193 - Rational design of humics-based remedial agents for installation of injectable permeable reactive barriers embedded with nano zero-valent iron

View Session Detail

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Abstract: Good quality of soil and groundwater is one of the most important assets throughout the World. There are various methods for their remediation, among which one of the most promising is creation of the permeable reactive barriers (PRB). Recently, another alternative approach is emerged based on a use of engineered nanoparticles (ENPs) for groundwater remediation. Nano-zerovalent iron (nZVI) is one of the most promising nanomaterials. However, vague understanding of potential harm ENPs may cause to humans and biotic receptors hinders application of ENPs in remediation technologies. Here, we propose to use natural surfactants – humic substances (HS) which are ubiquitous throughout the environment, firstly, for in situ installation of PRBs, and, secondly, for designing innovative hybrid nanomaterials composed of highly reactive nZVI particles embedded within biocompatible matrices of HS. The novel approach to rational design for acquiring humic remedial agents having the tailored properties is described. The humic backbone is used as a non-toxic, environmentally compatible matrix that is modified by introduction of surface active silanol groups and redox-active nanoparticles (e.g., zero-valent iron, nZVI). Interaction with organosilanes provides for high adhesive affinity of HS for mineral surfaces, incorporation of nanoparticles of zero-valent iron (nZVI) is used to enhance reducing capacity of the humic derivatives. The dynamic behaviour of the designed HS-based systems in aqueous phase is studied to reveal key parameters capable for switching these systems from soluble to immobilized state. The high-tech instrumental methods including small angle X-ray scattering and electromic microscopy are used for this purpose. We have proven the possibility of using HS and their silanol derivatives in different remediation technologies including sorption PRBs (on the example of azodyes). We have also shown that the efficiency of sorption system can be drastically improved through inserting reactive NPs such as nZVI into the PRB. The performance of the injected HPRBs is assessed using model contaminants, such as azodyes and heavy metals (Cr(VI). The research was supported by the Russian Science Foundation (16-14-00167) in part of humics-siloxane systems synthesis.

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