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Evaluation of the sediment remediation potential of magnetite impregnated activated carbons and biochars

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We evaluated the sediment remediation potential of magnetic composite materials synthesized by precipitating magnetite minerals onto activated carbons and biochars. Magnetite impregnation did not reduce the phenanthrene sorption capacity of the activated carbon or biochar component of the composite materials. The phenanthrene sorption capacity of the composite materials correlated with the surface areas of the pristine carbonaceous sorbents. XRD data and mass magnetic susceptibility data indicate that the mineral component of the composites is indeed nearly 100% magnetite. Addition of magnetic activated carbon to River Tyne sediment slurries reduced polycyclic aromatic hydrocarbon availability by more than 90%. After 3 months of mixing, 77% of the added magnetic activated carbon could be recovered with a magnetic rod. Continued monitoring showed that polycyclic aromatic hydrocarbon availability remained low following the magnetic recovery of most of the added sorbent mass. XRD analysis confirmed the presence of magnetite in the recovered sorbent material, with some other mineral phases such as calcite and quartz also being identifiable. Magnetic activated carbon has potential as a recoverable sorbent amendment for the treatment of sediment polluted with hydrophobic organic compounds. Further work will include an evaluation of the long-term magnetic sorbent effectiveness and stability in unmixed sediments under aerobic and anaerobic conditions and regeneration and re-use options for the recovered sorbent materials.