

Soybean Oil Epoxidation: Kinetics of the Epoxide Ring Opening Reactions

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Abstract

ABSTRACT The epoxide ring opening reaction (ROR) can be considered the most important side reaction occurring in the epoxidation of soybean oil reaction network. This reaction consistently reduces the selectivity to epoxidized soybean oil (ESBO). In this work, this reaction has been studied in different operative conditions to evaluate the effect on ROR rate of respectively: (i) the Bronsted acidity of the mineral acid (H₂SO₄ or H₃PO₄), used as catalyst for promoting the oxidation with hydrogen peroxide of formic to performic acid, that is, the reactant in the epoxide formation; (ii) the concentration of the nucleophilic agents, normally present during the ESBO synthesis like HCOOH, HCOOOH, H₂O, H₂O₂; (iii) the stirring rate that changes the oil-water interface area; (iv) the adopted temperature. Many different kinetic runs have been made, in different operative conditions, starting from an already epoxidized soybean oil. On the basis of these runs two different reaction mechanisms have been hypothesized, one promoted by the Bronsted acidity mainly occurring at the oil-water interface and one promoted by the nucleophilic agents, in particular by formic acid. As it will be seen, the kinetic laws corresponding to the two mentioned mechanisms are quite different and this explain the divergent data reported in the literature on this subject. All the kinetic runs have been correctly interpreted with a new developed biphasic kinetic model.

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