HYDROGEN PRODUCTION FROM ACETIC ACID-PHENOL STEAM REFORMING OVER BIMETALLIC NICKEL-COBALT SUPPORTED ON LANTHANUM OXIDE-GAMMA ALUMINUM OXIDE CATALYST

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To my beloved Prophet ***Mohammad SalawatoAllah Aleyh***

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ABSTRACT

Hydrogen has been recognized as a sustainable and renewable energy carrier for the portable application. Acetic acid and phenol are considered as the unwanted product in the bio-oil derived from the pyrolysis of biomass. This study is to propose the catalytic steam reforming of the mixture over bimetallic Nickel-Cobalt (Ni-Co) supported on Lanthanum (III) Oxide (La2O3) and gamma-aluminum oxide (γ-Al2O3). The scope of works including the catalyst characterization and the catalyst testing in a fixed bed reactor operated at ambient pressure. The catalyst performance tests are carried out in a fixed bed reactor at atmospheric pressure and temperature from 600°C to 800°C to compare the catalyst dilution, feed flow rate in the range of 0.16 to 0.56 mL/min, and the catalyst weight of 0.1 to 0.3 g. The acidity of the prepared catalyst is less than γ-Al2O3 but higher than La2O3. The total surface area of the fresh catalyst decreased by exposing in the reaction from 48 to 30 m2/g. It was found that the maximum feed conversion achieved 99.99% for acetic acid and 95.5% conversion for phenol at 800 oC in the effect of temperature by using catalyst dilution of silicone carbide (SiC). Instead, hydrogen yield and mole fraction decreased with the presence of dilution. The highest temperature of 800 oC in this study, and the other parameters like 0.2 gram catalyst and 0.36 ml/min flow rate achieved the highest hydrogen gas which was about 98%. It was resulted that the presence of SiC was able to increase the conversion of feed due to extension of residence time but it affected negatively in hydrogen yield. Hydrogen production also increased by increasing of phenol and acetic acid concentration. The catalyst did not show a significant deactivation for the period of study. This catalyst is promising for the real application.

ABSTRAK

Hidrogen telah dikenalpasti sebagai pembawa tenaga mampan dan boleh diperbaharui untuk aplikasi mudah alih. Asid asetik dan fenol dianggap sebagai produk yang tidak diingini di dalam bio-minyak yang diperolehi daripada pirolisis biojisim. Kajian ini mencadangkan pembaharuan stim bermangkin campuran terhadap dwi-logam Nikel Cobalt (Ni-Co) yang disokong pada Lantanum (III) Oksida (La2O3) dan gamma-aluminium oksida (γ-Al2O3). Skop kajian ini merangkumi pencirian pemangkin dan ujian pemangkin di dalam reaktor katil tetap yang beroperasi pada tekanan ambien. Ujian prestasi pemangkin dijalankan di dalam reaktor katil tetap pada tekanan atmosfera dan suhu 600 oC hingga 800 oC untuk mmbandingkan pencairan pemangkin, kadar aliran suapan antara 0.16 mL/min hingga 0.56 mL/min dan berat pemangkin dari 0.1g hingga 0.3g. Tahap keasidan bagi pemangkin yang disediakan adalah lebih rendah daripada γ-Al2O3 tetapi lebih tinggi dariapada La2O3. Luas permukaan untuk pemangkin segar berkurangan daripada 48 kepada 30 m2/g kesan penggunaan daripada reaksi. Adalah didapati bahawa penukaran makanann suapan maksimum mencapai 99.99% untuk asid asetik dan 95.5% penukaran untuk fenol pada suhu 800 oC di atas kesan suhu dengan menggunakan pemangkin pencairan. Sebaliknya, pemilihan dan pecahan mol hydrogen berkurang dengan kumunculan pemangkin pencairan. Suhu tertinggi 800 oC dan parameter lain seperti 0.2 gram pemangkin dan 0.36 mL/min kadar aliran menghasilkan gas hidrogen yang tertinggi iaitu sekitar 98% bagi kedua-dua komponen. Adalah ditunjukkan bahawa kehadiran silicon karbida (SiC) mampu meningkatkan asid asetik dan penukaran fenol disebabkan lanjutan masa yang tinggal tetapi ia memberi kesan negatif kepada pemilihan hidrogen. Penyahaktifan pemangkin yang ketara tidak diperhatikan sepanjang masa kajian. Pemangkin tersebut berpotensi untuk penggunaan sebenar.