ENZIMATIC POLYCONDENSATION OF 1,4-BUTANEDIOL AND DIETHYL SUCCINATE

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Polybutylene Succinate (PBS) is a biodegradable polyester produced from monomers provided by biotechnological processes, that have gained great attention in the last years. In addition, biocatalysis collects advantageous features as their high selectivity, milder operating temperature, products free of toxic metals and the possibility of reuse (when immobilized). Herein, we investigate the lipase-catalyzed synthesis of PBS via polycondensation reactions of 1,4-butanediol and diethyl succinate. Reactions were performed at different temperatures (70, 80 and 90 ^{o}C) with Novozym 435 as biocatalyst, both in bulk and using diphenyl ether (5 and 50 wt%) as solvent. The kinetic behavior of the reactions was monitored by the by-product condensation. The use of 5 wt% of diphenyl ether as solvent led to an increase in reaction rate in comparison to reactions performed in bulk due to diffusional advantages, but did not lead to higher molecular weights. This behavior was attributed to deleterious effect of this solvent on enzymatic activity, which decayed from 31.1 U.g^{-1} (before the reaction) to 4.5 U.g^{-1} after the reaction using diphenyl ether as solvent. In the bulk reactions the reuse of immobilized formulation of lipase Novozym 435 was possible during 6 cycles, with good catalytic activity in the first 4 cycles. Moreover, the loss of enzyme activity in the last cycles was recovered through enzyme partial replacement (addition of 25% of fresh enzyme to 75% of used one). On the other hand, when diphenyl ether was used as solvent the reuse of the immobilized enzyme was impaired by its decreased activity, as well as its use in longer enzymatic reactions. Thus, further developments are required either in the selection of good solvents for PBS that do not affect enzyme activity or in the formulation of immobilized biocatalyst that are not affected by the currently known solvents for PBS.