

## **ABSTRACT**

### **STUDY OF THE USE OF THE RESPONSE SURFACE METHODOLOGY (RSM) FOR PRODUCT OPTIMIZATION OF THE TRANSESTERIFICATION REACTION OF PALM OIL USING ZEOLITE-A CATALYST**

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Transesterification of palm oil with methanol using zeolite-A catalyst has been carried out in this study. The zeolite-A catalyst was synthesized using silica from rice husk and food grade aluminum foil by hydrothermal method at 100 °C for 72 hours followed by calcination at 550 °C for 6 hours. The resulting zeolite was characterized using X-Ray Diffraction (XRD), Scanning Electron Microscope (SEM), Particle Size Analyzer (PSA), dan Brunauer-Emmett-Teller (BET). Evaluation of the optimum conditions for the transesterification reaction was carried out using the Response Surface Methodology (RSM) with 3 factorial levels, namely considering the reaction parameters simultaneously by considering the interaction of one parameter with another. In this study, the reaction parameters that affect the rate of conversion of oil to biodiesel were observed including the amount of catalyst, the ratio of methanol to oil, and reaction time. The results of the research evaluated by RSM showed that the optimum conditions for the transesterification reaction were the amount of catalyst 9.6%, the ratio of methanol:oil 6:1, and the reaction time was 4.3 hours with an oil conversion of 99%. Optimum product yields were then analyzed using GC-MS. The results of the GC-MS analysis showed the formation of a methyl ester mixture with the main components being methyl palmitate and methyl oleate.

**Keywords :** Zeolite-A, transesterification, RSM, biodiesel, palm oil.

## ABSTRAK

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

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Transesterifikasi minyak kelapa sawit dengan metanol menggunakan katalis zeolit-A telah dilakukan pada penelitian ini. Katalis zeolit-A disintesis menggunakan bahan baku silika dari sekam padi dan *aluminum foil food grade* dengan metode hidrotermal pada suhu 100 °C selama 72 jam yang dilanjutkan dengan kalsinasi pada suhu 550 °C selama 6 jam. Zeolit yang dihasilkan dikarakterisasi menggunakan *X-Ray Diffraction* (XRD), *Scanning Electron Microscope* (SEM), *Particle Size Analyzer* (PSA), dan *Brunauer-Emmett-Teller* (BET). Evaluasi kondisi optimum reaksi transesterifikasi dilakukan menggunakan *Response Surface Methodology* (RSM) dengan 3 level factorial yakni mempertimbangkan parameter reaksi secara bersamaan dengan mempertimbangkan interaksi satu parameter dengan yang lainnya. Pada penelitian ini, diamati parameter reaksi yang mempengaruhi tingkat konversi minyak menjadi biodiesel meliputi jumlah katalis, nisbah metanol terhadap minyak, dan waktu reaksi. Hasil penelitian yang dievaluasi dengan RSM menunjukkan kondisi optimum reaksi transesterifikasi yaitu pada jumlah katalis 9,6%, nisbah metanol:minyak 6:1, dan waktu reaksi 4,3 jam dengan konversi minyak sebesar 99%. Hasil produk optimum kemudian dianalisis menggunakan GC-MS. Hasil analisis GC-MS menunjukkan terbentuknya campuran metil ester dengan komponen utamanya yaitu metil palmitat dan metil oleat.

**Kata kunci :** Zeolit-A, transesterifikasi, RSM, biodiesel, minyak kelapa sawit