

**KROMIUM/NANOZIRKONIA TERSULFATASI: PREPARASI,
KARAKTERISASI DAN APLIKASINYA SEBAGAI KATALIS
UNTUK KONVERSI PLASTIK MENJADI
BAHAN BAKAR CAIR**

LATIFAH HAULI
16/408188/SPA/00602

INTISARI

Preparasi, karakterisasi dan aplikasi katalis kromium/nanozirkonia tersulfatasi untuk mengonversi plastik menjadi bahan bakar cair telah dilakukan. Preparasi katalis nanozirkonia tersulfatasi (ZrO_2-SO_4) dilakukan dengan metode impregnasi basah dengan variasi konsentrasi H_2SO_4 0,2; 0,5 dan 0,8 M dan variasi temperatur kalsinasi 600; 700; 800 dan 900 °C selama empat jam. Katalis ZrO_2-SO_4 yang dihasilkan dikarakterisasi dengan menggunakan FTIR, XRD dan SEM-EDS. Nilai keasaman katalis diukur dengan menggunakan metode adsorpsi basa amonia. Katalis ZrO_2-SO_4 dengan keasaman yang paling tinggi diimpregnasi dengan logam Cr dengan variasi konsentrasi logam 0,5; 1 dan 1,5% (b/b). Metode impregnasi basah yang digunakan untuk modifikasi logam Cr pada ZrO_2-SO_4 adalah metode refluks. Katalis dikarakterisasi dengan menggunakan FTIR, XRD, XRF, SAA, SEM-Mapping dan TEM. Katalis Cr/ZrO_2-SO_4 yang dihasilkan dilakukan uji keasaman dengan metode adsorpsi basa amonia dan katalis yang dihasilkan digunakan untuk proses perengkahan plastik LDPE. Proses pirolisis plastik telah dilakukan sebagai langkah awal penyiapan umpan produk cair. Hidrorengkah plastik LDPE dilakukan pada variasi temperatur 200; 250; 300 dan 350 °C, variasi katalis, dan penggunaan kembali katalis bekas. Produk cair yang dihasilkan dikarakterisasi dengan GC-MS.

Hasil penelitian menunjukkan katalis ZrO_2-SO_4 0,8 M pada temperatur kalsinasi 600 °C memiliki puncak serapan spesifik sulfat paling tajam dan nilai keasaman paling tinggi yaitu 3,81 mmol/g. Keberadaan logam Cr pada ZrO_2-SO_4 0,8 M memberikan pengaruh pada peningkatan luas permukaan katalis untuk semua katalis yang terimpregnasi logam pada berbagai konsentrasi. Luas permukaan spesifik katalis dan nilai keasaman katalis paling tinggi dihasilkan oleh katalis 1,0% (b/b) Cr/ZrO_2-SO_4 yaitu masing-masing sebesar 14,56 m^2g^{-1} dan 8,22 mmol/g. Temperatur optimum pada reaksi hidrorengkah dihasilkan pada 250 °C. Produk cair paling tinggi dihasilkan oleh katalis 1,0% (b/b) Cr/ZrO_2-SO_4 sebanyak 40,99% dengan selektivitas produk cair pada fraksi bensin sebesar 38,06%. Penggunaan katalis bekas 1,0% (b/b) Cr/ZrO_2-SO_4 mampu stabil hingga tiga kali pengulangan.

Kata kunci: bahan bakar, katalis, kromium, plastik LDPE, zirkonia tersulfatasi

CHROMIUM/SULFATED NANOZIRCONIA: PREPARATION, CHARACTERIZATION AND APPLICATION AS CATALYST FOR PLASTIC CONVERSION INTO LIQUID FUEL

LATIFAH HAULI
16/408188/SPA/00602

ABSTRACT

Preparation, characterization, and catalytic activity test of sulfated nanozirconia (SZ) modified with chromium for hydrocracking of LDPE-based plastic waste have been investigated. SZ catalysts were prepared by wet impregnation with different concentrations of sulfuric acid (0.2, 0.5 and 0.8 M) and calcination temperatures (600, 700, 800 and 900 °C). The obtained SZ catalysts were characterized by FTIR, XRD and SEM-EDS. The acidity test of catalysts were conducted by ammonia adsorption method. SZ which had the highest acidity value was further modified with chromium (0.5, 1.0 and 1.5% wt. %) by refluxing method then characterized by FTIR, XRD, XRF, SAA, SEM-Mapping, TEM and acidity test by ammonia adsorption. The obtained catalysts were further used for hydrocracking of LDPE Plastic. The plastic pyrolysis process had been conducted as an initial step in preparing a liquid product feed. Hydrocracking of LDPE-based plastic waste was conducted at various temperatures and various catalysts. In addition, the optimum catalyst was repeatedly used for the reaction to demonstrate the stability of the catalyst. Liquid products obtained by the hydrocracking were characterized by GCMS.

The results showed that the 0.8 M SZ at 600 °C was the optimal condition with the highest acidity value of 3.81 mmol/g and it has the highest specific adsorption band. The presence of Cr on SZ could increase the specific area of catalysts. The highest specific area and acidity value were obtained by Cr/SZ with 1.0 wt.% of 14.56 m²g⁻¹ and 8.22 mmol/g, respectively. The effective temperature for hydrocracking was 250 °C. The highest selectivity to liquid product and gasoline fraction were 40.99% and 38.06%, respectively. Hydrocracking of plastic waste over the used Cr/SZ catalyst with 1.0 wt.% Cr showed that Cr/SZ catalyst was stable and reusable up to three repetitions.

Keywords: catalyst, chromium, fuel, LDPE plastic, sulfated zirconia