

## **SINTESIS KARBON MESOPORI (KM) DARI GELATIN TULANG SAPI, KATALIS NiMo/KM DAN MoNi/KM UNTUK HIDRORENGKAH PELUMAS BEKAS**

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### **INTISARI**

Sintesis karbon mesopori (KM) dari gelatin tulang sapi, NiMo/karbon mesopori (NiMo/KM) dan MoNi/karbon mesopori (MoNi/KM) sebagai katalis pada hidrorengkah pelumas bekas telah dilakukan. Gelatin diekstraksi dari tulang sapi dengan perlakuan larutan  $\text{CH}_3\text{COOH}$ ,  $\text{NaOH}$  dan  $\text{HCl}$ . KM disintesis menggunakan gelatin tulang sapi sebagai prekursor karbon dan material silika yaitu SBA-15 (*Santa Barbara Amorphous-15*) sebagai cetakan. Katalis NiMo/KM disintesis dengan cara mengembankan logam Mo terlebih dahulu kemudian logam Ni. Katalis MoNi/KM disintesis dengan cara mengembankan logam Ni terlebih dahulu kemudian logam Mo. Logam Ni dan Mo diimpregnasi pada KM menggunakan metode impregnasi basah. Logam Ni dan Mo masing-masing berasal dari larutan garam  $\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$  dan  $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24} \cdot 4\text{H}_2\text{O}$ . Material KM dianalisis dengan spektrofotometer infra merah (FT-IR), *Transmission electron Microscope* (TEM), *Scanning Electron Microscope-Energy Dispersive Spectroscopy* (SEM-EDS) dan *Surface Area Analyzer* (SAA) berdasarkan persamaan Brunauer-Emmet-Teller (BET). Katalis NiMo/KM dan MoNi/KM dianalisis dengan SEM-EDS dan SAA berdasarkan persamaan BET. Keasaman katalis ditentukan dengan metode gravimetri menggunakan uap basa amonia sebagai adsorbat. Uji aktivitas katalis dilakukan pada hidrorengkah pelumas bekas menggunakan reaktor *stainless steel* sistem *semibatch* pada suhu  $475^\circ\text{C}$ , laju alir gas hidrogen 20 mL/menit, dengan variasi rasio berat pelumas/katalis 50, 100, 200, 300 dan 400. Fraksi cair hasil hidrorengkah dianalisis menggunakan kromatografi gas-spektroskopi massa (GC-MS).

Hasil penelitian menunjukkan bahwa material KM memiliki struktur mesopori teratur dengan diameter pori, luas permukaan, volume pori total, dan keasaman masing-masing sebesar 7,523 nm; 404,471  $\text{m}^2/\text{g}$ ; 0,760  $\text{cm}^3/\text{g}$ ; dan 5,42 mmol/g. Katalis MoNi/KM memiliki diameter pori, luas permukaan, volume pori total, dan keasaman masing-masing sebesar 6,455 nm; 628,171  $\text{m}^2/\text{g}$ ; 1,015  $\text{cm}^3/\text{g}$ ; dan 11,86 mmol/g. Katalis NiMo/KM memiliki diameter pori, luas permukaan, volume pori total, dan keasaman masing-masing sebesar 5,704 nm; 560,902  $\text{m}^2/\text{g}$ ; 0,802  $\text{cm}^3/\text{g}$ ; dan 11,28 mmol/g. Produk hidrorengkah pelumas bekas berupa fraksi cair tertinggi (64,15%) diperoleh menggunakan katalis MoNi/KM pada rasio berat pelumas/katalis 300 yang mengandung fraksi bensin, solar dan minyak berat masing-masing sebesar 45,58; 9,99; dan 0,78% b/b.

Kata kunci: hidrorengkah, karbon, katalis, mesopori, pelumas.

**SYNTHESIS OF MESOPOROUS CARBON (KM) FROM BOVINE BONE GELATIN,  
CATALYST NiMo/KM AND MoNi/KM FOR HYDROCRACKING  
OF WASTE LUBRICANT**

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**ABSTRACT**

Synthesis of mesoporous carbon (KM) from bovine bone gelatin, NiMo/KM catalyst and MoNi/KM catalyst for hydrocracking of waste lubricant have been conducted. The Gelatin was extracted from bovine bone using CH<sub>3</sub>COOH, NaOH and HCl. The KM was synthesized using bovine bone gelatin as carbon source and silica material (SBA-15 or Santa Barbara Amorphorous-15) as a template. NiMo/KM catalyst was synthesized by previously loading of Mo metal following by Ni metal. MoNi/KM catalyst was synthesized by previously loading of Ni metal following by Mo metal. The Ni and Mo metals were loaded onto the KM by wet impregnation method. The Ni and Mo metal was respectively derived from the salt solution of Ni(NO<sub>3</sub>)<sub>2</sub>·6H<sub>2</sub>O and (NH<sub>4</sub>)<sub>6</sub>Mo<sub>7</sub>O<sub>24</sub>·4H<sub>2</sub>O. The KM material was characterized by FT-IR spectrophotometer, Transmission electron Microscope (TEM), Scanning Electron Microscope-Energy Dispersive Spectroscopy (SEM-EDS) and Surface Area Analyzer (SAA) based of Brunauer-Emmet-Teller (BET) equation. The NiMo/KM and MoNi/KM catalyst was characterized by SEM-EDS and SAA based of BET equation. Acidities of catalyst were determined by gravimetric method using ammonia base vapor as adsorbate. The catalytic activity test was conducted on hydrocracking of waste lubricant using stainless steel reactor of a semibatch system at temperature of 475 ° C, hydrogen gas flow rate of 20 mL/min, under variation of lubricant/catalyst weight ratio of 50, 100, 200, 300 and 400. Liquid fraction of hydrocracking product was analyzed using GC-MS.

The research results showed that the KM material has a regular mesopore structure with a pore diameter, surface area, total pore volume, and acidity respectively 7.523 nm; 404.471 m<sup>2</sup>/g; 0.760 cm<sup>3</sup>/g; and 5.42 mmol/g. MoNi/KM Catalyst has a pore diameter, surface area, total pore volume, and acidity respectively 6.455 nm; 628.171 m<sup>2</sup>/g; 1.015 cm<sup>3</sup>/g; and 11.86 mmol/g. NiMo/KM Catalyst has a pore diameter, surface area, total pore volume, and acidity respectively 5.704 nm; 560.902 m<sup>2</sup>/g; 0.802 cm<sup>3</sup>/g; and 11.28 mmol/g. The highest liquid fraction (64.15%) as a hydrocracking product of the lubricant waste was obtained using a MoNi/KM catalyst at a lubricant/catalyst weight ratio of 300 which contains gasoline, diesel and heavy oil fraction of 45.58; 9.99; and 0.78 wt.%, respectively.

Keywords: carbon, catalyst, hydrocracking, lubricant, mesoporous.