

**FINAL PROJECT REPORT**  
**PRELIMINARY PLANT DESIGN OF**  
**ETHYL ACETATE PLANT USING**  
**PTSA CATALYST WITH PRODUCTION CAPACITY**  
**OF 14,787 TONS/YEAR**



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**SURABAYA**

**2007**

APPROVAL SHEET

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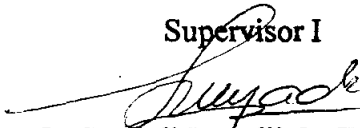
**Preliminary Plant Design of Ethyl Acetate Plant using PTSA Catalyst  
With Production Capacity of 14,787 Tons/Year**

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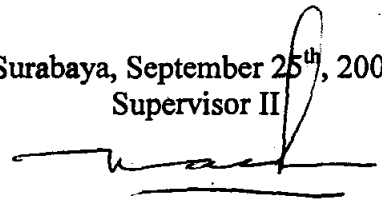
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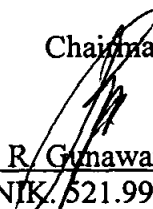
  
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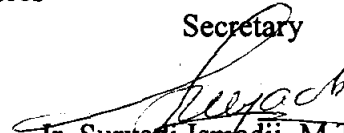
  
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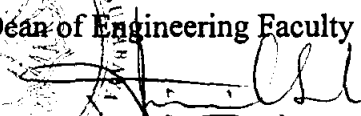
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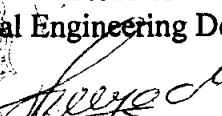
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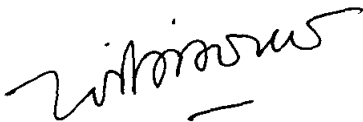
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I hereby declare that this research report is my own work and not an act of plagiarism in any part or as a whole, except referenced in the text. If it is known that this research report is not my own work, I am aware and willing to accept the consequences that this research report cannot be used as one of the requirements to achieve Bachelor of Engineering (*Sarjana Teknik*) degree.

Surabaya, September 25<sup>th</sup>, 2007



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Surabaya, September 25<sup>th</sup>, 2007



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## PREFACE

The authors would like to thank God for His blessing that the plant design project titled *Preliminary Plant Design of Ethyl Acetate Plant Using PTSA Catalyst with Production Capacity of 14,787 Tons/Year* can be completed. The plant design is one of the prerequisites to receive Bachelor of Engineering degree in Chemical Engineering Department, Faculty of Engineering, Widya Mandala Catholic University, Surabaya.

The authors acknowledge that the success of the project is supported by many people, thus the authors would like to say thank you to,

1. Ir. Suryadi Ismadji, M.T., Ph.D. and Ir. Nani Indraswati as our supervisors for the project.
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3. Our parents who have given a lot of help, materially and morally.
4. Our friends who have supported our final project.
5. Many others who cannot be mentioned one by one, who have helped us since the beginning of the project until the finishing of the report.

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

Surabaya, September 25<sup>th</sup>, 2007

The authors

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**ABSTRACT**

Ethyl acetate is an important industrial chemical used primarily as a solvent for various resins in protective coatings, and also used extensively in formulating printing inks and adhesives. In Indonesia the only company that produces ethyl acetate is PT. Sarasa Nugraha, Tbk. with production capacity of 4,500 tons/year. On the other hand, the demand of ethyl acetate is growing each year. Due to the increasing imports of ethyl acetate, the existence of another ethyl acetate producing company is plausible. The location of the ethyl acetate plant is designed to be built in Driyorejo Industrial Estate, Gresik, East Java.

The production of ethyl acetate consists of three main unit operations: esterification reaction, product separation, and purification. There are several processes to produce ethyl acetate, but the Fischer esterification is the best option to produce ethyl acetate. This process has many advantages compared to other processes because the raw materials needed are easily obtained and compared to other methods, Fischer esterification requires the least number of intermediate steps. Also, Fischer esterification process only produces water as side product which is not harmful to the environment.

The ethyl acetate plant is planned to operate continuously for 24 hours and 300 days in a year. The plant is designed with following specifications:

- Production Capacity : 14,787 tons ethyl acetate/year
- Land Area : 7,500 m<sup>2</sup>
- Number of Employees : 134 persons
- Raw materials and side product:
  - Raw materials:
    - Acetic Acid : 10,800 tons / year
    - Ethanol 95% : 10,080 tons / year
  - Side product:
    - Ethyl Acetate 45% : 1,590 tons / year
- Utilities:
  - Electricity : 400 kW
  - Gas : 244,467 MMBtu/year
  - Water : 53,834 m<sup>3</sup>/year
  - Zeolite : 7,840 kg/year
  - NaCl : 697 kg/year

**Economical analysis:**

Fixed Capital Investment : Rp. 35,758,240,000,-  
Working Capital Investment : Rp. 22,168,277,000,-  
Total Production Cost : Rp. 133,009,663,000,-  
Annual Revenue : Rp. 141,426,000,000,-

## 1. Linear Method

Rate of Return before taxes : 14.65 %  
Rate of Return after taxes : 9.59 %  
Pay Out Time before taxes : 5 years 1 months  
Pay Out Time after taxes : 6 years 10 months  
Break Even Point : 45.97 %

## 2. Discounted Cash Flow Method

Rate of Return before taxes : 19.93 %  
Rate of Return after taxes : 16.75 %  
Pay Out Time before taxes : 6 years 2 months  
Pay Out Time after taxes : 7 years  
Break Even Point : 33.99 %

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