Application of NZVI for in situ Remediation (A review)

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ABSTRACT

This review focuses on zero valent iron nanoparticles (nZVI) use for in situ remediation. The implication of nZVI-based strategies for environmental applications must be thoroughly evaluated before the technology can be further deployed in situ. The increasing use of strategies incorporating nZVI for soil and groundwater in situ remediation is raising some concerns regarding the potential adverse effects nZVI could have on indigenous microbial communities and ecosystem functioning. This review provides an overview of the current literature pertaining to the impacts of nZVI applications on microbial communities. In continuation of discussion we explained that nano scale zero-valent iron is an ideal reagent for removing pollutions like heavy metals from wastewater in Eh-controlled nZVI reactor. This reactor is capable of producing stable effluent from fluctuating influent. nZVI in uniform dispersion creates a highly-reducing condition which can be easily monitored using an ORP electrode. Monitoring E_h in nZVI reactor offers a reliable and convenient way to control and regulate treatment performance. Finally NZVI can be easily separated via gravitational settling and be recycled via pumping. nZVI recirculation increases material efficiency and enriches the heavy metal contents in reacted nZVI. Valuable mineral resources were harvested from the wastewater using the separation-recirculation system.The result of this preliminary qualitative evaluation indicates that at present, there are no significant grounds on which to form the basis that nZVI currently poses a significant, apparent risk to the environment, although the majority of the most serious criteria (i.e. potential for persistency, bioaccumulation, toxicity) are generally unknown. We recommend that in cases where nZVI may be chosen as the 'best' treatment option, short and long-term environmental monitoring is actively employed at these sites. We furthermore recommend the continued development of responsible nZVI innovation and better facilitated information exchange between nZVI developers, nano-risk researchers, remediation industry, and decision makers.

Keywords: Nano zero-valent iron, In situ remediation, Eh-controlled nZVI reactor, Environmental impact, Toxicity mechanisms

1. INTRODUCTION

Nano scale zero valent iron (nZVI) is the most commonly used nanomaterial in Europe and in the United States for soil and groundwater remediation. More recently, its use for wastewater remediation [1-3] and anaerobic digestion process enhancement [4, 5] has also received growing attention. Due to its reduced size, nZVI has a higher reactivity towards a broad range of contaminants, including halogenated compounds, nitrate, phosphate, polycyclic aromatic hydrocarbons, and heavy metals [1, 3, 6, 7] and a higher mobility compared to its micro scale counterpart. In addition, its application does not require excavation as highly concentrated nZVI slurries are directly injected underground, at or near the source of contamination. Consequently,