Nano-Fe^0 Immobilized onto Functionalized Biochar Gaining Excellent Stability during Sorption and Reduction of Chloramphenicol via Transforming to Reusable Magnetic Composite

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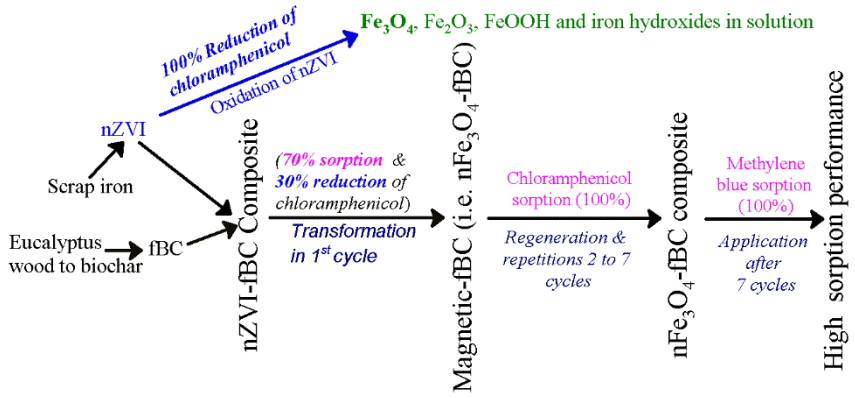
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Abstract:

The widely used nanosized zero-valent iron (nZVI or nFe^0) particles and their composite material lose reductive nature during application, and the stability of transformed composite material for repeatable application is not addressed to date. To shed light on this, nZVI was synthesized from scrap material and immobilized on functionalized biochar (fBC) to prepare nZVI-fBC composite. Comparative study between nZVI and nZVI-fBC composite on the removal of chlorinated antibiotic chloramphenicol from different water types was conducted. The results suggested that nZVI was solely responsible for reduction. Whereas nZVI-fBC could be applied once, within a few hours, for the reduction (29-32.5%) and subsequently sorption (67.5-70.5%) by transforming to a fully magnetic composite (nFe_3O_4-fBC) gaining stability and synergistic sorption performance. In both cases, two reduction by-products were identified namely 2-chloro-N-[1,3-dihydroxy-1-(4-aminophenyl)propan-2-yl]acetamide (*m/z* 257) and dechlorinated N-[1,3-dihydroxy-1-(4-aminophenyl)propan-2-yl]acetamide (*m/z* 223). The complete removal of 3.1 μM L^{-1} of chloramphenicol in different water was faster by nZVI-fBC (~12-15 h) than by stable nFe_3O_4-fBC composite (~18 h). Both nZVI-fBC and nFe_3O_4-fBC composites removed chloramphenicol in the order: deionized water > lake water > synthetic wastewater. nFe_3O_4-fBC showed excellent reusability after regeneration, with the regenerated nFe_3O_4-fBC (after 6 cycles application) showing significant performance for methylene blue removal (~287 mg g^{-1}). Therefore, the transformed nFe_3O_4-fBC composite is a promising and reusable sorbent for the efficient removal of organic contaminants.

Graphical Abstract:



Keywords— Functionalized biochar; Dechlorination; nZVI-fBC; Magnetic composite.

Professional Biography:

Mohammad Boshir Ahmed is a final year PhD student at “University of Technology Sydney” (UTS), Australia. He is also serving as “Technical Assistant” at “Environmental Engineering Research Laboratories”. Before that, he has completed his graduation and post-graduation from department of “Applied Chemistry and Chemical Technology” from “University of Rajshahi”, Bangladesh. He has published more than 20 papers (including 12 as first author) in reputed journals. He has received several awards including publication awards and award for finalist in “NSW Young Water Profession of the Year 2017” awarded by UTS and Australian Water Association, respectively.

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2	**Mohammad Boshir Ahmed,** John L Zhou, Huu Hao Ngo, Wenshan Guo,Md Abu Hasan Johir, Kireesan Sornalingam, M. Sahedur Rahman.	Chloramphenicol interaction with functionalized biochar in water: sorptive mechanism, molecular imprinting effect and repeatable application	***Sci. Total Environ.*** 609 (2017): 885-895.	**4.900, A**
3	**Mohammad Boshir Ahmed,** John L Zhou, Huu Hao Ngo, Wenshan Guo, Md Abu Hasan Johir, Kireesan Sornalingam, Dalel Belhaj, Monem Kallel.	Nano-Fe^0 immobilized onto functionalized biochar gaining excellent stability during sorption and reduction of chloramphenicol via transforming to reusable magnetic composite	***Chem. Eng. J.*** 322 (2017): 571-581	**6.216, A***
4	**Mohammad Boshir Ahmed**, John L Zhou, Huu Hao Ngo, Wenshan Guo, Md Abu Hasan Johir, Dalel Belhaj.	Competitive sorption affinity of sulfonamides and chloramphenicol antibiotics toward functionalized biochar for water and wastewater treatment	***Bioresour. Technol.*** 238 (2017): 306-312.	**5.651, A**
5	**Mohammad Boshir Ahmed**, John L. Zhou, Huu Hao Ngo, Wenshan Guo, Md Abu Hasan Johir, Kireesan Sornalingam	Single and competitive sorption properties and mechanism of functionalized biochar for removing sulfonamide antibiotics from water	***Chem. Eng. J.*** 311 (2017), 348-358.	**6.216, A***



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