"I admit that I have read this report and I found that it is suffice from the aspect of scope and quality to pass the

Bachelor Degree of Mechanical Engineering (Thermal-Fluid)"

Signature : .....

Supervisor Name : YUSMADY MOHAMED ARIFIN

Date : 12/12/05

ANALYZE OF FLUE GAS FROM STEAM POWER PLANT

MOHD RODY B. MOHAMAD ZIN

This report is hand over to Mechanical Engineering Faculty as a requirement to pass a Bachelor Degree of Mechanical Engineering (Thermal-Fluid).

Faculty of Mechanical Engineering
Kolej Universiti Teknikal Kebangsaan Malaysia

NOVEMBER 2005

ADMISSION

" I admit this report is done all by myself except statement that I have already stated on each one of them"

Signature : .....

Author : MOHD RODY B. MOHAMAD ZIN

Date : 19/12/05

This work is dedicated to my beloved mother, father, and sisters and to my younger brother. You all are the best...

To all my classmates, do remember our friendships. It was a happy moment to be with you guys in these past few years...

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ABSTRACT

The development of industry has indeed brought to the environmental degradation. Steam power plant as an important energy source in the industry now playing a very important role in environmental pollution.

Thus this project paper is prepared to study the analysis of gas flue from steam power plant. The study of this project paper were based on steam power plant in Thermodynamics lab in the Faculty of Mechanical Engineering in Kolej Universiti Teknikal Kebangsaan Malaysia, Ayer Keroh.

Sets of experiments were carried out in the steam plant by using Gas Analyzer which can measure the composition of gasses carried out from gas flue exhaust. There are four type of gasses come out from the exhaust. That is carbon monoxide, carbon dioxide, nitrogen oxides and sulfur oxides.

Those gasses can be reduced by using low firing flame, and complete combustion operation. There are other factors that give an effect to the composition of gasses such as excess air, type of fuel and firing flame.

ABSTRAK

Kemajuan industri sesungguhnya membawa kemusnahan terhadap alam sekitar. Jana kuasa stim merupakan salah satu sumber tenaga penting industri, memainkan peranan yang sangat penting dalam pencemaran alam sekitar.

Oleh itu, kertas kerja ini disediakan untuk mengkaji komposisi gas yang keluar dari cerobong asap janakuasa stim. Kajian ini dilaksanakan berdasarkan janakuasa stim yang terdapat di makmal termodinamik, fakulti kejuruteraan mekanikal di Kolej Universiti Teknikal Kebangsaan Malaysia, Ayer Keroh.

Beberapa set eksperimen telah dijalankan dengan menggunakan alat analisa gas untuk mendapatkan kompossisi dan jenis gas yang terdapat pada keluaran cerobong janakuasa stim. Terdapat empat jenis gas yang keluar iaitu karbon monoksida, karbon dioksida, nitrogen dioksida dan sulfur dioksida.

Gas ini dapat dikurangkan dengan menggunakan nyalaan pembakaran yang kecil dan melaraskan nisfah udara kepada minyak sehingga mencapai tahap pembakaran yang lengkap. Selain daripada itu, factor-faktor lain yang turut memainkan peranan adalah kandunagan udara, jenis bahan pembakar dan jenis nyalaan.

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SYMBOL	DEFINITION
CO	carbon monoxide
CO_2	carbon dioxide
CH4	methane
$C_{12}H_{26}$	Dodecanese
E	Excess air
FI	Flame intensity
HNO_3	nitric acid
H_2SO_4	sulfuric
H_2O	Water
K_2	Constant fuel value
LPG	Liquid petroleum gas
NO/NO_x	nitrous oxide
N_2O	nitrogen- dioxide
NO_3	nitric anhydride
N_2O_5	nitrous anhydride
NO_2	nitrogen trioxide
O_2	Oxygen
ppm	part per million
RN	Hydrocarbon radical
S.S.C	Specific Steam Consumption
SO_2	sulfur dioxide
SO_3	sulfur trioxide

GREEK SYMBOL	DEFINITION
ή	Efficiency
Л	Phy
Δ	Finite change in quantity

NOMENCLATURE	DEFINITION
KE	Total kinetic energy,kJ
N	Speed,m/s
P_b	Brake power
PE	Total potential energy, kJ
Q	Total heat transfer, kJ
Q_s	Heat supplied, kJ
S	Total entropy,kJ/K
T	Temperature,^{o}C or K
T	Torque,Nm
W	Total Work, kJ

SUBSCRIPT	DEFINITION
h	Specific enthalpy, kJ/kg
s	Isentropic
w	Work per unit mass, kJ/kg

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CHAPTER I

INTRODUCTION

Electricity is the only form of energy which is easy to transport, to use and easy to control. So it is mostly the terminal form of energy for transmission and distribution. Electricity consumption per capita is the index of the living standard of people of a place or country. Electricity in bulk quantities is produced in power plant, which can be of the following types: (a) Thermal, (b) Nuclear, (c) Hydraulic, (d) Gas Turbine and (e) Geothermal. Thermal, nuclear and geothermal power plants work with steam as the working fluid and have many similarities in their cycle and structure.

There is a growing concern about the environment all over the world. Environmental degradation is indeed a global problem as the environment is without borders. Especially the air pollution which accompanied by industrial development major environmental problems all over the world have serious implications for the health and well-being of people in the countries, both industrialized and developing.

According to the statistical data of the United States chemical air pollution in 1966, the largest contributors of the air pollution is the motor vehicles (60.6%), followed by industry and power plants (20.9%), and other small contributors such as space heating and reuse (9.1%) [5]. Power plants are, therefore, not the sole or largest contributors to environmental problem. However, there is a growing concern, as their numbers and size will continue to increase in decades ahead, especially for Malaysia, a country aims for vision 2020.

By foreseeing the effects of this growing concern which are now maybe neglected by some people, this project paper is prepared to study the gas flue from steam power plant.

1.1 OBJECTIVE PROJECT

The objective of this project is to analyze the composition of flue gas from steam power plant power in Thermodynamics lab in the Faculty of Mechanical Engineering in National of Technical University College of Malaysia by using the parameter that can be used to reduce or capture the pollution.

1.2 SCOPE PROJECT

The scope for this study is to analyze the composition of flue gas from steam power plant by calculate or identify the composition of different gasses in term of percentage. From this analysis, we must find the solution to reduce certain gas. It must come out with the cause of why certain gas is higher in term of composition than others.

1.3 PROBLEM STATEMENT

The problem statements for this study is to reduce or capture the condition of gasses come out from steam power plant. As we know there is a growing concern about the environment all over the world. Environmental degradation is indeed a global problem as the environment is without borders. And let us know that steam power plant is one of the sources that affected the air pollution which accompanied

by industrial development major environmental problems all over the world have serious implications for the health and well-being of people in the countries, both industrialized and developing. Therefore this study is pertaining to the above matter due to reduce the percentage of certain gasses in steam power plant.

1.4 PROBLEM ANALYSIS

The analysis that will be used is by calculate or identify the composition of different gasses in term of percentage. As we know, the problem of this project is to find the solution to reduce those gasses in term of pollution safetyness. Therefore some measurement apparatus is to be use for measure the percentage of those gasses.

CHAPTER II

STEAM POWER PLANT CYCLE

2.1 INTRODUCTION

Thermodynamics had its beginning in attempts to design a system to produce work from various sources of energy. For example, the design of electric power generating system starts with the application of certain basic engineering principles. The principles are called the First and Second Laws of thermodynamics. This chapter presents a brief review of the thermodynamic principles and their application to various processes [1]. In addition, the chapter covers the most commonly used power generating cycle that is steam power cycle. The Camot cycle is discussed and followed by Rankine cycle.

2.2 BASIC ENGINEERING PRINCIPLES

The first law of the thermodynamics states that energy is conserved. The overall energy balance established by the first law of thermodynamics applies to both reversible and irreversible processes. Although energy is conserved, it is, impossible to cover the original mechanical energy. There is no restriction in the direction of flow of heat and work in the first law of thermodynamics.

However, the first law of thermodynamics is not sufficient to describe a thermodynamics system fully. Therefore, through experimental evidence, the Second Law of thermodynamics is formulated whereby all thermodynamics cycles satisfy both the first and second laws of thermodynamics.

The Second law of thermodynamics states that heat normally flows from a higher temperature reservoir to a lower temperature sink and it is impossible to convert heat to work without outside effects taken into consideration. No matter what process is utilized for the conservation of thermal energy, there will be some losses in the total heat supplied The second law of thermodynamics is used to determine the maximum efficiency possible for a system. The second law also implies that all natural processes are irreversible.

2.3 STEAM POWER PLANT CYCLES

A cycle is a series of processes that begins and ends at the same time and can thus repeat indefinitely as long as needed The two basic power generating cycles are the carnot cycle and the rankine cycle.

2.3.1 The Carnot Cycle

The Carnot cycle is the ideal theoretical cycle. The Carnot cycle is the most efficient cycle that can operate between two constant temperature reservoirs[2]. The Carnot cycle serve as a useful comparison because the Carnot cycle is similar in many ways to a simple steam power plant cycle. With Carnot cycle, all the heat supplied is supplied at one fixed temperature, and all the heat rejected is rejected at a lower fixed temperature[3].

The cycle therefore consists of two isothermal processes joined by two adiabatic processes. Since all processes are reversible, then the adiabatic processes in the cycle are also isentropic. The cycle is most conveniently represented on a T-S diagram. The Carnot cycle consists of the following four processes as shown in figure 2.1.

1. The process 1-2 is reversible and adiabatic. The working substance expands and has it temperature decreased to that. of the low temperature reservoir.
2. The process 2-3 is reversible and isothermal. Heat is transferred to the low temperature reservoir.
3. The process 3-4 is reversible and adiabatic. The working substance is compressed and has its temperature increased back to that of the high temperature reservoir.
4. The process 4-1 is reversible and isothermal. Heat is transferred from the high temperature reservoir.

2.3.2 The Rankine Cycle

The ideal cycle for a simple power plant is a modification of the Carnot cycle. This ideal cycle, which is more suitable as a criterion for actual steam cycles than the Carnot cycle is called the Rankine cycle. Figure 2.2 indicated that the Rankine cycle is similar to the Carnot cycle with one exception in the condensation process.

Although the Carnot cycle is the most efficient cycle, unfortunately its work ratio is low. In contrast; the Rankine cycle is less efficient than a Carnot cycle for the same maximum and minimum temperatures. However there are practical difficulties in achieving Carnot cycle. Considering the Carnot cycle for steam as shown in figure 2.l, at state 2 the steam is T_2.

It is difficult to stop condensation at point 3 and then compress it just to state 4. It is more convenient to allow the condensation process to proceed to completion, as in figure 2.2. The working fluid is water at the new state point 3 in figure 2.2 and this can be conveniently pumped to boiler pressure as shown at state point 4. The pump has much smaller dimensions than it would have if it had to pump a wet vapour, the compression process is carried out more efficiently, and the equipment required is simpler and cheaper[3].