## Public Abstract

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Title: Equilibrium Limitations and Selectivity on Conversion of Glycerol to Propylene glycol.

This research focuses on developing a technology to quantify the glycerol to propylene glycol reaction at lower temperatures and pressures using concentrated glycerol while simultaneously achieving high selectivity towards propylene glycol and little or no selectivity towards ethylene glycol or other byproducts. The research emphasis of this project was to verify the equilibrium limitations and selectivity on conversion of glycerol to propylene glycol. For this emphasis during the research, glycerol, acetol, and propylene glycol were used as reagents. Reactions were carried out at 180, 200, 220, and 240ºC and at a system pressure of 1, 2, and 4 bars in the presence of a copper-chromite catalyst. The effect of temperature, pressure, residence time, water content, and H2: Glycerol mole ratio were evaluated. All results indicate that lower temperatures and higher pressures promote the selectivity on conversion of glycerol to propylene glycol. The amount of byproducts decreased with decreasing the residence time. Product quality correlates with lower water content. Catalyst productivity increased with decreasing H2: Glycerol mole ratio. An optimal H2: Glycerol mole ratio is near 15:1. Lower temperatures (220ºC) are the preferred operated conditions to increase the catalyst productivity. The results are also fully consistent with a two-step reaction in which the second step of conversion of acetol to propylene glycol is equilibrium limited. This equilibrium has an exothermic heat of reaction, and so, lower temperatures lead to more-favorable conversions.

This research provides a renewable and non-toxic alternative to commercially available toxic ethylene glycol antifreeze product.