

Thermo-Pyrolysis Conversion of Sewage Sludge into Biochar and its Characterization

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This research was conducted to evaluate and compare the quality of sewage sludge (SS) biochar produced by pyrolysis, in a laboratory scale reactor inside a muffle furnace and field scale Double Chamber Reactor (DCR). Small samples of (140 g) SS collected from a municipal sewage treatment facility was pyrolysed in a muffle furnace at different temperatures (250, 300, 350, 400, 450, 500, 550 °C) for two residence times (30 and 60 minutes) at a constant heating rate (10 °C/ minute). In field scale research, DCR reactor was fed with 12.5 kg of air dried SS and pyrolysed at 750 °C for 3 hours. It was observed that raw SS particles remained after pyrolysed at any temperatures between 250 and 550 °C for 30 minutes, and even for 60 minutes at lower temperature of 250 °C. The biochar produced by said heat treatment for 60 minutes were analyzed by International Biochar Initiative guidelines and leaching toxicity was assessed using Toxicity Characteristic Leaching Procedure (TCLP). Results showed that biochar recovery decreases with increasing pyrolysis temperature. Fixed carbon and ash content of biochar increased with increasing pyrolysis temperature while volatile solids decrease with increasing pyrolysis temperature. TCLP showed that conversion of SS to biochar reduced leaching potential of N, P, K, Ca, Mg, Mn and Pb by 77%, 79%, 7%, 1%, 55%, 23% and 68% when SS pyrolysis temperature increased from 300 to 550 °C. In the DCR reactor, leaching potentials of the same elements were comparable or even less than the biochar made at 550 °C in laboratory scale reactor. Further, it was observed that SS contained excessive amount of calcium due to lime (Ca(OH)₂) addition to septic tanks for maintaining pH. The results revealed that pyrolysis conversion of SS to biochar at elevated temperatures reduce the leaching potential of nutrients and metals.

Key words: Biochar, Leaching potentials, Pyrolysis, Sewage sludge