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Comparison of Catalyst Support for High Pressure Reductive Amination

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Abstract : Polyether amines synthesize by secondary hydroxyl polyether diol play an important role in epoxy hardener. The low molecular weight product is used in low viscosity and high transparent polyamine product for the logo, ground cover, especially for wind turbine blade, while the high molecular weight products are used in advanced agricultures such as a high-speed railway. High-pressure reductive amination process is required for producing these amines. In the condition of higher than 150 atm pressure and 200 degrees Celsius temperature, supercritical ammonia is used as a reactant and also a solvent. It would be a great challenge to select a catalyst support for such high-temperature alkaline circumstance. In this study, we have established a six-autoclave-type (SAT) high-pressure reactor for amination catalyst screening, which six experiment conditions with different temperature and pressure could be examined at the same time. We synthesized copper-nickel catalyst on different shaped alumina catalyst support and evaluated the catalyst activity for high-pressure reductive amination of polypropylene glycol (PPG) by SAT reactor. Ball type gamma alumina, ball type activated alumina and pellet type gamma alumina catalyst supports are evaluated in this study. Gamma alumina supports have shown better activity on PPG reductive amination than activated alumina support. In addition, the catalysts are evaluated in fixed bed reactor. The diamine product was successfully synthesized via this catalyst and the strength of the catalysts is measured. The crush strength of blank supports is about 13.5 lb for both gamma alumina and activated alumina. The strength increases to 20.3 lb after synthesized to be copper-nickel catalyst. After test in the fixed bed high-pressure reductive amination process for 100 hours, the crush strength of the used catalyst is 3.7 lb for activated alumina support, 12.0 lb for gamma alumina support. The gamma alumina is better than activated alumina to use as catalyst support in high-pressure reductive amination process.

Keywords : high pressure reductive amination, copper nickel catalyst, polyether amine, alumina
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