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Entitled

IMMOBILIZATION OF LIPASE ON ZIF FOR ENHANCED BIODIESEL PRODUCTION

by

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Abstract

This thesis presents a study on the use of lipase encapsulated inside hexagonal ZIF-8 for enhance biodiesel production. It was shown that the lipase encapsulation did not have a significant effect on the morphology, surface properties and crystallinity of the ZIF-8 crystals. The effects of methanol ratio, temperature, oil concentration and water content, on the biodiesel production yield and rate of reaction, were tested. The highest yield was obtained at a methanol ratio and temperature of 6:1 and 40 ^{o}C, respectively, and a drop was observed by increasing both. It was also shown that the yield decreased with the increase in water content. The activity and stability of the immobilized lipase in ZIF-8 by encapsulation was compared to that immobilized by surface adsorption. Although the adsorbed lipase on ZIF-8 showed higher activity, the stability of the encapsulated one was higher. At methanol ratio of 12:1, the encapsulated lipase in ZIF-8 maintained 83% residual activity after 5 cycles, compared to only 34% attained by the adsorbed lipase at the same conditions. The experimental results were used to determine the kinetics parameters of modified Ping Pong Bi Bi model, and the accuracy of the prediction were compared to those obtained by the Michaelis Menten model. To gain a better insight into how the reaction occurs inside the ZIF-8 crystal with encapsulated lipase, a diffusion-reaction model was developed and numerically solved. The results clearly show that the substrate did not diffuse deeply into the crystal, which further confirmed the mass transfer limitation that resulted in the lower activity of the encapsulated lipase as compared to the adsorbed one. The developed numerical model can be applied to any diffusion-reaction systems.