The Utilization of Biochar and Bacillus subtilis To Remove Regionally Prevalent Heavy Metals From Wastewater

Nagarajan, Shrihari (School: Thomas Jefferson Independent Day School)

Heavy metals from wastewater pose a severe threat to human and environmental health. Particularly, within the regional Tri-State Mining District (Missouri, Kansas, and Oklahoma), lead and zinc are the most prevalent heavy metals. As traditional methods for heavy metal removal from wastewater present economic and environmental downsides, sustainable alternatives are sought. Notably, biochar (pyrolyzed biomass) and microorganisms have gained considerable attention as such alternatives. Thus, this study sought to determine and compare the efficacy of various single systems and composite systems containing corn biochar, soybean biochar, and the microorganism Bacillus subtilis for Pb and Zn removal from aqueous solutions with 50 ppm initial heavy metal concentrations. After systems were initiated in triplicate, absorbance analysis and optical emission spectroscopy were respectively employed to determine proliferation and heavy metal adsorption over a 144-hour period. All systems exhibited adequate heavy metal removal. For Pb removal, the Soybean Biochar + B. subtilis composite system was the most effective with the highest final removal rate (93%) and adequate B. subtilis “carrier” potential. For Zn removal, the Soybean Biochar single system and Soybean Biochar + B. subtilis composite system were the most effective with the highest final removal rates (82% and 76%, respectively) and adequate B. subtilis “carrier” potential (applicable to the composite system). Although all composite systems were not significantly more effective than the respective single systems, the most effective systems found in this study have the potential to be employed in the wastewater treatment process and remove dangerous heavy metals.

Awards Won:
Fourth Award of $500