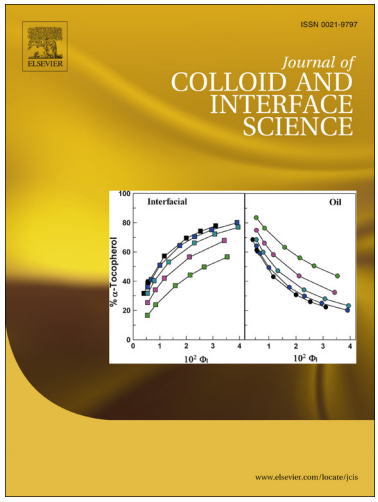

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Lead Sorptive Removal using Magnetic and NonMagnetic Fast Pyrolysis Energy Cane Biochars

Dinesh Mohan*[1], Prachi Singh[1], Ankur Sarswat[1], Philip H. Steele[2], and Charles U. Pittman, Jr.[3]

[1]School of Environmental Sciences, Jawaharlal Nehru University
New Delhi 110067, India
Email: dm_1967@hotmail.com
[2]Forest Products Department, Mississippi State University
Mississippi State, MS 39762, USA
[3]Department of Chemistry, Mississippi State University,
Mississippi State, MS 39762, USA

Abstract:

Energy cane biochar was prepared in a 72 sec fast pyrolysis at 425^{0}C in an auger-fed reactor, and ground into 250-600 micron diameter particles. This biochar was magnetized by fusing an iron oxide phase to the particles by mixing aqueous biochar suspensions with aqueous Fe^{3+}/Fe^{2+} solutions, followed by NaOH treatment. These biochars were characterized by Raman, FT-IR, X-ray, SEM, SEM-EDX, TEM, EDXRF, pHzpc, elemental analyses, S_{BET}, and magnetic moment determinations. The S_{BET} of energy cane biochar was negligible and increased to 37.13 m^2/g after Fe^{3+}/Fe^{2+}/NaOH magnetization. The dry biochar contains 18.4% oxygen. This allows swelling in water and permits sorption inside the solid as well as on its pore surfaces, leading to high capacities at low surface areas. Maximum lead removal occurred at pH 4-5. Sorption isotherms exhibited increasing lead removal (Q^0, mg/g) as temperature increased for nonmagnetic [$Q^0_{25^0C}$ = 45.70; $Q^0_{35^0C}$ = 52.01 and $Q^0_{45^0C}$ = 69.37] and magnetic [$Q^0_{25^0C}$ = 40.56; $Q^0_{35^0C}$ = 51.17 and $Q^0_{45^0C}$ = 51.75] biochars. Second order kinetics best fit the lead removal data. Furthermore, magnetic energy cane biochar was easily manipulated by low external magnetic field, thereby, allowing its easy recovery for further recycling and replacement from water. ECBC and MECBC were also successfully applied for Pb^{2+} removal from contaminated ground water. Therefore, both chars can be used as potential green low cost sorbents for lead remediation to replace commercial activated carbon.

Keywords: sorption, energy cane biochar, magnetic energy cane biochar, biochar, lead adsorption, metal removal

*Corresponding author. E-mail address: dm_1967@hotmail.com (Dinesh Mohan).