Kinetics of the HPPO Process

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Propene oxide (PO) is a highly reactive chemical used as an intermediate for the production of numerous commercial materials such as polyether polyols (polyglycol ethers), propene glycols and propene glycol ethers [1,3]. Nowadays, several routes to produce PO are possible and chemical plants based on these technologies are already running [1,4]; among them, the most convenient one, in terms of both economy of the process and environmental impact, is the direct epoxidation of propene with hydrogen peroxide (HPPO - Hydrogen Peroxide Propene Oxide) [1,5] in the presence of titanium silicalite-1 as catalyst (TS-1) [6-10] and methanol as solvent. By using this catalyst, the reaction is normally carried out under mild conditions (40-50 °C and 20-30 bar), and theoretically, only water is generated as byproduct (see scheme 1).

![Scheme 1 – Epoxidation of propene](image-url)

In 2008, after about 25 years from the first ENI patent, Evonik (former Degussa) and SKC have launched the first commercial-scale propene oxide plant, based on the HPPO technology [1], with a capacity of 100 ktons/year. The next year BASF and DOW Chemical started with a new plant based on a similar technology, with a 300 ktons/year capacity [1]. After that, some new plants were put on stream or are under construction [1,11-13].

Despite this high industrial interest, only few papers have been published till now concerning about the principal reaction [14,15] but no information can be found in the literature about regarding the side-reactions that reduce the yield of the process and increase the costs of PO purification.

For this reason, a dedicated experimental investigation of the HPPO kinetics, performed in batch and fed-batch reactors, concerning all the possible reactions that are involved in the reaction network, has been performed. All the obtained data have been interpreted with general kinetic laws. These expressions, and the related parameters, can be useful to maximize the HPPO process in terms of safety and productivity.

References


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