Metal-Oxide-Infused Biochar for the Adsorptive Removal of Heavy Metals From Simulated Runoff: A Preventative System to Combat Soil Contamination

Muthuswamy, Taroon (School: American Heritage School of Boca Delray)

This experiment focuses on the effectiveness of metal oxide nanoparticle infused biochar in adsorbing heavy metals (Pb and Cd) from simulated runoff. The basis of this experiment is the surface-level interactions that occur between biochar and heavy metals that enable binding. Furthermore, these interactions are bolstered by the presence of metal oxide nanoparticles. The hypothesis is that ZnO-infused biochar or Fe3O4-infused biochar would be more effective compared to standard biochar. The experimental layout involved a vertical tube that enabled the flow of runoff (50 mL) through layers of soil (3 g) and biochar (1 g) – this enabled contact between the runoff and biochar for adsorption of heavy metals. Additionally, this setup was meant to simulate runoff channels, soil-based runoff pathways that are overtly present in numerous agricultural settings. The concentration of lead/cadmium in the runoff was measured prior to being poured into the tube and then compared to the concentration upon the fluid's exit. Plate readings of samples post-exposure to a colorimetric assay showed that ZnO/Fe3O4-infused biochar was more effective than standard biochar, with Fe3O4-infused being overall the most effective biochar variation with removal efficiencies of approximately 95%. This research contributes heavily to the overall goal of sustaining the environment as it provides an efficient method for preventing heavy metals from contaminating soil and farmland. With modified biochar’s ability to adsorb heavy metals from water, this project has additional applications in wastewater treatment.

Awards Won: