

**PRODUCTION OF BIODIESEL FROM JATROPHA OIL BY USING  
MICROWAVE IRRADIATION**

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MICROWAVE IRRADIATION

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A thesis submitted in fulfilment of the  
requirement for the award of the degree of  
Master of Mechanical Engineering

Faculty of Mechanical Engineering  
Universiti Teknologi Malaysia

JANUARY 2013

*To my beloved father and mother  
Bakheit Ahmed, Nawal Babeker  
my brother and sisters..  
and to all my friends*

## **ACKNOWLEDGEMENT**

First of all, I would like to say Alhamdulillah, for giving me the strength, patience and health to go through all obstacles in order to complete this research.

The special thank goes to my helpful supervisor, Professor Dr. Ir. Farid Nasir Bin Hj. Ani for his supervision, valuable and critical ideas, comments and guidance throughout my research.

My appreciation extends to Nor Syarizan Mat Nor and all laboratory staffs in thermodynamic laboratory and chemical laboratory for helping me in this project.

Last but not least, I would like to express my love and many thanks to my parents, family and friends, who have supported, assisted and motivated me throughout this research.

## ABSTRACT

Environmental issues, the growing demand for energy, political concerns, increasing crude oil prices and the medium term depletion of petroleum created the need for the development of vegetable oils as alternative fuels. Vegetable oil based fuels (bio fuels) are promising alternative fuels for diesel engines because of their environmental and strategic advantages. Biodiesel is gaining more and more importance as an attractive fuel due to the depleting fossil fuel resources. Chemically biodiesel is monoalkyl esters of long chain fatty acids derived from renewable feed stock like vegetable oils and animal fats. The costs of feedstock and production process are two important factors which are particularly against large-scale biodiesel production. *Jatropha curcas* oil (JCO) is considered a future feedstock for biodiesel production because it is easily grown in harsh environments and is a non-edible crop that is not in demand as a food source. Microwave irradiation is one of the good methods to reduce the reaction time and get the higher yield; however, heterogeneous transesterification using a solid catalyst rather than a liquid acid or base catalyst is a more environmentally responsible way to utilize crude *Jatropha* oil for biodiesel production. The use of a heterogeneous catalyst also avoids neutralization and washing steps, thereby leading to a simpler and more efficient process. This project presents optimize three critical reaction parameters including catalyst concentration, microwave exit power and reaction time from the transesterification of used *Jatropha curcas* oil (JCO) by using microwave irradiation in an attempt to reduce the production cost of biodiesel. To arrest the reaction, similar quantities of methanol to oil molar ratio (6:1) and calcium oxide as the catalyst were used. The results showed that the best yield percentage (96%) was obtained using 300W microwave exit power, 8 % (wt) CaO and 7 min. From the results obtained it was clear that free acid methyl ester (FAME) was within the standards of biodiesel and diesel fuel.

## ABSTRAK

Isu alam sekitar, permintaan yang semakin meningkat untuk tenaga, keseimbangan politik, peningkatan harga minyak mentah dan kekurangan jangka sederhana petroleum mewujudkan keperluan bagi pembangunan minyak sayuran sebagai bahan api alternatif, bahan api berasaskan Minyak sayuran (bahan bakar bio) menjanjikan bahan api alternatif bagi diesel enjin kerana kelebihan alam sekitar dan strategik, Biodiesel semakin lebih dan lebih penting sebagai bahan api yang menarik kerana bahan api semakin berkurangan sumber fosil. Kimia biodiesel adalah ester monoalkyl rangkaian panjang asid lemak yang diperolehi daripada stok suapan boleh diperbaharui seperti minyak sayuran dan lemak haiwan. Minyak *Jatropha curcas* (JCO) dianggap bahan mentah masa depan bagi pengeluaran biodiesel kerana ia mudah ditanam dalam persekitaran yang sukar tumbuh dan adalah tanaman yang tidak boleh dimakan yang tidak berada dalam permintaan sebagai sumber makanan. Penggunaan mangkin heterogen juga mengelakkan langkah penutralan dan membasuh, sekali gus membawa kepada proses yang mudah dan lebih cekap. Projek ini membentangkan dan mengoptimumkan tiga parameter kritikal reaksi termasuk kepekatan pemangkin, kuasa gelombang mikro keluar dan reaksi masa dari transesterification digunakan *jatropha curcas* minyak (JCO) dengan menggunakan penyinaran gelombang mikro dalam usaha untuk mengurangkan kos pengeluaran biodiesel. Untuk reaksi kuantiti yang sama dengan metanol kepada nisbah minyak molar (06:01) dan kalsium oksida sebagai pemangkin telah digunakan. Keputusan menunjukkan bahawa hasil peratusan terbaik (96%) telah diperolehi dengan menggunakan kuasa gelombang mikro dengan keluaran 300W, 8% (wt) CaO dan 7 min. Daripada keputusan yang diperolehi, ia adalah jelas bahawa asid metil ester (FAME) adalah bebas dalam piawai biodiesel dan diesel.