Biosurfactant Enhanced Solubilization and Degradation of Tce Using Bimetallic Fine Fe/Ni Particles

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Abstract:

In this study, the potential of freshly prepared Fe/Ni fine bimetallic particles to dechlorinate up to 1900 mg/L (60 % higher than water solubility) of Trichloroethylene (TCE) solubilized in UH- biosurfactant was investigated. UH- biosurfactant was produced from used vegetable oil under non-septic conditions. The bimetallic (Fe/Ni) loading was 275 mg/L and the degradation was investigated in continuously stirred batch reactor. The degradation was approximated using the first order kinetic relationship.

Introduction:

Trichloroethylene (TCE), a chlorinated dense non-aqueous phase liquid (DNAPL), is widely used as an industrial cleaning solution and a degreasing agent. Given the high frequency of use, handling, and transportation, along with past disposal and storage practices, chlorinated DNAPL compounds presently represent a significant threat to the soil and groundwater. The release of chlorinated solvents into subsurface environment has led to extensive contamination of groundwater and underscores the need to develop innovative technologies to remediate groundwater. The use of zero valent iron for in situ remediation has expanded to several kinds of reducible contaminants. Since the dechlorination reaction is surface mediated, decreasing the size of iron to nanosize increases the rate of reduction of TCE (Schrick et al., 2002). The combination of high reactivity and smaller size make the metal particles more useful to wide array of environmental applications such as groundwater remediation and soil and sediment treatment (Zhang, 1999).

Objective:

The overall objective of this study was to investigate the potential of using freshly prepared bimetallic Fe/Ni fine particles to rapidly degrade TCE solubilized in a biosurfactant.

Testing program:

Experiments were conducted in continuously stirred batch reactors to determine the reduction of TCE using Fe/Ni. Dechlorination up to 1900 mg/L TCE solubilized in UH-biosurfactant was investigated. The concentration of TCE was analyzed using the SHIMADZU GC-14A gas chromatograph.

Production of bimetallic fine Fe/Ni:

Bimetallic fine Fe/Ni particles were produced by solution method using $FeSO_4.7H_2O$ and $NiCl_2.6H_2O$ solutions and reducing it by using $NaBH_4$ under inert

atmosphere of nitrogen.

Reduction of TCE:

The degradation of 1900 mg/L by using Fe/Ni fine bimetallic particles in UH-biosurfactant is shown in Fig.1. From the figure, UH- biosurfactant degraded 1900 mg/L up to 50 mg/L in less than 60 hours. The degradation rate of TCE solubilized in UH - biosurfactant was 0.037 (mg/L) using 275g/L bimetallic Fe/Ni particles as shown in Fig. 2.

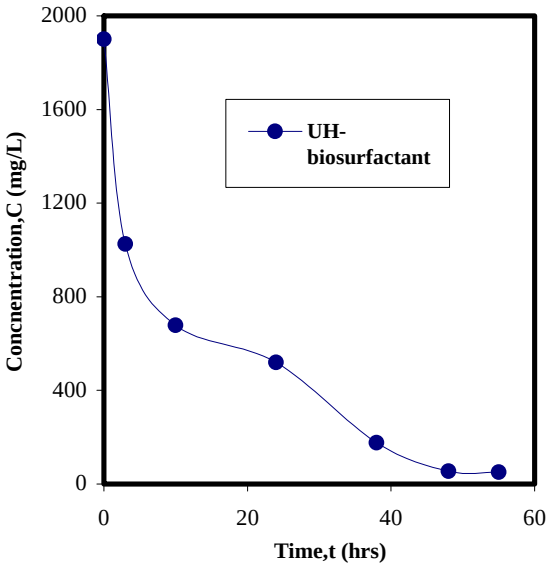

FIG. 1. Degradation of 1900 mg/L TCE Solubilized in Various Surfactants using 275 g/L Fe-Ni particles

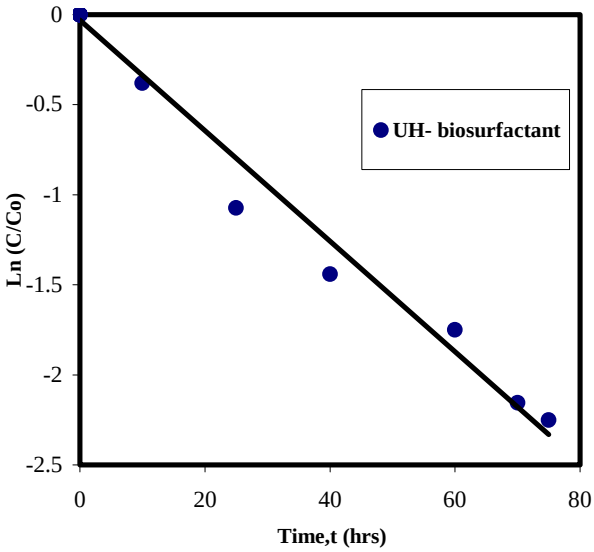

FIG. 2. First Order Degradation of TCE with UH-biosurfactant

Conclusion:

Fe/Ni fine particles was effective in degrading 1900 mg/L TCE solubilized in biosurfactant. TCE solubilized in UH- biosurfactant had degraded using bimetallic fine Fe/Ni particles can be represented by a first order relationship.

Acknowledgement:

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References:

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