Hydrotreating minyak kemiri sunan dengan katalis NiMo/-Al2O3 untuk pembuatan bahan bakar diesel terbarukan = Hydrotreating of kemiri sunan oil over NiMo/-Al2O3 catalyst for renewable diesel production

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Abstrak

Bahan bakar minyak memainkan peran yang sangat penting dalam pengembangan industri, transportasi, pertanian serta aktivitas manusia lainnya. Bahan bakar minyak yang umum digunakan adalah bahan bakar berbasis fosil yang jumlahnya terbatas, tidak terbarukan serta berdampak negatif terhadap lingkungan. Oleh karena itu dewasa ini penelitian dan produksi bahan bakar bersih dan terbarukan berbasis minyak nabati dan lemak hewani marak dilakukan. Biodiesel sebagai bahan bakar nabati yang populer untuk substitusi minyak diesel konvensional didapati masih banyak kelemahan baik di dalam proses produksinya maupun dari kualitas produk biodiesel itu sendiri. Oleh karena itu dibutuhkan teknologi konversi minyak nabati yang lebih efisien dan menghasilkan bahan bakar setara solar atau yang dikenal renewable diesel.
Teknologi hydrotreating katalitik sebagai existing technology di kilang pengolahan minyak bumi memiliki kemampuan untuk mengkonversi baik trigliserida maupun asam lemak bebas melalui satu tahap reaksi menjadi hidrokarbon jenis parafinik setara minyak diesel konvensional yang tidak mengandung senyawa oksigen sehingga stabilitasnya lebih baik dari biodiesel. Proses Hydrotreating katalitik berbasis NiMo/-Al2O3 yang dikerjakan dalam penelitian ini bertujuan untuk mendapatkan produk minyak diesel terbarukan (Renewable Diesel) setara minyak diesel konvensional dengan menggunakan umpan minyak kemiri sunan yang pemanfaatannya masih menggunakan proses transesterifikasi menghasilkan produk biodiesel.
Penelitian ini dilakukan dalam tiga tahap yaitu preparsi katalis, karakterisasi katalis dan sintesis renewable diesel dengan proses hydrotreating. Hasil katalis yang telah dipreparasi dilakukan karakterisasi dengan Brunaur Emmet Teller (BET) dan didapat luas permukaan 105.5 m2/g serta volume dan diameter pori masing-masing sebesar 0.1842 cc/g dan 34.93 A0. Kemudian identifikasi dengan X-ray diffraction (XRD) menunjukan keberadaan logam Mo dan persebarannya dalam support yang cukup merata.
Hasil Scanning Electron Microscope (SEM) yang diperkuat X-ray Energy Dispersive (EDX) menggambarkan keberadaan logam Ni dan Mo dalam suatu komposisi mikro dan tekstur persebaran dari logam-logam aktif yang cukup merata. Produk hasil proses hydrotreating dengan variasi tekanan, suhu dan rasio berat katalis terhadap umpan minyak nabati dianalisis menggunakan Gas Chromatography (GC) dan dilakukan uji sifat fisika kimianya.
Hasil GC menunjukan kenaikan suhu dan tekanan operasi meningkatkan yield produk hidrokarbon range diesel dengan yield tertinggi sebesar 30.95% pada tekanan 60 bar dan suhu 400 0C. Nilai konversi dan selektifitas adalah masing-masing 33.48% dan 95.72% dengan arah reaksi cenderung ke mekanisme decarbonylation. Perubahan di dalam rasio berat katalis terhadap umpan minyak nabati tidak mempengaruhi yield produk secara keseluruhan. Analisis sifat fisika dan kimia terhadap produk sebelum dilakukan distilasi menunjukan penurunan nilai densitas, viskositas, angka iod dan angka asam yang cukup signifikan dan mendekati spesifikasi minyak diesel komersial.
.....Fuel plays a very important role in the development of industry, transportation, agriculture and other human activities. The ordinary fuel derived from fossils which has a limited reserves due to they are not

renewable and have a negative impact on the environment. Therefore, currently the research and production of clean and renewable fuels based on vegetable oils and animal fats had been conducted extensively. Biodiesel as a biofuel that is popular for the substitution of conventional diesel oil was found still has some weaknesses both in the production process as well as on the quality biodiesel product itself. Therefore a technology for conversion of vegetable oil in efficient way is needed to produce equivalent diesel fuel or renewable diesel.

Catalytic hydrotreating technology known as an existing technology in petroleum refineries has the ability to convert both triglycerides and free fatty acids through one reaction stage into hydrocarbons types paraffinic oil equivalent conventional diesel that contains no oxygen compounds thus better stability than biodiesel. Catalytic Hydrotreating process based on NiMo/-Al2O3 was conducted in this study aims to obtain renewable diesel oil products as well as conventional diesel oil using the feedstock of kemiri sunan oil which the utilization is still using the transesterification process to produce biodiesel.

This research was conducted in three phases, namely catalysts preparation, catalyst characterization and synthesis of renewable diesel by hydrotreating process.

The results of the prepared catalyst was characterized by Brunaur Emmet Teller (BET) and obtained 105.5 m2/g for the surface area and the pore volume and diameter of each are 0.1842 cc/g and 34.93 A0. Then identify with X-ray diffraction (XRD) showed the presence of metal Mo and spreading on the support of catalyst was fairly uniform. The results of Scanning Electron Microscope (SEM) were amplified Energy Dispersive X-ray (EDX) describes the presence of metal Ni and Mo in a micro composition and texture distribution of active metals are fairly evenly. Hydrotreating process products with variations in pressure, temperature and weight ratio of catalyst to feed vegetable oils were analyzed using Gas Chromatography (GC) and test of the physical and chemical properties.

GC results showed the increase in operating pressure and suhue increased the yield hydrocarbon products in the range diesel with the highest yield of 30.95% at a pressure of 60 bar and temperature of 400 0C. The conversion and selectivity is 33.48% and 95.72% where the reaction route tends to the decarbonylation mechanism. Changes in the weight ratio of catalyst to feed the vegetable oil did not affect the overall product yield. Analysis of physical and chemical properties of the product prior to distillation showed a decrease in the value of density, viscosity, iodine numbers and acid numbers are quite significant and closer specification commercial diesel oil.