

DESIGN OF SCRUBBER SYSTEM FOR TREATMENT OF WELDING GASES

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This report is submitted
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DECLARATION

I declare that this report entitled “Design of Scrubber System for Treatment of Welding Gases” is the result of my own work except for quotes as cited in the references.

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APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Bachelor of Mechanical Engineering with Honours.

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ABSTRACT

In the history of industrial development, until today, it is customary in the manufacturing process that the production of the products from the metals are carried out mostly using welding process to produce certain product. During the welding process, welders will be exposed to fume that is released as a result from the welding rod burning which is harmful to their health. This problem should be prevented to comply occupational safety and health requirement by the Department of Occupational Safety and Health Malaysia, by using specially designed scrubber that used to scrub the welding fume before it is released to the atmosphere. The purpose of this project is to design and fabricate a scrubber system that can remove welding fume to ensure that the fume is sucked out from the welding working space and later on scrubbed in a scrubber chamber thus create safe and healthy working environment and surrounding. The scrubber system that was selected to be used in this project is a wet scrubber system. As we know nowadays, the scrubber technology has been widely used in various application not only in cleaning the welding fume but also in all gases scrubbing in all kind of industries that release flue gases. The fabricated scrubber system was then tested in a welding workshop to assess its performance and efficiency in scrubbing the welding fume before released to the open atmosphere.

ABSTRAK

Dalam sejarah pembangunan perindustrian, sehingga hari ini, adalah menjadi kebiasaan dalam proses pembuatan bahawa pengeluaran produk dari logam dijalankan kebanyakannya menggunakan proses kimpalan untuk menghasilkan sesuatu produk tertentu. Semasa proses kimpalan dijalankan, kebiasaannya pengimpal akan terdedah kepada asap yang dibebaskan akibat pembakaran rod kimpalan yang membahayakan kesihatan mereka. Masalah ini harus dicegah untuk mematuhi peraturan keperluan keselamatan dan kesihatan pekerjaan oleh jabatan keselamatan dan kesihatan pekerjaan Malaysia, dengan menggunakan scrubber yang direka khas yang digunakan untuk merawat asap kimpalan sebelum dilepaskan ke atmosfera. Tujuan projek ini adalah untuk mereka bentuk dan menghasilkan sistem scrubber yang boleh mengeluarkan asap kimpalan yang bersih dan untuk memastikan bahawa asap disedut dari ruang kerja kimpalan dan kemudian disejukkan di ruang pengelek sehingga mewujudkan persekitaran kerja yang selamat dan sihat. Sistem scrubber yang telah dipilih untuk digunakan dalam projek ini adalah sistem scrubber basah. Pada masa kini seperti yang kita tahu, teknologi scrubber telah digunakan secara meluas dalam pelbagai aplikasi bukan sahaja dalam membersihkan asap kimpalan tetapi juga semua gas dalam semua jenis industri yang melepaskan gas dari serombong. Sistem scrubber yang dihasilkan kemudian diuji dalam bengkel kimpalan bagi menilai prestasi dan kecekapannya dalam merawat asap kimpalan sebelum dilepaskan ke persekitaran terbuka.

DEDICATION

I dedicate this thesis to my supervisor, Prof. Madya Ir. Dr. Ts. Abdul Talib bin Din and to my friend Muhammad Faizal bin Mohd Akram, Ahmad Khuzairi bin Abu, Ahmad Naufal Hakimi bin Aminuddin who have guide me throughout this project. This thesis is also dedicated to my parents who have been a great source of support mentally and physically.

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LIST OF SYMBOLS AND ABBREVIATIONS

SO ₂	-	Sulfur Dioxide
Cl ₂	-	Chlorine
PM	-	Particulate Matter
CO ₂	-	Carbon Dioxide
CO	-	Carbon Monoxide
NO _x	-	Nitrogen Oxides
SO ₂	-	Sulphur Dioxide
O ₃	-	Ozone
SMAW	-	Shielded Metal Arc Welding
GMAW	-	Gas Metal Arc Welding
FCAW / MIG	-	Flux Cored Arc Welding
GTAW / TIG	-	Gas Tungsten Arc Gas Welding

GRE	-	Glass Reinforced Epoxy
QFD	-	Quality Function Development
HOQ	-	House Of Quality
PVC	-	Polyvinyl Chloride
AC	-	Alternating Current
L/G	-	Liquid-To-Gas
NDIR	-	Non-Dispersion Infrared
LCD	-	Liquid Crystal Display
RPM	-	Revolutions Per Minute
TDS	-	Total Dissolved Solids
PPM	-	Parts Per Million
EPA	-	Environmental Protection Agency
Q	-	Flow Rate
A	-	Area
V	-	Velocity

LIST OF APPENDICES

- A Detailed Design
- B Gantt Chart of PSM II

CHAPTER 1

INTRODUCTION

This chapter covers the background of study, problem statement, objectives, and scopes of this project. The chapter overview is also included in this chapter.

1.1 BACKGROUND STUDY

In the process of developing a developed country, the environment is an important element of stable development. Under the Malaysian environmental quality (1974) law, the environment means the physical factors surrounding human life. It includes soil, water, climate, sound, odor, taste, biological factors and social factors that depend on each other, between biological factors and physical factors.

A wet scrubber system is one form of scrubber that is used to take away harmful gases from industrial exhaust gases known as flue gas before they are discharged into the atmosphere. It absolutely was the initial form of cleansing system, and utilizes a wet substance to get rid of acidic gases that contribute to acid precipitation. The scrubber system also uses a water spray system to remove acidic and toxic gases because this water spray can absorb dirty smoke at the same time that it can contribute to acid rain (Bashir, 2014)

When smoke comes in the scrubber. The first process of the smoke will be sprayed by water and the clean smoke will rise up and be released. When the gas is sprayed with liquids, the heavier contaminants are pulled out of the gas and attached to the liquid due to its

chemical composition. The chemicals can be used together with water. These chemicals are specifically selected to react with certain air pollutants-typically acidic gas. Burning exhaust gas may contain substances that are considered harmful to the environment, and the cleaner can remove or neutralize it. Wet scrubber system are used to clean air, fuel gas or other gases from a variety of contaminants and dust particles such as sulfur dioxide (SO₂) and chlorine (Cl₂) (Thipichpon, 2016)

1.2 PROBLEM STATEMENT

The Industry welding grows quickly and rapidly from year to year. Technological advances are increasingly sophisticated but many ignore the responsibility to safeguard the environment, which will affect both human health and the environment. The environment will be affected if this air pollution problem is not controlled by every industry or plant. Industry that liberates and emits polluted smoke into the air due to burning and also the process of producing a product will cause air pollution. To solve this problem, we need to generate a device that can take care and protect the environment from being affected as a result of smoke and contaminated material and control which greatly reduced the contaminated air during welding work and boost the productivity of the factory. Most welding procedures, by their task mode and the mechanical hardware utilized, majorly affect nature and contamination is not at all insignificant (Popovic, 2014)

1.3 OBJECTIVES OF THE PROJECT

The aim of this study is to improve the production of scrubber system for environment especially health of welder and to take care and make sure to be safe from

fumes and gases during the process of welding operation. Therefore, the objectives of this project are:

1. To design a prototype of scrubber system for the treatment of welding fume during the process or operation and releasing the clean gases to the environment.
2. To design a scrubber system using the CATIA V5R21 software and chose the right dimension for this design.

1.4 SCOPE OF RESEARCH WORK

This research aim is a study in production of design of scrubber system for treatment of welding fume. To obtain the research objective, three elements have been identified to be studied in this experiment. The three elements are:

- I. To design a tool that can absorb welding fume that is harmful to human health.
- II. To study and read research literature on how to solve environmental pollution problems that have taken place.
- III. This machine will be attached with some mechanism like Motor, Smoke Extractor Fan, filter and switch.

1.5 ORGANIZATION OF REPORT

The report is divided into several chapters and these chapters will explain about the information of the study. The organization of this report will be as follows; Chapter 1, the Introduction covers the project introduction, objective of the project, problem statement, and scope of study and brief description of the methodology. Next comes, Chapter 2, the Literature Review that covers the scrubber system process. Chapter 3 is about Methodology where it touches on method that is used including the design of the system. Then, Chapter 4 will tell

about the result and discussion obtained along the study. Finally, Chapter 5 includes the conclusion and recommendation for this project.

CHAPTER 2

LITERATURE REVIEW

2.0 LITERATURE REVIEW

This chapter contains the literature review that based on the objectives and scope of the project. This chapter is conducted in order to complete this research. This chapter contains welding process, scrubber process, fumes and gases management process, design optimization, piping system, electric application and the component of scrubber system.

2.1 THE SCRUBBER SYSTEM PROCESS.

Scrubber system is a tool that is used to filter and absorb the contaminated smoke caused by several factors, namely combustion, exhaust fumes from the plant, welding fumes, smoke from the vehicles, and many others. This scrubber system uses clean water drainage to trap and absorb the contaminated gases. The Government has set the rules and laws that must be followed by every industry. As an alternative or a way to preserve the environment from pollution is caused by the emancipation of pollution of smoke. Among the tools that can be used to clean the contaminated smoke is a wet scrubber system. It can reduce the toxic gases such as sulfur dioxide and chore through the exhaust drainage (Thipichpon, 2016)

2.2 SCRUBBER TYPE

There are a number of different types of scrubbers which vary in terms of both function and performance.

2.2.1 SPRAY TOWER

The simplest and most commonly used scrubber type is the type of spray tower. The nozzle spray will connect the liquid spray on the upper space where the liquid will be applied to the incoming gases. This type of scrubber can be mounted vertically or horizontally. Figure 2.1 shows the flow of incoming gas from the bottom space and will flow upwards. Water spray down from the nozzle attached to the center of the tower (Mussatti, 2002)

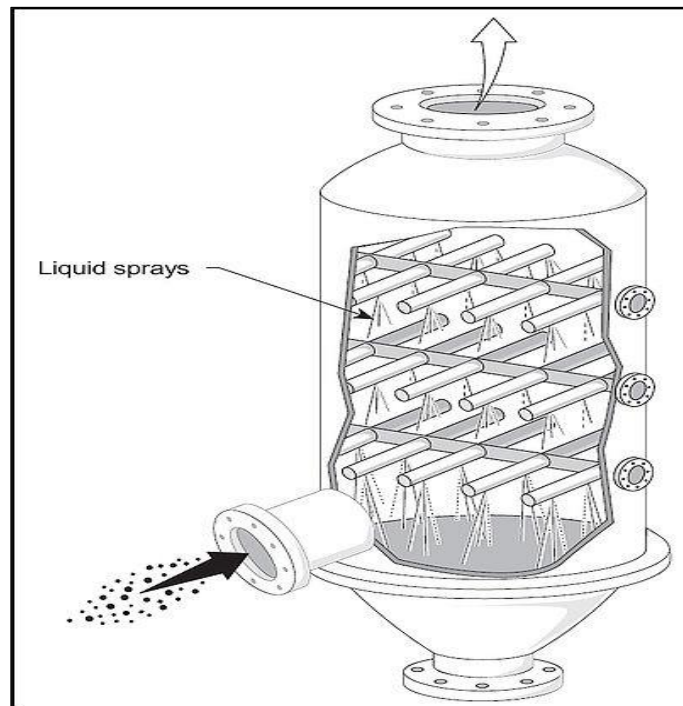


Figure 2.1: The Spray Tower Scrubber