Nano Zero-Valent Iron Decorated Biochar, Produced via Asynchronous and Synchronous Routes of Pyrolysis and Carbothermal Reduction for Water Remediation: Characteristics and Applications

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Abstract

Nanoscale zero-valent iron (nZVI), together with a biochar (BC) support, provides advantageous materials for wastewater purification via adsorption, reduction, complexation and advanced oxidation mechanisms. Fabricating the materials can be done via two production routes: nZVI loaded BC subjected to subsequent carbothermal reduction (BC-nZVI) and nZVI loaded biomass (BM) subjected to synchronous pyrolysis and carbothermal reduction (BM-nZVI). Nonetheless, the physicochemical characteristics and the remediation capability of the two materials have not been comparatively evaluated. The present study focuses on preparing and extensively characterizing these materials with subsequent comparative analysis of remedial action. Surface morphology, functionality, elemental composition and point of zero charge were evaluated. XRD peak pattern confirmed the formation of zero-valent iron and the nano-scale was confirmed by TEM. Synergistic adsorptive and degradative behavior of the materials towards p-nitroaniline (pNA) and p-nitrophenol (pNP) were studied by evaluating the optimum pH, which was pH 3.0, contact time of 180 minutes and isotherm patterns. Higher initial adsorption capacity was observed in BM-nZVI while more sustainability and stability over the regeneration cycles were portrayed by BC-nZVI. Therefore, it is conclusive that materials produced through both synchronous and asynchronous routes have signature advantages in purifying pNA and pNP contaminated water.

Keywords: *Biochar, Nanoscale Zero-valent Iron, Rice Husk, P-nitroaniline, P-nitrophenol*