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Overcoming kinetic limitations in biocatalysis

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The primary rationale for implementing biocatalysis is that it usually gives highly selective conversions resulting in reduced waste. However, for effective introduction of biocatalysis high product concentrations are required [1]. Usually at an industrial scale, the concentrations of the components are such that the reactions are challenged by substrate and product inhibition to the enzyme and therefore different strategies have to be applied to overcome this problem. One option is to introduce an auxiliary phase in the form of a solid resin. The resin can act as a carrier which supplies the inhibitory substrate within the critical concentration. Biocatalytic consumption of substrate from the aqueous phase causes additional substrate to diffuse from the carrier phase to accomplish *in-situ* substrate supply (ISSS) at the rate of biocatalytic demand. Similarly, as the product is formed, it diffuses back into the carrier phase to accomplish *in-situ* product removal (ISPR) [2].

In order to test this hypothesis, an ω-transaminase catalyzed reaction for the asymmetric synthesis of (S)-1-phenylethylamine was selected for experimental validation. The specific challenges that have to be addressed in this system include substrate and product inhibition and low aqueous solubility of the substrate [3]. In this study, a systematic methodology to select a resin as the auxiliary phase is presented. A broad range of resins comprising various surface areas, pore volumes and functional groups was used in experiments to quantify the partition coefficient and overall capacity of the resin for the substrate and product. With the selection of an appropriate resin, it was loaded with substrate and released into the reaction media. To make a comparison, the same reaction was carried out by adding the substrate directly to the reaction media. From the experimental findings, it can be stated that the addition of resin had a significant positive impact with respect to observed biocatalytic activity.

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