

Scale-up of industrial biodiesel production to 40 m³ using a liquid lipase formulation - DTU Orbit (08/11/2017)

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In this work, we demonstrate the scale-up from an 80 L fed-batch scale to 40 m³ along with the design of a 4 m³ continuous process for enzymatic biodiesel production catalysed by NS-40116 (a liquid formulation of a modified *Thermomyces lanuginosus* lipase). Based on the analysis of actual pilot plant data for the transesterification of used cooking oil and brown grease, we propose a method applying first order integral analysis to fed-batch data based on either the bound glycerol or free fatty acid content in the oil. This method greatly simplifies the modelling process and gives an indication of the effect of mixing at the various scales (80L to 40m³) along with the prediction of the residence time needed to reach a desired conversion in a CSTR.

Suitable process metrics reflecting commercial performance such as the reaction time, enzyme efficiency and reactor productivity were evaluated for both the fed-batch and CSTR cases. Given similar operating conditions, the CSTR operation on average, has a reaction time which is 1.3 times greater than the fed-batch operation.

We also showed how the process metrics can be used to quickly estimate the selling price of the enzyme. Assuming a biodiesel selling price of 0.6 USD/kg and a one-time use of the enzyme (0.1% (w/w_{oil}) enzyme dosage); the enzyme can then be sold for 30 USD/kg which ensures that that the enzyme cost is not more than 5% of the biodiesel revenue. This article is protected by copyright. All rights reserved

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