

Public Abstract

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Title: Catalytic Conversion of Glycerol to Propylene Glycol: Synthesis and Technology Assessment

This research is focused on developing a method that is applicable to the industrial-scale production of propylene glycol from glycerol with considerably high conversions and yields. The fundamental understanding behind this glycerol technology paves the way for future work on exploring some more commodity chemicals that will be derived from natural resources. The primary goal of this study is to convert glycerol to propylene glycol at lower temperatures and pressures than the multiple processes reported in the patent literature. A secondary goal is to attain high selectivity to propylene glycol with little selectivity towards ethylene glycol and other by-products.

Acetol was successfully isolated from dehydration of glycerol as the transient intermediate indicates that the reaction process for producing propylene glycol with high selectivity can be done in two steps. Reactive distillation technology was employed to shift the equilibrium towards the right and achieve high yields. High acetol selectivity levels (>90%) have been achieved using copper-chromite catalyst in semi-batch reactive distillation. This catalytic process provides an alternative route for the production of propylene glycol from renewable resources.

The low-pressure vapor-phase catalytic processing using copper-chromite catalyst has been proven as feasible for producing propylene glycol from glycerol. This approach was demonstrated in a continuous process to address the concerns of scalability and suitability for large scale production. The vapor-phase reaction approach allows glycerol to be converted to propylene glycol in a single reactor. Single-pass yields in excess of 50% and with 100% conversion of glycerol have been attained. Recycle schemes can minimize any adverse impact of propylene glycol yields less than 100%. A two-step reaction process to produce propylene glycol from glycerol via an acetol intermediate was proposed and validated. A large scale process is thereby potentially viable.