

## ABSTRACT

### STUDY OF USING RESPONSE SURFACE METHODOLOGY (RSM) FOR PRODUCT OPTIMIZATION OF COCONUT OIL TRANSESTERIFICATION REACTIONS USING ZEOLITE-A CATALYST

By

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In this study, the synthesis of zeolite-A from silica rice husk and food grade aluminum foil was carried out by the hydrothermal method for 72 hours at 100 °C, then calcined at 550 °C for 6 hours. The obtained zeolite samples were characterized using X-Ray Diffraction (XRD), Scanning Electron Microscope (SEM), Brunauer-Emmett-Teller (BET), dan Particle Size Analyzer (PSA). Then the zeolite-A obtained is used as a catalyst in the transesterification reaction of coconut oil to produce biodiesel. The optimum conditions for the transesterification reaction were evaluated using the Response Surface Methodology (RSM) with 3 factorial levels, namely observing variables that affect biodiesel conversion such as variations in the amount of catalyst (2.5%; 5%; and 7.5%), the ratio of methanol to oil (3:1, 4:1, and 6:1), and reaction times (15, 30, and 60 minutes). The transesterification reaction was carried out by the reflux method at a reaction temperature of 70 °C. The results showed that the optimum conditions were obtained by using a 2.5% catalyst, a methanol to oil ratio of 6:1, and a reaction time of 60 minutes with 98% conversion results. The mixture of methyl esters in the transesterification product at optimum conditions has been confirmed by the GC-MS technique, the main component of which is 41.37% methyl laurate.

**Keyword:** Transesterification, zeolite-A, coconut oil, biodiesel, RSM.

## ABSTRAK

### STUDI PENGGUNAAN *RESPONSE SURFACE METHODOLOGY* (RSM) UNTUK OPTIMASI PRODUK REAKSI TRANSESTERIFIKASI MINYAK KELAPA MENGGUNAKAN ZEOLIT-A SEBAGAI KATALIS

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Pada penelitian ini, dilakukan sintesis zeolit-A dari bahan baku silika sekam padi dan *aluminium foil food grade* menggunakan metode hidrotermal selama 72 jam pada suhu 100 °C, kemudian dikalsinasi dengan suhu 550 °C selama 6 jam. Sampel zeolit yang didapatkan, dikarakterisasi menggunakan *X-Ray Diffraction* (XRD), *Scanning Electron Microscope* (SEM), *Brunauer-Emmett-Teller* (BET), dan *Particle Size Analyzer* (PSA). Zeolit-A selanjutnya digunakan sebagai katalis dalam reaksi transesterifikasi minyak kelapa untuk menghasilkan biodiesel. Kondisi optimum reaksi transesterifikasi dievaluasi menggunakan *Response Surface Methodology* (RSM) dengan *3 level factorial* yakni mengamati variabel yang mempengaruhi konversi biodiesel seperti variasi jumlah katalis (2,5%; 5%; dan 7,5%), nisbah metanol terhadap minyak (3:1, 4:1, dan 6:1), dan waktu reaksi (15, 30, dan 60 menit). Reaksi transesterifikasi dilakukan menggunakan metode refluks pada suhu reaksi 70 °C. Hasil penelitian menunjukkan kondisi optimum diperoleh pada penggunaan katalis sebanyak 2,5%, nisbah metanol terhadap minyak 6:1, dan waktu reaksi 60 menit dengan hasil konversi sebesar 98%. Campuran metil ester dalam produk transesterifikasi pada kondisi optimum telah terkonfirmasi dengan teknik GC-MS, diperoleh komponen utamanya yaitu metil laurat sebesar 41,37%.

**Kata Kunci:** Transesterifikasi, zeolit-A, minyak kelapa, biodiesel, RSM.