Higher Technical Institute

MECHANICAL ENGINEERING DEPARTMENT

DIPLOMA PROJECT

DESIGN AND CONSTRUCTION OF A SMALL SCALE PILOT PLANT FOR PRODUCING ETHANOL FUEL FROM CRADE SURPLUS OR CO. PRODUCTS

MI/1016

ZENONAS KANNAS 3M

JUNE 2005

HIGHER TECHNICAL INSTITUTE

MECHANICAL ENGINEERING DEPARTMENT

DIPLOMA PROJECT

DESIGN AND CONSTRUCTION OF A SMALL SCALE PILOT PLANT FOR PRODUCING ETHANOL FUEL FROM GRADE SURPLUS OR CO-PRODUCTS

M/1016

ZENONAS KANNAS

3M

HIGHER TECHNICAL INSTITUTE

JUNE 2005

DESIGN AND CONSTRUCTION OF A SMALL SCALE PILOT PLANT FOR PRODUCING ETHANOL FUEL FROM GRADE SURPLUS OR CO-PRODUCTS

by

Zenonas Kannas

Project Report Submitted to

The Department of Mechanical Engineering

Of the Higher Technical Institute

Nicosia Cyprus

In partial fulfillment of the requirements for the diploma of

TECHNICIAN ENGINEER

IN

MECHANICAL ENGINEERING

June 2005

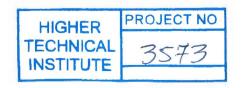


TABLE OF CONTENT

* <u>Abstract</u>	
*Introduction	1-2
* <u>Chapter 1</u>	
NEED OF ALCOHOL OVER GASOLINE	
1.1 Need for fuel alternatives	3
1.2 A liquid to be name as a fuel must obey the following conditions	3-5
1.3 Suitable type of alcohol	6
1.4 Advantages of ethanol	6
1.5 Properties of ethanol	7-8
1.6 The steps for production ethanol	8-9
* <u>Chapter 2</u>	
PRODUCTION OF ETHANOL	
2.1 Preparation of feedstocks	11
2.1.1 Conversion of starches by enzimatic hydrolysis	12-13
2.2 Fermentation	14
2.2.1 Yeast strains	15
2.2.2 Nutritional requirement	15-16
2.2.3 Sugar concentration	16
2.2.4 Temperature	16-17
2.2.5 Infections	17

2.3 Distillatio

*Chapter 3

PROCESS CONTROL

3.1 Control of cooking and hydrolysis	22
3.1.1 Input control	22
3.1.2 Temperature, pH ,and enzyme control	23
3.1.3 Automatic controls	23
3.2 Control of fermentation	24
3.2.1 Temperature and pH control	24
3.2.2 Automatic control	24
3.2.3 Control with attention at intervals only	25
3.3 Controls of distillation	25-26
3.4 Control of ethanol drying system	26
3.5 Control of pumps and drives	27
3.6 Heat source controls	27-28
3.6.1 Emissions	28
3.6.2 Boiler safety features	28
* <u>Chapter 4</u>	
PRESENTATIVE ETHANOL PLANT	

4.1 Overview the plant	29-36
4.2 Start-up and shutdown	37
4.2.1 Preliminaries	37

4.2.2 Mash preparation	37
4.2.3 Cooking	38
4.2.4 Saccharification	38
4.2.5 Fermentation	38-39
4.2.6 Pump-out and cleanup	39
4.2.7 Distillation	39-42
4.2.8 Shutdown	42-43
4.3 Daily operation	43-44
* <u>Chapter 5</u>	
MAINTENANCE CHECKLIST	
5.1 Maintenance checklist	45
* <u>Conclusions</u>	46
*Appendices	47-48
* <u>References</u>	49-50

Acknowledgements

I would like to express my sincere appreciation to my supervisors Dr Andreas Stassis and Dr Nicos Angastiniotis for all the input and quittance that they provided. They was always actively helpful in every phase of the project. Without their support I would not have been able to accomplish my task at this level. Also, they helped me by sending me via the internet windpower page and gave me valuable feedback for this project. My sincere thanks also go to Mr Andreas Panteli (*Brewing Manager*) of Photos Photiades Breweries Ltd. He was always very helpful for my work.

INTRODUCTION

The world of the 20th century presents many critical challenges one of the most important being concerns over the environment. As population increases and the standard of living improves, there is an increasing concern that there will be a shortage of energy to heat our homes and power the vehicles we so heavily depend on. On the other hand we must consider the need for clean air, clear water, clean fuel, and biodegradable, renewable materials.

Alternative energy sources can be easily developed with the existing technology. These energy sources are renewable, cleaner, and more dependable than traditional fuel. Ethanol is one of them. It is am alcohol made by fermenting grape or other similar products which are rich in sugar, such as corn and sorghum are good sources, but potatoes, sugarcane, Jerusalem articholles, and other farm plants and vastes are also suitable.

The first blends in the 1970's were 10% by volume (E-10) while a blend of 85% by volume (E-85) was introduced in the late 1990's.

The idea to design and construction of a small scale pilot plant for producing ethanol fuel, has moved my interest, specially when I learned that alcohol industries in Cyprus have thousands of tons of alcohol waste stored in warehouses that can't be used and also can't be thrown away.

Ethanol can be used to increase octane levels, decrease engine emissions, and can extend the supply of gasoline.

There are three primary ways in which ethanol can be used as a fuel:

- 1. as a blend of 10 percent ethanol with ninety percent gasoline.
- 2. as a component of reformulated gasoline, directly and/or as ethyl tertiary butyl either (ETBE) or
- 3. directly as a fuel with is percent or more gasoline know as "E-85"

So, I considered that, the idea of using this alcohol waste as a fuel will not only solve the problem of storing it but also help to solve the problem of depending on other sources, and to keep providing us with fuel. Everything in our country depends on the black gold (fuel) as many of us call it. We use fuel to produce electricity, fuel to heat our homes, fuel for our vehicles. Can anybody ever imagine if someday the deposits of fuel are no longer available, what will happen to all of us;!