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DEHYDRATION OF ISOBUTANOL TO ISOBUTENE IN A SLURRY REACTOR

Topical Report

Contractor:
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EXECUTIVE SUMMARY

The April 1990 Alternative Fuels Proposal to the Department of Energy (RFP #RP22-90PC90018) involved the development of new technology, based on the liquid phase process, for conversion of coal-derived synthesis gas to oxygenated hydrocarbon fuels, fuel additives, and fuel intermediates. The objective of this work was to develop a slurry reactor based process for the dehydration of isobutanol to isobutene. The isobutene can serve as a feedstock for the high octane oxygenated fuel additive methyl tertiary-butyl ether (MTBE).

Alumina catalysts were investigated because of their wide use as a dehydration catalyst. Four commercially available alumina catalysts (Catapal B, Versal B, Versal GH, and Al-3996R) were evaluated for both activity and selectivity to the branched olefin. All four catalysts demonstrated conversions greater than 80% at 290°C, while conversions of near 100% could be obtained at 330°C. The reaction favors low pressures and moderate to low space velocities.

A yield of 0.90 mole isobutene per mole reacted isobutanol or better was obtained at conversions of 60-70% and higher. From 75 to 98% conversion, the four catalysts all provide isobutene yields ranging from 0.92 to 0.94 with the maximum occurring around 90% conversion. At low conversions, the concentration of diisobutyl ether becomes significant while the concentration of linear butenes is essentially a linear function of isobutanol conversion.

Doping the catalyst with up to 0.8 wt % potassium showed a modest increase in isobutene selectivity; however, this increase was more than offset by a reduction in activity. Investigations using a mixed alcohols feed (consistent with isobutanol synthesis from syngas) demonstrated a small increase in the C4 iso-olefin selectivity over that observed for a pure isobutanol feed.

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