Effect of the experimental variables on the one-step methyl isobutyl ketone synthesis from 2-propanol: Catalyst and reaction condition optimization

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Abstract

A one-step, gas-phase process for methyl isobutyl ketone (MIBK) synthesis from 2-propanol is studied as an alternative to the commercial process from acetone and hydrogen at high pressures. A bifunctional metallic copper/acid-base oxide catalyst (Cu-Mg-Al), able to operate at mild temperatures and atmospheric pressure, was developed for this process. Copper was chosen for its ability to convert alcohols to carbonyl compounds without breaking the C-O bond, whereas the Mg and Al cations were included to generate mixed oxides of moderate acid and base properties that are essential for MIBK formation. This catalyst promotes all the reaction steps involved in the synthesis from 2-propanol: The metallic site participates in the hydro-dehydrogenation steps whereas the acid-base pair site promotes the C-C bond forming aldol condensation reaction. The effect of different experimental conditions such as contact time, reaction temperature and atmosphere (N_2 or H_2) was investigated, as well as those of catalyst copper content and acid-base properties. By operation at 533 K and atmospheric pressure in N_2 using a Cu-Mg-Al (6.4 wt.% Cu) catalyst, a MIBK yield of 27 % was obtained. This value is similar to the 30 % of the current commercial process from acetone and H_2 at high pressures.

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