Novel Cu-Fe-carbon nanofiberous beads for the treatment of Cr(VI) and DDVP co-contaminated wastewater

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Abstract:

Co-contamination of toxic metals and organic pollutants has been reported over one third of the all polluted lands worldwide. The leachate from the polluted lands mix into different water bodies, ultimately, contributing in water pollution. The present study presents a hybrid technique to treat wastewater co-contaminated with Cr(VI) and the dichlorvos (DDVP) pesticide. A Cu-Fe bimetal doped carbon nanofiberous (CNF) micron sized (~1 cm) beads are used as a adsorbent for Cr(VI), simultaneously as a catalyst for CWAO of DDVP. Briefly, suspension polymerization technique has been used for synthesis of phenolic beads. Bimetallic salts were added to the polymer suspension during a polymerization step. Phenolic beads were then carbonized and activated. The CNFs were grown over the prepared porous metal-doped carbon beads using chemical vapour deposition. Physico-chemical surface characterization and adsorption-oxidation data were presented. Adsorption of Cr(VI) and CWAO of DDVP has been performed sequentially. Mechanistically, adsorption of Cr(VI) over the beads take place through the combination of both, physi- and chemisorption. Whereas, physisorption facilitated by the large surface area of the material, when the Fe nanoparticles of the bimetallic Cu-Fe-CNF beads were induce the partial reduction of Cr(VI) into the less toxic Cr(III). The latter ions was adsorbed by the negatively charged electron clouds of the CNFs. The negatively charged aqueous $HCrO_4^-$ was adsorbed by the protonated $FeOH^{2+}$. Degradation or mineralization of DDVP occurred synergistically via direct oxidation by the oxidizing Cr(VI) adsorbed on the beads and indirect oxidation by the Cu-generated OH radicals in the aqueous phase.

Biography:

Arun Kumar is pursuing Ph.D. degree in the department of chemical engineering at IIT Kanpur (India). His research interests are adsorption, environmental pollution control,

synthesis and application of carbon nanofibres and nanoparticles, lattice Boltzmann modelling. He has 3 journal publications in this field.

Prof. Nishith Verma is a professor of chemical engineering at Indian Institute of Technology Kanpur (India). Pro. Verma holds a B. Tech degree from IIT Kharagpur (India) and Ph.D. degree from the University of Arizona (USA), both in chemical engineering. Prof. Verma has more than 100 journal publications and 9 patents.