Catalytic Synthesis of Ethylene from Ethanol Dehydration over Palm Oil Clinker derived Mesoporous SBA-15 : Effects of Physicochemical Properties on Ethylene Formation

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Abstract:
The current study investigated on the ethanol (C2H5OH) dehydration for ethylene (C2H4) production over commercial SBA-15 (SBA-15(Comm.)) and palm oil clinker derived SBA-15 (POC-SBA-15) with pH 3, 5, and 7. The fresh catalysts were characterized by XRD, BET, N2 isotherm, FTIR, TEM, FESEM and NH3-TPD, and confirmed the successfully formation of POC-SBA-15 by comparing with SBA-15(Comm.). At the reaction temperature range 200-400 °C, all the POC-SBA-15 catalysts performed better than SBA-15(Comm.), in which the POC-SBA-15(pH 5) exhibited the best catalytic activity. Overall, C2H5OH conversion and C2H4 selectivity increased in the order of SBA-15(Comm.) < POC-SBA-15(pH 3) < POC-SBA-15(pH 3) < POC-SBA-15(pH 3). The superiority of POC-SBA-15(pH 5) can be attributed to the enriched weak acid sites that aid in protonating the hydroxyl (-OH) group of C2H5OH. Spent catalysts characterizations confirmed the least coke deposition on POC-SBA-15(pH 5). The best catalyst was then investigated in term of C2H5OH concentration and weight hourly space velocity (WHSV) in the function of temperature. C2H5OH concentration tended to affect the C2H4 selectivity more apparent than C2H5OH. Highest C2H5OH conversion and C2H4 selectivity were achieved at 74.65% and 92.21%, respectively over POC-SBA-15 (pH 5) at reaction temperature of 400 °C, C2H5OH concentration of 50 wt.% and WHSV of 10,000 cm3/g.h.

Keywords : Ethanol Dehydration; Ethylene; Palm Oil Clinker; Mesoporous SBA-15.

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