Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.35128

Applications of carbon-black derived from methane pyrolysis: An examination of the change in hydraulic and chemical properties of soils amended with carbon-black biochar composites

ALEXANDER(SASCHA) DORIAN[1], ERIKA CASTRO[1], CEDRICK RAMOS[1], FANGSHUAI WU[1], GABRIEL LIU[1], ARASH GHADERI[1], ANEESHMA PETER[1], BRIAN SMERDON[1] AND DANIEL S. ALESSI[2]

[1]University of Alberta
[2]University of Texas at Austin

To reduce greenhouse gas emissions and mitigate climate change, alternative forms of energy, including hydrogen fuel, are beginning to replace fossil fuels. Hydrogen production from the pyrolysis of methane, called “Turquoise Hydrogen,” produces H_2 gas and a carbon-black byproduct. The focus of our research is to explore value-added uses for carbon-black rather than disposing of it in landfills. Biochar has a wide variety of environmental applications including in water treatment and as a soil amendment. Carbon-black is different than biochar in a few important ways: it is formed at higher temperature meaning it contains a higher fraction of carbon, whereas biochar has a higher oxygen and hydrogen content and contains several surface functional groups that are important in the removal of ions from aqueous solution. Carbon-black also contains a higher fraction of aromatic carbon, meaning it is more recalcitrant and more graphitic than biochar. In this study, carbon-black and biomass were co-pyrolyzed to make carbon-black + biochar composites. To explore a value-added application, these composites were then amended to saline soils with the aim of making them more amenable to crop growth. The goal of the study was to improve structure and hydraulic conductivity of the soils in order to permit dissolved salts to leach from the soil, thereby enhancing the soil’s agricultural potential. Two soils were collected in the vicinity of Bittern Lake, located in central Alberta, Canada: a highly saline solonetzic soil, and a less saline black chernozemic soil. In order to test our hypothesis, varying amounts of amendment material were investigated through laboratory column experiments that focused on hydraulic conductivity of the soils and simulated leaching in the vadose zone. Our results suggest that amending the soil with a composite does enhance hydraulic conductivity by approximately two to three times. However, there was not a clear trend relating the amendment type or level to increased soil hydraulic conductivity. The amendments are expected to increase the amount of salt leaching, reducing soil salinity over time, and improving soil arability.