



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI  
SHORT ABSTRACT OF THESIS

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This thesis has focused on the physical mechanism of the sono-hybrid processes for desulfurization of liquid fuels. Mainly two sono-hybrid techniques, viz. the combinations of oxidative desulfurization (with different oxidants)/ultrasound and biodesulfurization (either microbial or enzymatic)/ultrasound, have been treated. These sono-hybrid systems have also been combined with the phase transfer agent and surfactant systems. The thesis comprises of total 7 chapters. A brief description of contents of each chapter is as follows:

*Chapter 1* presents the general introduction to the subject of desulfurization with description of basic aspects of conventional as well as new techniques of desulfurization followed by description of aim and approach of the thesis.

*Chapter 2* deals with the investigations in ultrasound assisted oxidative desulfurization using the hybrid Fenton-peracetic acid system. An attempt is also made in distinguishing between contributions of ultrasound and cavitation to the process.

*Chapter 3* describes investigations in ultrasonic enhancement of phase transfer agent assisted oxidative desulfurization system. Two oxidant systems, viz. peracetic acid and performic acid have been coupled with a phase transfer agent. Synergistic links between the mechanisms of phase transfer agent and physical/chemical effects of ultrasound and cavitation have been identified.

*Chapter 4* presents further research on mechanistic links between ultrasound/cavitation and phase transfer agent. Kinetic and Arrhenius analysis of the experimental data has been coupled with simulations of cavitation bubble dynamics to get physical insight into the combined effect of PTA and ultrasound on oxidative desulfurization system.

*Chapter 5* presents investigations in microbial desulfurization using immobilized cells of *Rhodococcus rhodocorus* MTCC 3552. The approach has been to fit Haldane kinetics model to dibenzothiophene metabolism.

*Chapter 6* presents studies in ultrasound-assisted enzymatic desulfurization using system comprising Horseradish peroxidase enzyme and dibenzothiophene. This study involves identification of metabolic pathway of enzymatic degradation with study of conformational changes in the enzyme structure induced by ultrasound and cavitation.

*Chapter 7* presents an overview of the mechanistic investigations in various sono-hybrid techniques. Despite significantly different chemistry, several physical aspects of the four sono-hybrid techniques for oxidative desulfurization, viz. sono-Fenton-peracetic acid, sono-PTA-peracetic/performic acid, sono-microbial and sono-enzymatic, have been revealed to be strikingly similar. These physical aspects have been identified and discussed in this chapter.

In summary, this thesis is a mechanistic investigation of ultrasound assisted desulfurization of liquid fuels. The results and analysis presented in this thesis have brought forth some crucial links and interactions between the individual mechanisms of different desulfurization techniques that eventually result in enhancement of the process. These mechanistic insights not only give important input for further research in this area but also form important guidelines for optimization and scale-up of the process.