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Entitled

IMMOBILIZATION OF LIPASE ON METAL ORGANIC FRAMEWORKS FOR BIODIESEL PRODUCTION

by

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Abstract

In this Thesis, the mechanism, kinetics, and thermodynamics of lipase adsorption on the surface of different MOFs, namely ZIF-67, ZIF-8 and HKUST-1, have been thoroughly investigated and tested for biodiesel production. The three supports have different structures, pore sizes, chemical properties, and surface areas. The influence of temperature, initial protein loading, and contact time on the adsorption and catalytic properties of the resultant biocatalysts were investigated. The catalytic properties were assessed on biodiesel production from olive oil transesterification. The highest lipase adsorption capacity of 26.9 mg/g was achieved using ZIF-67 at 45^{o}C and initial protein concentration of 0.6 mg/mL. The maximum capacities of ZIF-8 and HKUST-1 were 18.95 mg/g and 0.50 mg/mL at 35^{o}C and 17.53 mg/mL at 45^{o}C and 0.60 mg/mL, respectively. The equilibrium adsorption data suggested that the lipase adsorbed physically on ZIF-67 and ZIF-8 and chemically of HKUST-1. The data were best fitted with Langmuir isotherm model for the three supports. Whereas, of the adsorption kinetics data were best fitted using Elovish's model for ZIF-67 and ZIF-8, and pseudo second model for HKUST-1. It was also found that the process was influenced by intraparticle and film diffusion. The prepared bio-catalyst was successfully used to catalyze the transesterification of olive oil to produce biodiesel in a solvent-free medium. The ZIF-8 and ZIF-67 showed better catalytic activity achieving 88% and 90% conversion, whereas HKUST-1 showed better operational stability owing to the stronger chemical adoption. In addition, diffusion-reaction kinetics of biodiesel production using adsorbed lipase on ZIF-8 has been analyzed. The investigation provided an insight into adsorption pathways and probable mechanism involved and a better understanding of their application in biodiesel production.