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Ultrasound Assisted Biodesulfurization of Liquid Fuel using Free and Immobilized Cells of *Rhodococcus rhodochrous* MTCC 3552: A Mechanistic Investigation

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Abstract

This paper attempts to gain mechanistic insight into enhancement effect of sonication on biodesulfurization. The approach has been to fit Haldane kinetics model to dibenzothiophene (DBT) metabolism and analyze trends in model parameters concurrently with simulations of cavitation bubble dynamics. Mechanistic synergy between sonication and biodesulfurization is revealed to be of both physical and chemical nature. Generation of micro-turbulence in medium by sonication leads to fine emulsification and enhancement of DBT transport across organic/ aqueous interphase. Microturbulence also enhances transport of substrate and product across cell wall that increases reaction velocity (V_{max}). Michaelis constant (K_m) and inhibition constant (K_I), being intrinsic parameters, remain unaffected by sonication. Radicals produced by transient cavitation oxidize DBT to DBT-sulfoxide and DBT-sulfone (intermediates of metabolism), which contributes enhancement of biodesulfurization. However, high shear generated by ultrasound and cavitation has adverse effect on action of surfactant β-cyclodextrin for enhancement of interphase transport of DBT.

Keywords: Biodesulfurization, Dibenzothiophene, Ultrasound, Cavitation, Haldane kinetics