Experimental assessment of the selective dehydration of 2,3-butanediol into 3-buten-2-ol and 1,3-butadiene

*Beruk A. Bekele, Jeroen Poissonnier, Joris W. Thybaut**

Laboratory for Chemical Technology, Technologiepark 125, B−9052 Gent, Belgium

The selective dehydration of 2,3-butanediol (BDO) is currently being investigated as a potential renewable route for 1,3-butadiene (BD) production. Different researchers have investigated this reaction using a variety of catalysts at atmospheric pressure and different temperatures in the range of 250°C to 500 °C. Satoshi Sato et al. have studied all rare earth oxides and some transition metal oxides obtaining a maximum selectivity towards BD of 88% at complete conversion [1]. Tsukamato et al have also studied the reaction and obtained 91% selectivity at full conversion using CsH_2PO_4 [2]. Keith L. Hohn et al. have studied the two high surface area forms of Al_2O_3 (SCFa and F200) to investigate the effect of basic sites [3].

In the present work, the dehydration kinetics of 2,3-butanediol into 1,3-butadiene and its side reactions are investigated through the measurement of intrinsic kinetic reaction rates, preceded by a thermodynamic analysis [3]. The experiments are being performed over two different catalysts, i.e. ZrO_2 and a zeolite (ZSM-5). On the one hand the selectivity to 3-buten-2-ol is expected to peak at 325°C on ZrO_2 at about 50% [1]. On the other hand, ZSM-5 is selected because of its potential to perform the successive dehydration of 3-buten-2-ol selectively to BD, while being stable and commercially available [3]. Experiments are performed in a gas phase Berty type [4] of reactor at temperatures ranging from 300°C to 400°C as shown to be a suitable range for the formation of 3-buten-2-ol and BD from BDO [1,2,3]. Total pressures, in the range of 0.75 to 1.25 MPa, are applied at varying space times, an inlet molar ratio of water to BDO of 96 mol mol^{-1} and an inlet molar ratio of H_2 to BDO in the range 20 to 80 mol mol^{-1}. Moreover, intrinsic kinetics of the reaction will be revealed within this range of operating conditions.

References

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E-mail: joris.thybaut@ugent.be

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