Permeable reactive barriers made with zero valent iron-doped porous plaster for the treatementof organic nitro compounds on laboratory scale

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Permeablereactivebarrier (PRB) is a technology that has been recognized as being a cost-effective technology for “in situ passive method” groundwater remediation. It is an implementation of filtration consisting in a permeable zone, which passively captures a plume of contaminants through immobilization or transformation of the pollutants, releasing decontaminated water to the other side of the barrier.PRB’s are composed of inexpensive filler materials which may be doped with reagents specific for the remediation of particular compounds. It is reported that zero valent iron (ZVI) is particularly effective in the chemical degradation of persistent chlorinated compounds into non-toxic and harmless by-products. ZVIin anaerobic conditions is oxidized to iron chloride while the organohalide is transformed into volatile hydrocarbons. Waste iron shavings have been used to treat such pollutants in liquid water streams. We have elaborated porous plaster compositions doped withZVI in order to control the flux of water to be treated.

Our interestwas to test the PRB with ZVI in reacting with organic nitro compounds. We used nitroaniline as the model pollutant and passed it through a porous plaster column containing 5% by weight of iron powder. The nitroaniline was quantified by UV spectroscopy by measuring the absorption at 430 nm. Our results show that ZVI present in the calcium sulfate matrix is capable of reacting with the organic pollutant. The nitro compound is reduced to phenylenediamineandthe rate of the reduction depends on the molecular structure of the organic compound.

The porousplaster was formulated by adding 1 or 2 % of calcium carbonate to the calcium sulfate prior to adding water containing 2% phosphoric acid. This resulted in foaming of the mixture and formation of porous hardened plaster. Water flow could be controlled by the amount of porosity introduced into the plaster. The materials being low cost, it could be of interest to investigate further possibilities of including specific reagents such as calcium phosphates for the removal of metal ions, or hydrogen peroxide for the oxidation of textile dyes.

Our preliminaryresults will be presented together with future prospects.

Sweeny KH, Fischer JR reductive degradation of halogenated pesticides, 1972, US Patent n°3,640,821.