Remediating Soils: Designing Biochars to Meet the Need

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Biochar, the porous, carbon-rich product of pyrolysis, may provide an additional tool for remediating both metal and organic contaminated soils and for reducing other soil limitations. Soils contaminated with metals, organics or limited in some other way is a world-wide problem and strategies are needed to reduce contaminant movement and reduce their bioavailability or to alleviate other soil limitations. Current approaches to remediate contaminated soils include the use of organic-rich composts or other organic amendments, lime, ash, and P additions. Similarly, other soil physical and nutrient limitations may be remedied with inputs of organic matter, lime and fertilizer. "Designer" or engineered biochars may provide a means of making biochar to address a specific contamination or limitation, because biochar properties can be modified to match those needed to remediate problem soils. For example, water holding capacity limitations of sandy soils can be improved with biochar made from pine chips or switchgrass made at 350 °C (Novak et al., 2012). It has also been shown that swine or poultry manures blended with other feedstocks and pyrolyzed can supply adequate P for crops and improve soil water holding, without leaching P (Novak et al., 2013). With respect to metal and organic contaminated soils, biochar properties important for remediating these soils, such as surface area, porosity, CEC, pH, hydrophobicity, and polarity can be controlled through pyrolysis feedstock selection, feedstock blending, pyrolysis temperature and conditions, activation and post production processing. The goal of producing designer biochar is to make biochars that can remediate specific soil contaminants and limitations. Biochars with preferential sorption affinity for Pb and Cu have been produced; while others have been produced with a high affinity for organics. Other high-pH biochars reduce metal availability by simply raising soil pH. Manure-based biochar has been shown to reduce toxic Cr(VI) to the non-toxic Cr(III) form. Designer biochar in combination with compost or other known remediation approaches may provide better remediation results than compost or the other approaches alone. Since biochar properties can be adjusted, it is imperative that their properties be measured to insure that amending soil with biochar will provide the targeted remediation and not detrimental. This presentation will review the state-of-the-science of designing biochars with specific properties important for soil remediation and present strategies and cautionary notes regarding the use of biochar to remediate contaminated soils and soils with other limitations.