

## SINTESIS KATALIS Ni, W, Ni-W/LEMPUNG TERPILAR SiO<sub>2</sub> DAN APLIKASINYA PADA PROSES *HYDROCRACKING* PLASTIK *HIGH DENSITY POLYETHYLENE* (HDPE) MENGHASILKAN HIDROKARBON FRAKSI BAHAN BAKAR MINYAK (BBM)

DARWANTA  
20/486179/SPA/00745  
INTISARI

Telah dilakukan sintesis katalis berbasis lempung terpillar silika (*Silica Pillared Clay* = SiPILC) berbahan dasar *Montmorillonite* dari lempung bentonit sebagai padatan pendukung logam katalis Ni, W dan perpaduannya. Tujuan riset ini menghasilkan katalis unggul dengan karakteristik optimum untuk proses *hydrocracking* plastik HDPE menghasilkan produk cair yang mengandung senyawa hidrokarbon fraksi Bahan Bakar Minyak (BBM).

SiPILC disintesis dari *Montmorillonite* dengan pengarah molekul *Cetyl Trimethyl Ammonium Bromide* (CTAB) dan *Tetra Ethyl Ortho Silicate* (TEOS) sebagai sumber silika dengan variasi rasio mol TEOS/*Montmorillonite*. Impregnasi logam Ni, W dan Ni-W pada SiPILC melalui metode impregnasi basah dengan variasi banyaknya logam yang diimpregnasikan. Karakterisasi lempung, SiPILC dan katalis hasil sintesis dilakukan dengan XRD, BET, FTIR, XRF, NH<sub>3</sub>-TPD, SEM-EDX dan TEM. Katalis hasil sintesis diuji aktivitas katalitiknya pada proses *hydrocracking* plastik HDPE. Produk cair hasil *hydrocracking* dikarakterisasi dengan GC-MS. Masing-masing katalis dikaji *reusability*-nya dan katalis penghasil produk cair terbanyak setelah diuji *reusability* 10 kali dilakukan regenerasi. Katalis regenerasi diuji aktivitas katalis pada proses *hydrocracking* plastik HDPE.

Hasil penelitian menunjukkan bahwa teknik isolasi dekantasi menghasilkan *Montmorillonite* 41,83% dan fraksi berat 58,17% serta meningkatkan nilai KTK-nya dari 49 meq/100 g menjadi 54,50 meq/100 g. SiPILC dengan rasio optimum mol TEOS/*Montmorillonite* = 60 memiliki tinggi pilar 14,34Å, luas permukaan spesifik tertinggi sebesar 570,66 m<sup>2</sup>/g yang sangat potensial sebagai padatan pendukung logam. Aktivitas katalis hasil sintesis pada keadaan optimumnya menghasilkan produk cair dan komposisi fraksinya adalah : Ni2%/SiPILC60 54,25% (78,36% bensin dan 21,64% solar), W6%/SiPILC60 59,39% (59,81% bensin dan 40,19% solar), Ni-W/SiPILC60 69,68% (39,72% bensin dan 60,28% solar). Katalis hasil sintesis masih menunjukkan aktivitas yang stabil dalam menghasilkan produk cair sampai penggunaan ulang 5 kali. Regenerasi katalis Ni-W/SiPILC60 bekas 10 kali pakai telah berhasil dilakukan dan dibuktikan dengan kembalinya aktivitas katalitik seperti katalis barunya. Katalis bimetal Ni-W/SiPILC60 lebih unggul dari monometalnya karena memiliki keunggulan sinergi bifungsional (hidrogenasi + *cracking*), dispersi logam, selektivitas produk cair dan kestabilan terhadap kokas yang lebih baik.

**Kata kunci:** katalis *hydrocracking*, lempung terpillar, plastik HDPE, produk cair, regenerasi katalis

**SYNTHESIS OF Ni, W, Ni-W/SiO<sub>2</sub> PILLARED CLAY CATALYSTS AND THEIR APPLICATION IN THE HYDROCRACKING PROCESS OF HIGH-DENSITY POLYETHYLENE (HDPE) PLASTIC TO PRODUCE LIQUID HYDROCARBON FUEL FRACTIONS**

**DARWANTA**  
**20/486179/SPA/00745**

**ABSTRACT**

Synthesis of a catalyst based on silica-pillared clay (Silica Pillared Clay = SiPILC) based on Montmorillonite from bentonite clay has been conducted as a supporting solid for Ni, W catalyst metals, and their combinations. This research aims to produce superior catalysts with optimal characteristics for the HDPE plastic hydrocracking process to produce liquid products containing Fuel Oil fraction hydrocarbon compounds.

SiPILC is synthesized from Montmorillonite with the molecular director Cetyl Trimethyl Ammonium Bromide (CTAB) and Tetra Ethyl Ortho Silicate (TEOS) as a silica source, with variations in the mole ratio of TEOS/Montmorillonite. The wet impregnation of Ni, W, and Ni-W metals on SiPILC has variations in the amount of metal impregnated. Clay, SiPILC, and synthesized catalysts were characterized with XRD, BET, FTIR, XRF, NH<sub>3</sub>-TPD, SEM-EDX, and TEM. The synthesized catalyst was evaluated for catalytic activity in the HDPE plastic hydrocracking process. GC-MS characterizes liquid products resulting from hydrocracking. Each catalyst was studied for reusability, and the catalyst that produced the most liquid products after being evaluated for reusability 10 times was regenerated. The regeneration catalyst was evaluated for catalyst activity in the hydrocracking process of HDPE plastic.

The results showed that the decantation isolation technique produced 41.83% Montmorillonite and a weight fraction of 58.17% and increased the cation exchange capacity value from 49 meq/100 g to 54.50 meq/100 g. SiPILC with an optimal mole ratio of TEOS/Montmorillonite = 60 has pillar height of 14.34 Å and the highest specific surface area of 570.66 m<sup>2</sup>/g, which has excellent potential as a metal support solid. The catalyst activity of the synthesis at its optimal state produces liquid products, and the composition of the fraction is: Ni<sup>2</sup>%/SiPILC60 54.25% (78.36% gasoline and 21.64% diesel), W<sup>6</sup>%/SiPILC60 59.39% (59.81% gasoline and 40.19% diesel), Ni-W/SiPILC60 69.68% (39.72% gasoline and 60.28% diesel). The synthesized catalyst still shows sTabel activity in producing liquid products until 5 reuses. The regeneration of the used Ni-W/SiPILC60 catalyst 10 times has been successfully conducted and is evidenced by the return of catalytic activity, such as that of the new catalyst. The Ni-W/SiPILC60 bimetallic catalyst is superior to its monometallic counterpart due to its bifunctional synergy (hydrogenation + cracking), metal dispersion, liquid product selectivity and better coke stability.

**Keywords:** hydrocracking catalyst, pillared-clay, HDPE plastic, liquid product, catalyst regeneration.