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Fate of organoarsenic compounds in presence of natural minerals and their sequestration using novel sulfidated nZVI particles in complex groundwater matrix

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Arsenicosis or arsenic poisoning in groundwater is an environmental calamity affecting millions of people globally per annum. There are a lot of scientific research have been done on inorganic arsenic in groundwater but researches on the organo-arsenic contaminants in the groundwater system are limited. Roxarsone (4-Hydroxy-3-nitrophenyl arsonic acid) (ROX) and P-arsanilic acid (4-aminophenyl arsonic acid) (PAA) are two organo-arsenic compounds used as feed additives to improve the quality and pigmentation of meat in poultry and swine farms. In this study the sorption of these two organo-arsenic species on naturally occurring iron colloids: hematite, magnetite and maghemite and clay colloids: bentonite and kaolinite, were done for the groundwater matrices. Magnetite showed the highest sorption in case of both ROX and PAA with the sorption capacity of 55.99% and 59.63% respectively. The sorption capacities of both ROX and PAA in decreasing order as follows: Magnetite > maghemite > hematite. The clay colloids had zero to minimal interactions with the ROX and PAA. Kaolinite had a very low sorption capacity of 3.069% for PAA. Bentonite had zero adsorption of both ROX and PAA. This study further describes the comparative removal of these two organo-arsenic contaminants from the groundwater using Nano-Zero Valent Iron (nZVI) and Sulfurized Nano-Zero Valent Iron (S-nZVI) synthesized by a new nontoxic method. nZVI showed the removal capacity of 18.47% and 11.15% for ROX and PAA at 100 mg/L in complex groundwater matrices respectively. In contrast the novel S-nZVI showed an excellent removal of 90.67% and 86.27% for ROX and PAA at 100 mg/L groundwater solutions respectively, suggesting that it could safely be used for the remediation of the organo-arsenic contaminants as emerging contaminants form the groundwater system.

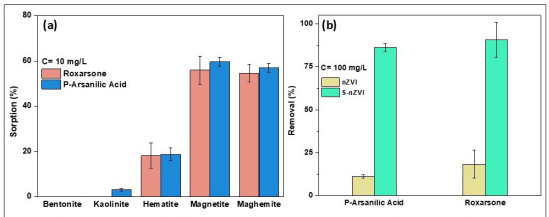

Fig. 1 (a) Interaction between mineral colloids and organo-arsenic species and (b) removal of organo-arsenic species using nZVI and novel S-nZVI