

Slovak Society of Chemical Engineering Institute of Chemical and Environmental Engineering Slovak University of Technology in Bratislava

PROCEEDINGS

 $51^{\rm st}$ International Conference of the Slovak Society of Chemical Engineering SSCHE 2025

Hotel DRUŽBA Jasná, Demänovská Dolina, Slovakia May 27 - 30, 2025

Editors: Assoc. Prof. Mário Mihaľ

ISBN: 978-80-8208-158-2, EAN: 9788082081582

Published by the Faculty of Chemical and Food Technology Slovak Technical University in Bratislava in Slovak Chemistry Library for the Institute of Chemical and Environmental Engineering; Radlinského 9, 812 37 Bratislava, 2024

Sauer, L., Přibyl, M.: Enzyme synthesis and continuous flow separation of (R)-1-phenylethanol in a modular microfluidic system, Editors: Mihaľ, M., In 51st International Conference of the Slovak Society of Chemical Engineering SSCHE 2025, Jasná, Demänovská Dolina, Slovakia, 2025.

Enzyme synthesis and continuous flow separation of (R)-1-phenylethanol in a modular microfluidic system

Lukáš Sauer¹ and Michal Přibyl¹

¹University of Chemistry and Technology, Prague, Technická 5, 166 28 Praha 6, Czechia

e-mail: sauerl@vscht.cz

Key words: (R)-1-phenylethanol, Continuous flow production, Microfluidics, Enantiomer

The synthesis of enantiomerically pure compounds remains a key challenge in chemical engineering, particularly for industrial applications. Microfluidic systems, which significantly enhance reaction and transport processes, offer a promising approach to overcoming this challenge. In this study, we present a modular microfluidic platform designed for the continuous production of (R)-(+)-1-phenylethanol (R-PE) from racemic 1-phenylethyl acetate (PEAc). The system integrates a packed-bed reactor (PBR) with immobilized lipase for enantioselective hydrolysis and a slug flow extractor (SFE) for efficient removal of unreacted substrate using hexane. Kinetic analysis of the enzymatic process revealed competitive inhibition by R-PE, while extraction studies provided insights into separation efficiency and mass transfer characteristics. By optimizing residence times in both modules, we achieved nearly 90% yield of R-PE within a total reaction time of 260 s - up to 100 times faster than conventional batch reactors. Our results demonstrate how precise kinetic and transport data can be leveraged to design efficient continuous-flow processes for the rapid production of optically active compounds.



Fig. 1: A scheme (A) and photo (B) of PBR, a scheme of SFE (C), a scheme of the modular microfluidic system (D).