gas, adding value to the soybean oil industry and the natural gas industry. Use of an environmentally friendly product like soybean oil to replace harsh organic chemicals used in gas sweetening would lessen the negative environmental impact of natural gas production and add value and a new use for soybean oils.