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Surface Interactions Between Sewage-Derived Biochar and the Antibiotic Ciprofloxacin

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The use of antibiotics in fisheries, animal husbandry, and human medicine has led to a global increase in the number and concentration of antibiotics detectable in the environment. This has led to an increase in antibiotic-resistant pathogens which threaten the effectiveness of current antibiotic treatments, ultimately posing a significant risk to public health, agricultural sustainability, as well as ecosystem balance. In particular, antibiotic resistance compromises our ability to treat common infectious diseases in both humans and animals and could lead to increased mortality rates due to conditions that are currently treatable. This presentation focuses on the use of pyrolytic carbon, or biochar, derived from sewage sludge from a wastewater treatment plant, as a sustainable and cost-effective approach for the remediation of antibiotics. In this study, we investigated the sorption of the antibiotic ciprofloxacin (CIP) using biochar produced at two different pyrolysis temperatures, 550°C and 700°C. We used a range of tools to characterize the biochar, with and without the presence of CIP. First scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM-EDS) was used to characterize the morphology of the two biochars. We saw that with increasing pyrolysis temperatures the biochar particle size decreased, and ash fraction increased. High-performance liquid chromatography with a diode array detector (HPLC-DAD) and Fourier transform infrared (FTIR) spectroscopy were used to quantify CIP sorbed to the biochar and characterize the sorption mechanism, respectively. We observed the highest amount of CIP sorption from pH 8-10 for both biochars. FTIR spectral data showed that increasing pyrolysis temperatures led to decreased surface sites for binding, however the 700°C biochar showed more CIP removal from pH 8-10 than the 500°C biochar. This is likely twofold- with increased sorption relating to increased hydrophobicity in the 700°C biochar and an increase in ash content leading to an increase in colloids with larger surface area to volume ratio when compared to the bulk biochar. The results show that sewage sludge derived biochar, particularly those produced at higher pyrolysis temperatures, offers a viable strategy for reducing antibiotic contamination in the environment that may contribute to antibiotic resistance.