188f Functionalized Membranes for Acid Catalysis

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Acid catalysts are vital to the chemical industry. One important transformation that benefits from acid catalysis is esterification. Solid acid catalysis using a variety of commercially available polymeric ion-exchange resins (IERs) can overcome process difficulties such as liquid acid disposal, corrosion, and other hazard encountered with homogeneous catalysts. However, particle attrition and diffusional mass transfer resistance limit the utility of these processes. This presentation deals with the application of functionalized microfiltration membranes as a heterogeneous solid phase catalyst for the esterification reaction between ethanol and acetic acid. Catalyst sites are provided by sulfonated polystyrene grafts immobilized in the membrane pores.

Extensive tests on the activity of the modified catalytic membrane have shown an average conversion of 16% (acetic acid) with a residence time of less than 20 seconds. This was improved to greater than 65% at 70oC. Comparisons with sulfuric acid and IER showed improved performance due to two effects. First, the local concentration of catalyst was much higher in the membrane compared to the same equivalents of catalyst in solution (homogeneous). Second, transport of the reactants by convection greatly increases accessibility to reactive sites. The membranes were reasonably stable during formation, with no loss of grafted chains during activation with 0.5 N sulfuric acid. Degradation of the membrane grafts during flowthrough experiments has been mediated through increased graft molecular weight and through covalent bonding using free-radical polymerization.