Nanoparticles for the remediation of agrogenic contaminated soil and groundwater – a review

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ABSTRACT: Oral presentation on the topic of nano-mechanics.

INTRODUCTION

The wide spread use and strong reliance on both fertilizers and pesticides made of agrigenic pollution one of the major contemporary threats to environment and human health. Impacts on the environment vary from local effects, such as eutrophycation[1, 2], loss of biodiversity and diminished ecosystem health[3], to global effects, such as the aggravation of global warming[2, 4] and ozone layer depletion[5]. The novelty of nanoremediation and its early successes, reported for various contexts, present the prospect for the development of relevant applications for agrigenic contaminants.

EXPERIMENTAL/THEORETICAL STUDY

A literature review was conducted in 34 databases, following a four steps methodological approach. First, a set of pertinent terms were used in the initial searches. Second, synonyms from the first set of terms were used to perform further searches. Third, from the selected papers, other relevant terms were identified to perform a third set of searches. In the forth step, the bibliography of the selected papers was researched for further relevant papers. The set of studies selected for in-depth analysis were exclusively laboratorial ones. Each study was assessed by set of relevant characterization variables.

RESULTS AND DISCUSSION

Nanoparticles have been proven as generally effective remediation agents. Nevertheless, the effectiveness of the nanoparticulate agents can be substantively conditioned by such media characteristics as the ionic strength, the content of natural organic matter, anionic competition and inadequate pH, the latter for nitrates. Moreover, the intrinsic tendency to agglomeration further limits the nanoparticles' effectiveness. Stabilized iron based nanoparticles have manifested low tendency for agglomeration and controlled reactivity thus significantly enhancing their decontamination effectiveness. The association of palladium to nZVI further enhances the decontamination effectiveness while severely restricting the formation of toxic byproducts. Electrokinetic systems have proven to improve the transport of nanoparticles in the media.

CONCLUSION

This review highlighted that chlorinated hydrocarbons, heavy metals, dinitrotoluene and some agrichemicals are the major contaminants being addressed by nanoparticles. The use of nanoparticulate agents has been reported to be effective for all contaminants, though occasionally other remediation technologies prove to be more effective. Nanoparticles operate in two major ways, the reduction, and thus degradation of the contaminant, or by sorption, i.e. the nanoparticles work as a sink for the contaminant. But both these approaches might display limitations, e.g. the reduction of nitrate by nZVI gives rise to other contaminants that have to be addressed afterwards, and sorbed contaminants have varying degrees of susceptibleness to desorption. Thus, such media conditions as ionic strength, anionic competition, content of natural organic matter and inadequate pH, for nitrates, can hamper the remediation of the contaminants.

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ACKNOWLEDGMENTS

It is acknowledged the kind support and infrastructure access, which enabled the current work, provided in the scope of the Programa Doutoral de SSO by the Faculdade de Engenharia da Universidade do Porto.