TETRACYCLINE REMOVAL BY BIO-FENTON PROCESS IN DIATOMS USING SBR

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1. INTRODUCTION

Presence of antibiotics in the environment lead to the development of antibiotic resistant genes in the environment. It is of great importance to develop efficient and cost-effective treatment technologies for the removal of antibiotic from contaminated waters in order to avoid the health risks and environmental risks. In the natural environment, many aquatic plants and algae are capable of producing hydrogen peroxide (H_2O_2) by their metabolic activities (Reis et al., and Inagaki et al.,). This hydrogen peroxide from aquatic life forms can be effectively used for the production of highly reactive hydroxyl radicals by introducing an iron catalyst, which is called bio-Fenton process. In the present study, diatoms were used for the bio-Fenton studies. Hydroxyl radical production in diatoms was confirmed using Electron Spin Resonance (ESR) technique, and removal experiments of tetracycline were conducted in SBR.

2. MATERIALS AND METHODS

Enriched mixed culture of diatom was used for the experiments.

2.1 Identification of Bio-Fenton Process using ESR

The diatoms were mixed with trapping reagent, DMPO and Fe and the filtrate was analyzed using ESR spectroscopy. The settings of the ESR equipment were microwave power, 4mw; modulation amplitude, 0.1mT; field, 336.250mT; sweep width,5mT; gain,200 and time constant,0.1s.

2.2 Removal of tetracycline hydrochloride in SBR

Four sequence batch reactors R1, R2, R3 and R4 represents the Control, iron complex formation, bio-Fenton and absorption reactors respectively. 0.5mg/L of Fe as FeSO4 and 0.0324mg/L dry weight correspondent initial inoculum was used. Two runs for R2 and three runs were done for R3 and R4, where as in R1 tetracycline was not added further since there was no significant decrease in the R1.

3. RESULTS AND DISCUSSION

3.1 Mechanism of bio-Fenton reaction in diatoms.

The mechanism of bio-Fenton process is explained in fig (1), and equations (1) and (2).

$$Fe^{2+} + H_2O_2 \rightarrow OH^{\bullet} + OH^{-} + Fe^{3+} \cdots\cdots (1)$$

$$Fe^{3+} + H_2O_2 \rightarrow OOH^{\bullet} + Fe^{2+} + H^{+} \cdots\cdots (2)$$

3.2 Identification of Bio-Fenton Process using ESR

The ESR signals of diatoms and Fe with trapping reagent was compared with the signal of 0.02mM H2O2, 1mg/L Fe and the trapping reagent. The comparable similar signals indicated the bio-Fenton process is successful in diatoms. (Fig.2)

3.3 Removal of Tetracycline

We could observe good removal performance of tetracycline by the bio-Fenton process in diatoms in sequence batch reactor in three consecutive runs. (fig.3).

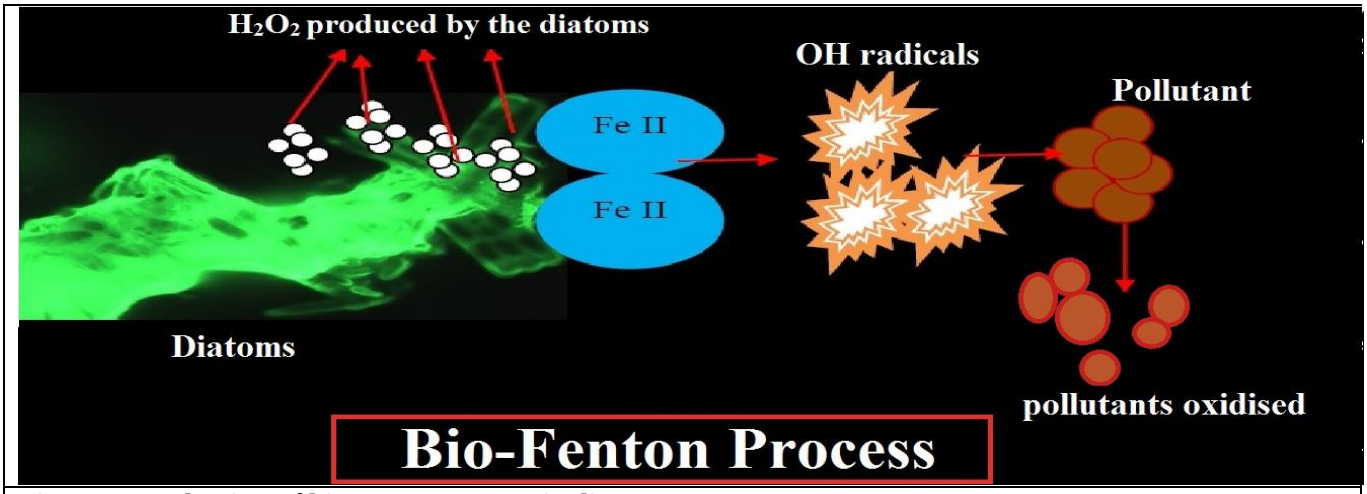

Figure 1. Mechanism of bio-Fenton process in diatoms

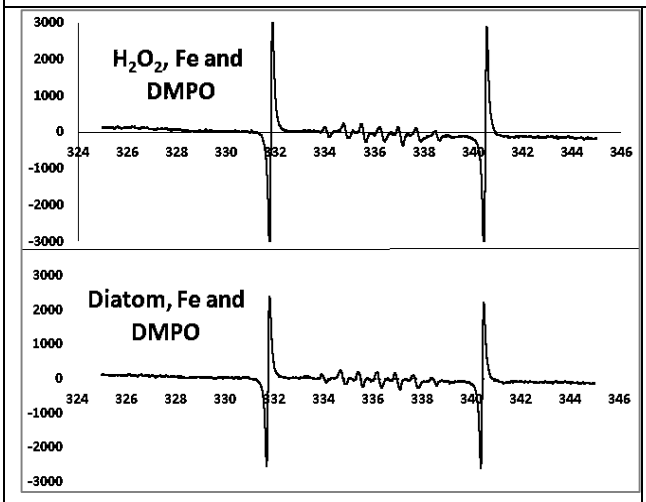

Figure 2. ESR signals comparison between hydrogen peroxide and diatoms

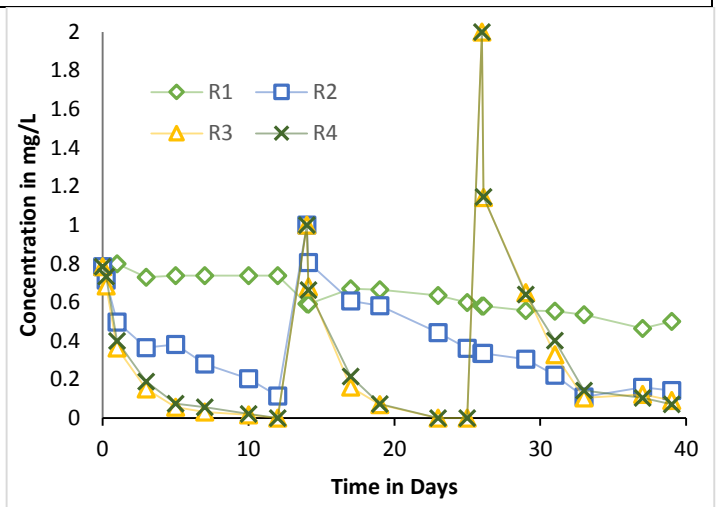

Figure 3. Removal of tetracycline in SBR

4. CONCLUSIONS

The diatoms were successfully able to produce the hydroxyl radicals as a result of bio-Fenton process. The bio-Fenton reaction by diatoms and its capability to remove the tetracycline hydrochloride from water make it a promising footstep in the removal of antibiotics, and thereby the reduction of possibility of antibiotic resistant genes in the aquatic environment.

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