

GLYCERINE PITCH FROM GLYCERINE CONCENTRATION PROCESS AS
ALTERNATIVE FUEL FOR BOILER OPERATIONS

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Dedicated to

My Family

&

Special dedication to

My Mother

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ABSTRACT

The usage of energy in world is increasing rapidly where the industries accounts 50% of world energy uses. Palm based oleochemical are producing series of products such as fatty acid, methyl esters, fatty alcohols and glycerine which means that oil palm industries generate a number of wastes too and the estimated oil palm waste contribute RM 6379 million of energy annually. Glycerine pitch has a calorific value of about 3300kcal/kg. This research is focused on utilizing energy in glycerine pitch by using it as fuel in boiler for both economical and environmental reason. Glycerine pitch is classified as a waste under Schedule S181 of the Environmental Regulations in Malaysia where the treated glycerine pitch is disposed in landfills. Glycerine pitch will be blend with diesel at the ratio of 20:80, 30:70, 40:60, and the calorific value of each blend of diesel and glycerine pitch will be determined. The mixture of glycerine fuel and diesel is known as blend 20:80, blend 30:70 and blend 40:60. The blend fuels are used as fuel in boiler and after firing, flue gas temperature and emission level is determined using combustion analyzer. Lastly, the limitation and advantages of using glycerine pitch as fuel in boiler is compared with natural gas.

ABSTRAK

Penggunaan tenaga di dunia meningkat dengan cepat di mana industri menyumbang 50% daripada penggunaan tenaga dunia. Oleokimia berasaskan sawit menghasilkan siri produk seperti asid lemak, ester metil, alkohol lemak dan gliserin yang bermaksud bahawa industri kelapa sawit menjana beberapa sisa juga dan dianggarkan sisa kelapa sawit menyumbang RM 6379 juta tenaga setiap tahun. Sisa gliserin mempunyai nilai kalorific sebanyak 3300 kcal/kg. Kajian ini memberi tumpuan kepada penggunaan tenaga dalam sisa gliserin dengan menggunakannya sebagai bahan api dalam dandang untuk tujuan ekonomi dan alam sekitar. Sisa gliserin diklasifikasikan sebagai sisa di bawah Jadual S181 Peraturan Alam Sekitar di Malaysia di mana sisa gliserin yang dirawat perlu dilupuskan di tapak pelupusan. Sisa gliserin akan dicampur dengan diesel pada nisbah 20:80, 30:70, 40:60, dan nilai kalori dalam setiap campuran diesel dan sisa gliserin akan ditentukan. Sisa gliserin dan diesel yang dicampur akan dikenali sebagai campuran 20:80, 30:70 dan 40: 60. Ketiga tiga campuran ini akan digunakan sebagai bahan api dalam dandang stim dan suhu gas cerobong dan tahap pelepasan akan ditentukan dengan menggunakan alat analisis pembakaran. Akhirnya, kelebihan dan kelemahan penggunaan sisa gliserin sebagai bahan api dalam dandang akan dibandingkan dengan gas asli.

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LIST OF SYMBOLS

CO_2	-	Carbon dioxide
C_p	-	Specific heat of flue gas
H_2	-	Hydrogen
h_g	-	Enthalpy of steam
h_f	-	Enthalpy of water
m	-	Mass of dry flue gas
O_2	-	Oxygen
T_a	-	Ambient temperature
T_f	-	Flue gas temperature

LIST OF ABBREVIATIONS

AAS	-	Actual air supplied
ASWP	-	Authorised safe working Pressure
Blend 20:80	-	Mixture of 20% glycerine pitch and 80% diesel
Blend 30:70	-	Mixture of 30% glycerine pitch and 70% diesel
Blend 40:60	-	Mixture of 40% glycerine pitch and 60% diesel
EA	-	Excess air supplied
FFA	-	Free fatty acid
GCV	-	Gross calorific value
PFAD	-	Palm fatty acid distillate
PCEO	-	Pan century edible oils

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CHAPTER 1

INTRODUCTION

1.1 Research Background

The usage of energy in the world is increasing rapidly where the industries accounts 50% of world energy uses [8]. Malaysia is the largest producers and exporters of palm oil in world where palm oil cultivation occupies 4.49 hectares of land producing 17.73 million tonnes of palm oil and 2.13 tonnes of palm kernel oil [1]. The growth of palm oil industry in Malaysia over the last four decades are very rapid where it is estimated that the Malaysian will be producing an average of 15.4 tonnes of palm oil between 2006 -2012 [3]. Palm based oleochemical are producing series of products such as fatty acid, methyl esters, fatty alcohols and glycerine which means that oil palm industries generate a number of wastes too and the estimated oil palm waste contribute RM 6379 million of energy annually [2, 4].The present work is focusing on the utilization of the waste at oleo chemicals, glycerine pitch by using it as fuel in boiler operation and the energy and cost savings obtained.

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1.2 Research Objectives

The objectives for this research are:

- 1) To utilize glycerine pitch from glycerine concentration process by burning in boiler as fuel.
- 2) To determine the optimum blend of diesel and glycerine pitch for maximum efficiency and minimum emission in boilers.
- 3) To compare the savings of using glycerine pitch as fuel in boilers with natural gas and diesel.

1.3 Problem Statements

IOI oleochemicals was established in 1991 in Pasir Gudang, Johor to cater growing demand for fine vegetable based bio-degradable oleochemicals. Today, it is one of the biggest palm oil refinery in world with an annual capacity of more than 1 million tons of refined palm oil and palm oil products. In IOI oleochemicals, the splitting plant is able to produce natural glycerine from vegetable oils by continuous splitting process and it is used in products such as tooth paste, pharmaceuticals, edible foods and confections. The main feed stocks for the splitting plant are Palm Fatty Acid Distillate (PFAD) and Palm stearin and the by products is a mixture of water and glycerine which is known as sweet water. The sweet water is then distilled leaving glycerine pitch as the residue. The splitting plant produces 30 tons of glycerine pitch as residue which is sent to wastewater treatment plant for Anaerobic followed by Aerobic treatment before disposal. Glycerine pitch is classified as a waste under Schedule S181 of the Environmental Regulations in Malaysia where the treated glycerine pitch is disposed in landfills [2]. This research is focussed on utilizing energy in glycerine pitch by using it as fuel in boiler for both economical and environmental reason.

1.4 Scope of Research

In this research brief description on energy content of the waste will be discussed. The mixture of glycerine pitch and diesel will be used as fuel in fire tube boiler and the energy savings will be compared with diesel and natural gas. The limitation and limitation and advantages of glycerine pitch as fuel in boiler will be compared to natural gas and diesel.

1.5 Theoretical Framework

This study will determine the energy and cost saving obtained by using glycerine pitch as fuel in boilers. Figure 1.1 summarises the frame work of this research.

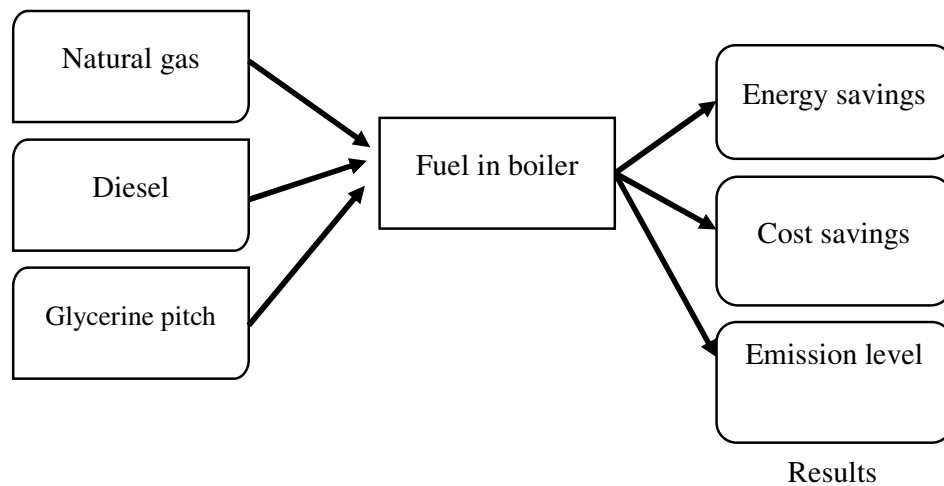


Figure 1.1 : Theoretical Framework

1.6 Thesis Outline

Chapter 1 is the introduction chapter. This chapter presents the research background, statement of the problem, objectives and scopes of the study, research contributions, methodology of research, and the overall outline of this thesis.

Chapter 2 presents the literature review on related subjects concerning this thesis. In this chapter, the method of producing glycerine pitch in oleochemical industry and review on published articles related to glycerine pitch are described.

Chapter 3 presents the methodology and experimentation of different fuels model. In this chapter, the method to determine efficiency of boiler is introduced. The ratio of blend and the method of producing it is discussed. Finally, the experimentation setup to conduct the experiment is described.

Chapter 4 presents the results obtained by using different kind of fuel. The efficiency and cost of producing is compared. Discussion on limitation and advantages of using blend of glycerine pitch and diesel as fuel is compared to natural gas.

Chapter 5 is the concluding chapter. This chapter summarizes the works done in this entire study. The directions and recommendations for future research works are also outlined.

1.7 Research Methodology and Flowchart

The methodologies involved in this study are shown in Figure 1.1. The project starts by collecting reading materials such as books, journals and technical papers related to glycerine pitch and its current utilization.

Research has been done continuously throughout this study to get a better understanding on the idea of using glycerine pitch as fuel in boiler operation. Based on the research conducted, usage of glycerine pitch as fuel for boiler operation was crucially analysed and the ratio of mixing was used as the input for experiment.

Glycerine pitch is mixed with diesel in ratio 20:80, 30:70, and 40:60 and the mixture is known as blend 20:80, blend 30:70 and blend 40:60 respectively. This study was done on experimentation basis on actual boilers in plant. After firing, emission level and flue gas temperature is determined using combustion analysis.

Combustion efficiency of each fuel in boiler is calculated using direct method. The efficiency of different fuels is compared and discussed. Finally, the thesis is concluded and recommendation for future works is suggested.

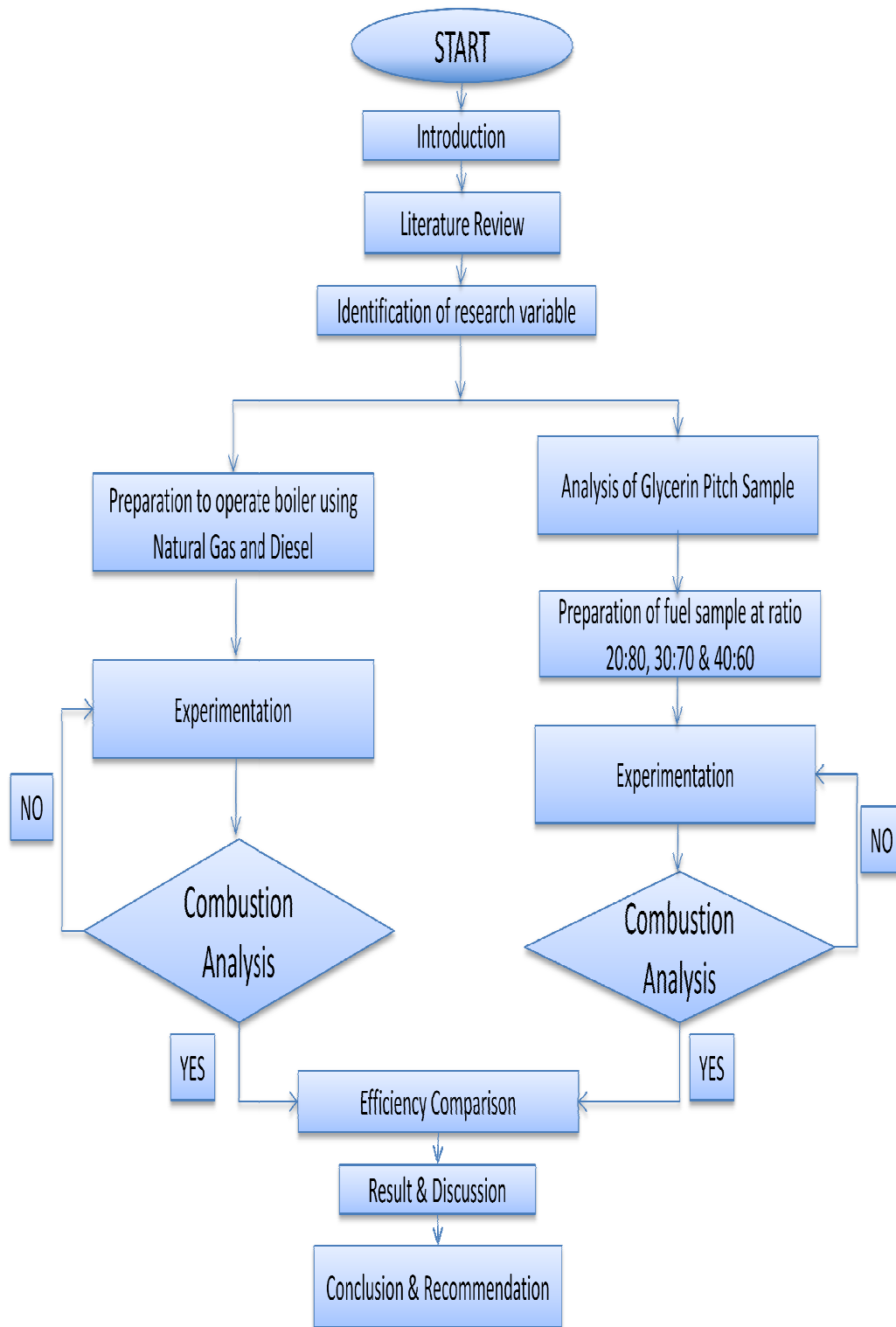


Figure 1.2: Flowchart of research

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