A Novel Technique to Digest Biochar for Metal Analysis

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Biochar (BC) is a low cost carbonaceous adsorbent material widely used for the removal of toxic metal ions from aqueous systems due to their highly porous nature and presence of various functional groups. Depending on the feedstock used to produce these carbonaceous materials, the trace metal content may vary. Various digestion techniques have been incorporated to analyze the metal content of BC though a proper method has not yet been established. This study was focused on finding a suitable method to totally digest the carbonaceous material and to evaluate the matrix effect. Both open vessel and microwave digestion methods were carried out for BC derived from tea waste, king coconut husk, Douglas fir and steam activated coconut shell biochar (CSBC) using mixtures of 69% nitric acid (NA), fuming nitric acid (FNA), 98% sulfuric acid (SA) and 30% hydrogen peroxide (HP) and their turbidity were measured. Lowest turbidities for open vessel digestions were observed for SA/HP mixture for low-temperature pyrolyzed BC with no external heating (2.04 – 7.90 FNU). Microwave digestions provided satisfactory turbidity levels for NA, NA/SA mixture, FNA and FNA/SA mixture for all types of carbonaceous material (1.58 – 20.97 FNU). The matrix effects were compared using cadmium, copper, lead and zinc using flame atomic absorption spectrophotometry. Digestion mixture containing only fuming nitric acid showed the lowest matrix effect for cadmium (1.2) for CSBC and copper (2.4) for CSBC while the mixture containing only nitric acid shows lowest matrix effect (7.6) for zinc with respect to Douglas fir BC. Recovery study confirmed the suitability of FNA as a suitable digestion mixture incorporated with microwave energy.

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