Purifying biorefinery by-products: A kinetics and thermodynamics approach using solvent-aided layer crystallization

Mitra Ila[1]*, Marjatta Louhi-Kultanen[1], Erik Temmel[2], Manfred Stepanski[2], Michael Ginter[3], Ben McKay [4], Siu-Ha Soo-Tang[4], Ed de Jong[4]

[1]Department of Chemical and Metallurgical Engineering, School of Chemical Engineering, Aalto University, Espoo, Finland
[2]Sulzer Chemtech Ltd, Winterthur, Winterthur, Switzerland
[3] Vogelbusch Biocommodities GmbH, Vienna, Austria
[4]Avantium, Amsterdam, Amsterdam, The Netherlands
*mitra.ila@aalto.fi

Abstract

Production processes in biorefineries results in by-products that can be used directly as raw materials in various manufacturing processes or converted into valuable products . Therefore, developing a process in a sustainable manner entails utilizing the process by-products rather than their disposal. Due to presence of impurities in by-product streams, further downstream purification is required to meet the desired purity level.

Solvent-aided melt crystallization is a promising technology for purification of relatively viscous melts. However, the choice of solvent has a significant effect on thermodynamics and crystallization kinetics. This study aimed to examine and compare the impact of use of different additives, single[1] and binary solvents, on crystal growth rate and the purification of glycerol as a by-product of a bioprocess. The different compositions of solvents within the solubility range in the targeted component were evaluated based on liquid-liquid phase equilibrium data estimated by Aspen plus V11.0 software. The influence of each solvent system on melting point depression of the melt was estimated by modified UNIFAC Dortmund model. The kinetics of layer crystallization of each system were evaluated using in-situ image analysis maintained at different crystallization driving force based on predicted solid-liquid equilibrium data. The effect of solvent on purity of final products were evaluated by high-performance liquid chromatography (HPLC). The results ultimately lead to optimization of the process in terms of operating conditions and more efficient use of the solvent, leading to improved downstream purification performance and product quality.

Reference

(1) Eisenbart, F. J.; Ulrich, J. Solvent-Aided Layer Crystallization—Case Study Glycerol–Water. Chem Eng Sci 2015, 133, 24–29. https://doi.org/https://doi.org/10.1016/j.ces.2014.12.060.

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