High yield of isosorbide production from sorbitol dehydration catalysed by Amberlyst 36 under mild condition

Muhammad Ridzuan Kamaruzaman[a], *Xiao Xia Jiang*[b,c], *Xiu De Hu*[c], *Sim Yee Chin*[a,d,*]

[a]Faculty of Chemical & Process Engineering Technology, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Gambang, Kuantan, Pahang, Malaysia

[b]School of Mechanical Engineering, Ningxia University, 750021 Ningxia, Yinchuan, China

[c]State Key Laboratory of High efficiency Utilization of Coaland Green Chemical Engineering, Ningxia University, 750021 Ningxia, Yinchuan, China

[d]Center of Excellence for Advanced Research in Fluid Flow, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Kuantan, Pahang, Malaysia

ABSTRACT

Isosorbide (ISB), one of the important polyols, can be produced through the sequential intramolecular dehydration of sorbitol (SL) derived from an abundance renewable biomass resources. The advantages of its rigid structure have granted the ISB a wide application in the polymer industries. An acidic catalyst in the liquid phase was conventionally used in the dehydration process. This homogeneously catalysed reaction gave low ISB yield and required additional downstream processes to separate the catalyst. The present study employed solid acidic ion exchange resin, Amberlyst 36 in the SL dehydration at a mild condition. The effect of important operating parameters such as stirring speed, catalyst loading, temperature and reaction time was investigated. The increase of catalyst loading from 5 to 7 wt% did not significantly affect the ISB yield. A higher temperature increased the reaction rate whereas a prolonged reaction time increased the conversion of SL and yield of ISB to the maximum. In terms of giving a higher ISB yield during SL dehydration, AM 36 was found to outperform the other resin catalysts reported in the literature. Both SL conversion and ISB yield of>99% were recorded after a 4 h reaction at 423 K with catalyst loading of 5 wt% and stirring speed of 300 RPM. The reaction kinetics was evaluated under a mass transfer resistances free condition at the reaction temperature ranged from 373 K to 423 K. The kinetic data well fitted to the Langmuir-Hinshelwood (LH2) model that took side reaction into account. The activation energy for dehydration SL to ST, dehydration ST to ISB and dehydration of SL to other side products such as humins were 109.22, 109.46 and 104.17 kJ/mol respectively.

KEYWORDS: Sorbitol dehydration; Kinetic modeling; Sorbitan; Isosorbide

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