Direct synthesis of propylene oxide in a packed bed membrane reactor

E. Kertalli, N. Kosinov, J.C. Schouten, T.A. Nijhuis

PII: S1385-8947(16)31030-0
DOI: http://dx.doi.org/10.1016/j.cej.2016.07.084
Reference: CEJ 15533

To appear in: *Chemical Engineering Journal*

Received Date: 16 February 2016
Revised Date: 21 July 2016
Accepted Date: 22 July 2016

Please cite this article as: E. Kertalli, N. Kosinov, J.C. Schouten, T.A. Nijhuis, Direct synthesis of propylene oxide in a packed bed membrane reactor, *Chemical Engineering Journal* (2016), doi: http://dx.doi.org/10.1016/j.cej.2016.07.084

Direct synthesis of propylene oxide in a packed bed membrane reactor

E.Kertalli[a], N. Kosinov[b], J. C. Schouten[a,*], T. A. Nijhuis[c]

[a]*Department of Chemical Engineering and Chemistry, Laboratory of Chemical Reactor Engineering, Eindhoven University of Technology, P.O. Box 513, 5600 MB, Eindhoven, The Netherlands*
[b]*Schuit Institute of Catalysis, Laboratory of Inorganic Materials Chemistry, Eindhoven University of Technology, PO Box 513, 5600 MB Eindhoven, The Netherlands*
[c]*Sabic, Geleen, The Netherlands*

Abstract

In the present work, the direct synthesis of propylene oxide (PO) in the liquid phase is successfully performed in a packed bed membrane reactor. We show that this engineering device can be implemented under mild reaction conditions (low temperature and pressure) and outside the explosive regime (low hydrogen concentration), making it appealing for industrial applications. The ceramic membrane allows for a separate feed of the reactants, therefore addressing the PO selectivity issue related to the propylene hydrogenation. The reaction is operated in a continuous methanol flow fed with propylene inside the tubular membrane; hydrogen and oxygen are fed through the porous material. We observe that the feeding strategy of the reactants has an important effect on key parameters such as PO selectivity and productivity. By separating propylene from hydrogen, the propane formation was reduced with respect to conventional packed bed reactors. Moreover, the addition of small amounts of NaBr to the reaction medium increases the catalytic activity to PO, but also to propane formation. Therefore, this study provides a good starting point in the design of a membrane reactor device for the direct synthesis of PO where the main limitations such as propylene hydrogenation and water formation can be addressed.

*Corresponding author
Email address: j.c.schouten@tue.nl (J. C. Schouten)