

Comparison study of plug flow and batch reactors for the reaction of glycerol with tert-butanol catalyzed over Amberlyst-70

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The reaction of glycerol with tert-butanol (TBA) on the sulfonated carbon catalyst (Amberlyst-70) was carried out in a plug flow and batch reactor for producing value added products, gasoline and diesel fuels additives. The reaction was performed under the temperatures ranged from 160°C to 190°C and the pressure ranged from 50atm to 70atm. The results showed that the conversion of glycerol to react with TBA in the plug flow system was significantly decreased from 100% to 70% within 4hr. This reaction was based a molar ratio of TBA to glycerol of 4:1 in the flow rate of 0.5mL/min or weight hour space velocity (WHSV=1.2) at the pressure of 50atm and temperature of 180°C. Meanwhile, no tri-butyloxy glycerol ether (TBGE) and low boiling point hydrocarbons (HCs) was found in plug flow reactor. On the contrary, they were found in the batch reactor, and the catalyst decade was slight to compare with the plug flow reactor. There is possible reason for the active sites of A-70 catalysts, sulfonated group, rapidly leached away by the flow stream of reactant and product during the reaction. Finally, the product mixtures was cooled down directly separating into oil phase (including TBGE and HCs) and water phase (including glycerol) at reaction temperature > 180°C in batch reactor. A high octane number (>100) of distilled oil was obtained from simple distillation at 225°C. It could be a candidate of fuel additive for gasoline (bio or petroleum). The composition of products were also analyzed by GC/MS and quantified by GC and Karl Fisher.

Keyword: glycerol, tert-butanol, fixed bed reactor, oxygenated additive.

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