NEBRASKA CENTER FOR ENERGY SCIENCES RESEARCH

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Innovative Approaches to Sustainable Agriculture: Greening Ammonium Sulfate Production

Abstract.
Ammonium sulfate (NH4)2SO4 is a fertilizer and soil conditioner crucial in agriculture. However, traditional production of this compound often involves energy-intensive processes and raises environmental concerns. This proposal focuses on advancing the electrified production of green (NH4)2SO4 and assessing it as a fertilizer in Nebraska's agriculture, with a specific emphasis on the process modeling and design of an integrated process to valorize sulfur impurities captured in the desulfurization units of coal-fired power plants. By evaluating the proposed approach's scalability, cost-effectiveness, and environmental impact, we aim to demonstrate the potency of the proposed approach in valorizing sulfur removed from the flue gas and supplying green fertilizers. This path is of primary interest as it integrates renewable energy with fossil fuel-powered generation schemes and produces (NH4)2SO4. Flue gas desulfurization (FGD) using ammonia can achieve an effective SO2 removal by producing ammonium sulfate. Ultimately, this research aims to advance sustainable agriculture by providing a green and efficient solution for (NH4)2SO4 production while desulfurizing flue gas efficiently. We rely on life cycle cost analysis (LCCA) to identify sustainable materials for electrocatalysis. Our LCCA will be updated with information on our catalysts' performances, including thermodynamics and kinetics data. The goal of this project will be materialized by following our specific objectives: a) developing a model for green ammonia production, b) optimizing the ammonia-based FGD process, c) assessing ammonium sulfate as a fertilizer and the health and economic effects of ammonia release, and d) conducting LCCA analysis to assess the sustainability of utilizing ammonia in FGD and production of ammonium sulfate as green fertilizer in moderate condition. The findings from this research will support the advancement of green ammonia and (NH4)2SO4 synthesis, promoting more environmentally friendly and economically viable approaches to meeting the increasing demand in agriculture and other areas.