

**SINTESIS MATERIAL SILIKA MESOPORI TERSULFATASI
TERIMPREGNASI NIKEL (Ni/SMS) SEBAGAI NANOKATALIS
DALAM KONVERSI SAMPAH PLASTIK LDPE MENJADI BAHAN
BAKAR FRAKSI GASOLIN**

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INTISARI

Preparasi, karakterisasi, dan aplikasi material nanokatalis silika mesopori tersulfatasi terimpregnasi logam nikel untuk mengkonversi sampah plastik LDPE menjadi bahan bakar fraksi gasolin telah dilakukan. Preparasi katalis silika mesopori (SiO_2) dilakukan dengan metode *sol-gel* dengan NaHCO_3 sebagai *template* mesopori. Katalis SiO_2 yang dihasilkan disulfatasi dengan metode refluks dengan variasi konsentrasi H_2SO_4 1; 1,5; dan 2 M. Katalis silika mesopori tersulfatasi (SMS) dengan keasaman tertinggi diimpregnasikan logam Ni dengan variasi 1%, 2%, dan 3% (b/b) dengan metode refluks. Material katalis SiO_2 , SMS, dan Ni/SMS dikarakterisasi dengan FTIR, XRD, XRF, SAA, FESEM-EDX *Mapping*, TEM, TGA, dan XPS. Selain itu, ketiga katalis dengan keasaman terbaik tersebut digunakan dalam proses perengkahan sampah plastik LDPE yang sebelumnya telah dipirolisis. Perengkahan dilakukan dalam dua variasi, yaitu perengkahan katalitik dan hidrorengkah katalitik. Selain itu, penggunaan berulang katalis dalam proses hidrorengkah dilakukan sebanyak tiga kali. Minyak produk pirolisis dan perengkahan dianalisis dengan GC-MS dan dilakukan uji nilai kalor serta hasilnya dibandingkan dengan gasolin komersial. Katalis yang telah dilakukan setelah proses hidrorengkah katalitik dan penggunaan berulang hidrorengkah katalitik dikarakterisasi dengan FESEM-EDX *Mapping* dan TEM.

Hasil penelitian menunjukkan bahwa sintesis katalis SiO_2 , SMS, dan Ni/SMS telah berhasil dilakukan. Sulfatasi SiO_2 menghasilkan katalis SMS-2 dengan keasaman terbaik. Sementara itu, impregnasi logam Ni pada SMS-2 menghasilkan katalis Ni 1/SMS-2 dengan keasaman terbaik. Pada hasil uji aktivitas dan selektivitas katalis pada hidrorengkah plastik LDPE menunjukkan persentase aktivitas dan selektivitas terbaik pada katalis Ni 1/SMS-2 dengan persentase konversi produk cair sebesar 53,9% dan persentase fraksi gasolin sebesar 44,59%. Katalis Ni 1/SMS-2 menunjukkan kemampuan *reusability* hingga 2 kali proses hidrorengkah dengan persentase konversi produk cair sebesar 64,50% dan persentase fraksi gasolin sebesar 41,43%.

Kata kunci: gasolin, hidrorengkah, impregnasi nikel, plastik LDPE, silika tersulfatasi.

SYNTHESIS OF NICKEL-IMPREGNATED SULFATED MESOPOROUS SILICA MATERIAL (Ni/SMS) AS A NANOCATALYST IN THE CONVERSION OF LDPE PLASTIC WASTE INTO GASOLINE FRACTION FUEL

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ABSTRACT

The preparation, characterization, and application of nickel-impregnated sulfated mesoporous silica material to convert LDPE plastic waste into gasoline fraction fuel have been carried out. Mesoporous silica (SiO_2) catalyst preparation was carried out using the sol-gel method with NaHCO_3 as the mesoporous template. The SiO_2 catalyst was sulfated using the reflux method with varying concentrations of 1; 1.5; and 2 M H_2SO_4 . The sulfated mesoporous silica (SMS) catalyst with the highest acidity was impregnated with Ni metal with varying of 1%, 2%, and 3% (w/w) using the reflux method. The SiO_2 , SMS, and Ni/SMS catalyst materials were characterized by FTIR, XRD, XRF, SAA, FESEM-EDX Mapping, TEM, TGA, and XPS. Apart from that, the three catalysts with the best acidity are used in the cracking process of LDPE plastic waste which has previously been pyrolyzed. Cracking was carried out in two stages, namely catalytic cracking and catalytic hydrocracking. In addition, the repeated use of the catalyst in the hydrocracking process was carried out three times. The pyrolysis and cracking product oil was analyzed using GC-MS and the calorific value was tested and the results were compared with commercial gasoline. The catalyst that had been carried out after the catalytic hydrocracking process and repeated use of catalytic hydrocracking was characterized using FESEM-EDX-Mapping and TEM.

The research results show that the synthesis of SiO_2 , SMS, and Ni/SMS catalysts have been successfully carried out. The SiO_2 sulfatation process produced the SMS-2 catalyst with the best acidity. Meanwhile, impregnation of Ni metal on SMS-2 produced Ni 1/SMS-2 catalyst with the best acidity. The LDPE plastic hydrocracking showing the best percentage of activity and selectivity on the Ni 1/SMS-2 catalyst with a liquid product conversion percentage of 53.9% and a percentage of the gasoline fraction of 44.59%. The Ni 1/SMS-2 catalyst shows reusability up to 2 times the hydrocracking process with a liquid product conversion percentage of 64.50% and a gasoline fraction percentage of 41.43%.

Keywords: gasoline, hydrocracking, LDPE plastic, nickel impregnated, sulfated silica.