

**RESEARCH PROJECT REPORT**

**CONVERSION OF OIL WITH HIGH FREE FATTY ACID  
CONTENT INTO BIODIESEL USING SUB-CRITICAL  
METHANOL**



**Submitted by:**

**Maria Bangun Rizkiana**  
**Jenni Lie**

**NRP. 5203013012**  
**NRP. 5203013022**

**DEPARTMENT OF CHEMICAL ENGINEERING**  
**FACULTY OF ENGINEERING**  
**WIDYA MANDALA CATHOLIC UNIVERSITY**  
**SURABAYA**  
**2016**

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The research entitled:

**Conversion Oil with High Free Fatty Acid Content into Biodiesel Using Sub-Critical Methanol**

which was conducted and submitted by:

Name : Maria Bangun Rizkiana

NRP : 5203013012

has been approved and accepted as one of requirement for **Bachelor of Engineering** degree in Chemical Engineering Department, Faculty of Engineering, Widya Mandala Surabaya Catholic University by following supervisors.

Supervisor

  
Ir. Suryadi Ismadji, Ph.D

NIK. 521.93.0198

Surabaya, 26<sup>th</sup> of May 2016

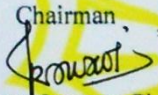
Co-Supervisor

  
Felycia Edi Soetaredjo, Ph.D

NIK. 521.99.0391

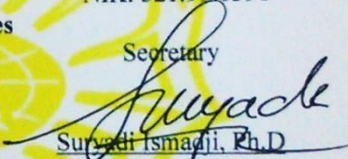
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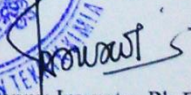
Dean of  
Engineering Faculty

  
Ir. Suryadi Ismadji, Ph.D

NIK. 521.93.0198

Authorized by

Head of Chemical  
Engineering Department

  
Wenny Irawaty, Ph.D

NIK. 521.97.0284



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The research entitled:

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Name : Jenni Lie

NRP : 5203013022

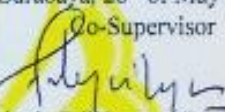
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NIK. 521.93.0198

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Felicia Edi Soetaredjo, Ph.D  
NIK. 521.99.0391

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Wendy Irawaty, Ph.D  
NIK. 521.97.0284

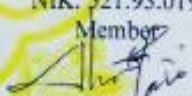
Secretary

  
Sunardi Ismadji, Ph.D  
NIK. 521.93.0198

Member

  
Aning Awucitra, ST., M.EngSc  
NIK. 521.03.0563

Member

  
Ir. Yohanes Sudaryanto, MT  
NIK. 521.89.0151

### Authorized by

Dean of  
Engineering Faculty

  
Ir. Suradi Ismadji, Ph.D  
NIK. 521.93.0198

Head of Chemical  
Engineering Department

  
Wendy Irawaty, Ph.D  
NIK. 521.97.0284

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Maria Bangun Rizkiana  
NRP. 5203013012



Jenni Lie  
NRP. 5203013022

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Maria Bangun Rizkiana

5203013012

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Jenni Lie

5203013022

## **PREFACE**

The authors would like to thank God for His blessing so our research project has been accomplished. This report is one of the prerequisites in achieving Bachelor of Engineering degree in Chemical Engineering. The authors realize that the completion of this report is achieved by the support of many people. Therefore, the authors would like to thank to:

- 1 Ir. Suryadi Ismadji, Ph.D., as Principal Supervisor and Felycia Edi S., Ph.D. as Co Supervisor
- 2 Wenny Irawaty, Ph.D. as Head of the Committees, Aning Ayucitra, ST., M.EngSc, and Ir. Yohanes Sudaryanto, MT., as members of committees
- 3 Ir. Suryadi Ismadji, Ph.D and Dra. Adriana Anteng Anggorowati, M.Si. as the Head of Process and Chemical Analysis Laboratory, respectively.
- 4 Mr. Novi and Mr. Pudjo as the technicians in Process and Unit Operation Laboratories, respectively.
- 5 Our parents and family who have given a lot of help and support, both materially and morally.
- 6 Our lecturers, friends and also those who are too many to be listed by name that had contributed their kind assistance

The authors realize that this report is far from perfect, therefore any critics and comments which will better improve the research is gladly accepted. Lastly, the authors hope that the report will be useful to all readers who need information regarding the research of the report.

Surabaya, 11<sup>th</sup> May 2016

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## ABSTRACT

The consumption of palm cooking oil in Indonesia is very high, and as a result, the used cooking oil (UCO) which is mostly end up as the waste is also high. Direct discharge of UCO into environment causes serious environmental pollution problems. UCO contains triglyceride and free fatty acid, which can be converted into biodiesel. In this study, the conversion of UCO into biodiesel was conducted using subcritical methanol method. The effect of the process parameters such as the ratio of UCO to methanol, temperature, and pressure on the yield of biodiesel was investigated. Based on the Response Surface Method; temperature, pressure, and UCO to methanol ratio gave significant effect on the FAME yield. From the experimental result, the maximum FAME yield obtained was 88.43% with the purity up to 97% (180°C, 45 bar, 3:10), while the maximum yield calculated by RSM was 88.8115% with the optimum condition: 174.7°C, 45 bar for UCO to methanol ratio 3.263:10. The components in the FAMEs product are Undecanoic Acid Methyl Ester (C11:0), Myristoleic Acid Methyl Ester (C14:1), *cis*-10-Pentadecenoic Acid Methyl Ester (C15:1), Stearic Acid Methyl Ester (C18:0), Oleic Acid Methyl Ester (C18:1n9c), Elaidic Acid Methyl Ester (C18:1n9t), *cis*-8,11,14-Eicosatrienoic Acid Methyl Ester (C20:3n6), Heneicosanoic Acid Methyl Ester (C21:0), Arachidonic Acid Methyl Ester (C20:4n6), *cis*-5,8,11,14,17-Eicosapentaenoic Acid Methyl Ester (C20:5n3), Erucic Acid Methyl Ester (C22:1n9) *cis*-13,16-Docosadienoic Acid Methyl Ester (C22:2) Tricosanoic Acid Methyl Ester (C23:0).