

SINTESIS DAN KARAKTERISASI KATALIS BASA HETEROGEN MATERIAL MAGNETIK-SiO₂/CaO UNTUK TRANSESTERIFIKASI MINYAK KELAPA JELANTAH MENJADI METIL ESTER

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INTISARI

Penelitian ini telah berhasil mensintesis katalis basa heterogen CaO yang diimbangkan pada material magnetik termodifikasi silika (MM-SiO₂) dan diaplikasikan dalam transesterifikasi minyak kelapa bekas menjadi metil ester. Material magnetik terlapis silika (MM-SiO₂) disintesis melalui proses sol-gel menggunakan tetraetoksisilan (TEOS) dan setiltrimetilamonium bromida (CTAB), MM-SiO₂ kemudian diimpregnasi dengan CaO secara basah dengan persentase berat 10%, 20%, dan 30% terhadap CaO kemudian dikalsinasi pada suhu 800 °C selama 5 jam. Katalis yang dihasilkan dikarakterisasi dengan XRD, XRF, FTIR, SAA, serta FE-SEM EDX *Mapping*, sedangkan aktivitas katalitik diuji melalui variasi waktu reaksi, konsentrasi katalis, dan rasio mol minyak terhadap metanol.

Hasil penelitian menunjukkan bahwa katalis MM-SiO₂/CaO berhasil disintesis pada variasi persentase berat MM-SiO₂ terhadap CaO 10%, 20%, dan 30%. Peningkatan persentase MM-SiO₂ meningkatkan luas permukaan spesifik dan volume pori total. Dalam produksi metil ester, katalis 10% MM-SiO₂/CaO menunjukkan kinerja terbaik dengan hasil metil ester sebesar 86,20% pada kondisi reaksi optimum (suhu 60 °C, persentase katalis 3%, waktu reaksi 1 jam, dan rasio mol minyak:metanol 1:15).

Uji penggunaan ulang (*reusability*) katalis dilakukan tiga siklus reaksi menunjukkan bahwa katalis 10% MM-SiO₂/CaO memiliki kemampuan *reusability* yang cukup baik dengan penurunan hasil menjadi 66,09%. Katalis yang dihasilkan dalam penelitian ini menunjukkan performa yang cukup baik dalam produksi metil ester dan berpotensi untuk dikembangkan lebih lanjut untuk mendukung produksi biodiesel yang lebih berkelanjutan.

Kata kunci : kalsium oksida, material magnetik, minyak kelapa jelantah, silika

***SYNTHESIS AND CHARACTERIZATION OF HETEROGENEOUS BASE
MAGNETIC MATERIAL– SiO_2/CaO CATALYST FOR
TRANSESTERIFICATION OF WASTE COCONUT OIL INTO METHYL
ESTER***

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ABSTRACT

This research has successfully synthesized a heterogeneous base catalyst CaO supported on a silica-modified magnetic material (MM-SiO_2), and applied it to the transesterification of waste coconut oil into methyl esters. The silica-coated magnetic material (MM-SiO_2) was synthesized via a sol-gel process using tetraethyl orthosilicate (TEOS) and cetyltrimethylammonium bromide (CTAB). Subsequently, MM-SiO_2 was impregnated with CaO using the wet impregnation method at weight percentages of 10%, 20%, and 30%, followed by calcination at 800 °C for 5 hours. The resulting catalysts were characterized using XRD, XRF, FTIR, SAA, and FE-SEM EDX mapping. At the same time, the catalytic activity was evaluated by varying reaction time, catalyst concentration, and the molar ratio of oil to methanol.

The results showed that $\text{MM-SiO}_2/\text{CaO}$ catalysts were successfully synthesized at loadings of 10%, 20%, and 30% MM-SiO_2 . An increase in MM-SiO_2 content enhanced the surface area and total pore volume. In methyl ester production, the 10% $\text{MM-SiO}_2/\text{CaO}$ catalyst exhibited the best performance, achieving a methyl ester yield of 86.20% under optimum reaction conditions (temperature of 60 °C, catalyst loading of 3%, reaction time of 1 hour, and oil-to-methanol molar ratio of 1:15).

The catalyst's reusability test conducted over three reaction cycles, showed that the 10% $\text{MM-SiO}_2/\text{CaO}$ catalyst had fairly good reusability, with the yield decreasing to 66.09%. The catalyst produced in this study demonstrated good performance in methyl ester production and had the potential to be further developed to support more sustainable biodiesel production.

Keywords: . calcium oxide, magnetic material, silica, waste coconut oil