

# PRODUCTION OF PROPYLENE OXIDE FROM PROPYLENE GLYCOL

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## ABSTRACT

The primary goal of this research was to find a renewable synthesis method for the production of propylene oxide. Significant quantities of glycerin are formed as a co-product when soybean oil is used to produce bio-diesel. This glycerin can be used to produce propylene glycol, which can undergo dehydration over basic catalysts to produce propylene oxide (PO), along with eight other products: acetaldehyde, propionaldehyde, acetone, 2-propanol, 1-propanol, allyl alcohol, acetol, and dipropylene glycol. A variety of catalysts were prepared for each set of reactions, and dehydration was carried out in a plug flow reactor. For this thesis, only three main catalysts are presented, such as  $Na/Al_2O_3$  (sodium acetate on alumina), Cs-ETS-10, and Na acac/MgO (sodium acetyl acetonate on nanocrystalline MgO). Dehydration reactions were performed with different masses of catalyst, reactor temperatures, and residence times to optimize the selectivity to PO. The highest selectivity to PO was obtained as 12.33% for Na acac/MgO catalyst at 400° C, 0.1g, and a  $N_2$  flow rate of 20SCCM. Even though Cs-ETS-10 catalyst was active for PO production, it also produced higher amounts of dipropylene glycol (80%). Dipropylene glycol appears to act as an active intermediate in the dehydration of propylene glycol to propylene oxide over Cs-ETS-10 catalyst, which would limit PO selectivity to 50%. The  $Na/Al_2O_3$  resulted in low selectivity of 2% to PO, although it gave an appreciable selectivity of 60% to propionaldehyde. The reaction pathway to PO over these catalysts was also studied. Dehydration of propylene glycol to propylene oxide over  $Na/Al_2O_3$ , and Na acac/MgO catalysts appears to be a direct dehydration, rather than the involvement of a dipropylene glycol active intermediate.