Metallic Nanoparticles for the Treatment of Effluents Contaminated with Chlorinated Organic Compounds: a Review

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ABSTRACT

Nanomaterials are the core of a promising technology that can be used to accelerate and improve the transformation and detoxification of chlorinated organic compounds (COCs). Hence this review will cover topics such as efficient nanomaterials for COCs treatment, supports and stabilizers that improve the process, interactions of nanomaterials with the microorganisms involved, and emerging fields. The most common material used for treatment of waters polluted with COCs has been zero-valent iron (ZVI) because of its efficiency and low cost. However, there are concerns on the stability and long term durability of ZVI nanoparticles (NP). For this reason there are some works with other materials such as Pd, Zn or Ni and with combination of materials in the fabrication of NP. The bimetallic NPs allow for a lower cost of production, since one of the materials could be the most economic but not the most efficient whereas the second metal, the most expensive, provides the degradation capability. Alloyed and *crochet* types of bimetallic NP have been tested. The process with NP can be made more efficient by using a support that prevents the aggregation of NP during reaction and in some cases can facilitate the recovery of the NP afterwards. Currently, the application of NP in bioreactors and *in situ* treatments is gaining momentum. Another significant issue especially for hybrid treatments is the interaction between NP and the microbial community harbored in bioreactors and devices, ranging from toxicity issues to biosynthesis of NP. There has been attempts to incorporate metal NP onto the microbial cells for COC treatment, although more research is needed. Furthermore, there is increased interest on biosynthesis of NP with microorganisms in order to have true "nanoparticle-ized biomass" with increased degradation capability of pollutants. Among important emerging fields we can highlight the environmental impact assessment as well as life cycle analysis of the NP fabrication and use.

Keywords: chlorinated organic compounds, nanoparticles, pollutant treatment