UNIVERSITI TEKNIKAL MALAYSIA MELAKA

THE OPTIMIZATION OF WELDING PARAMETER FOR JOINING MILD STEEL 1020 USING ABB METAL INERT GAS (MIG) ROBOT WELDING

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Engineering Technology (Process and Technology) (Hons.)

by

NUR FATIHAH BINTI NASRUDIN

B071410549

951117105118

FACULTY OF ENGINEERING TECHNOLOGY

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NUR FATIHAH BINTI NASRUDIN	MOHD HAIRIZAL BIN OSMAN
No. 3, Jalan P8E/5, Presint 8, Putrajaya 62250, W.P. Putrajaya	Cop Rasmi:
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Signature	:	………………………………………….
Author's Name	:	NUR FATIHAH BINTI NASRUDIN
Date	:	…………………………………………

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology (Process and Technology) with Honours. The member of the supervisory is as follow:

……………………….

(MR MOHD HAIRIZAL BIN OSMAN)

ABSTRAK

Laporan ini adalah hasil daripada eksperimen untuk mengenal pasti kekuatan tegangan pada kawasan kimpalan. Dengan menggunakan Robot Kimpalan ABB Gas Lengai Logam untuk mengoptimumkan tetapan pada parameter kimpalan pada arus elektrik, voltan, kelajuan kimpalan dan corak kimpalan pada keluli lembut AISI 1020 sebagai bahan kerja. Umumnya, parameter kimpalan akan mempengaruhi keputusan kekuatan tegangan untuk bahan kimpalan. Corak eksperimen menggunakan Kaedah Taguchi dibina, nisbah isyarat bunyi digunakan untuk mempelajari kesan parameter kimpalan pada bahan yang dikimpal.

ABSTRACT

This report is the result of an experiment to investigate the tensile strength of the welding area. By using ABB Metal Inert Gas(MIG) Robot Welding to optimize the setting of welding parameter of voltage, welding speed and welding pattern on tensile strength of welding area of Mild Steel AISI 1020 as a workpiece material. In the main, the welding parameter will be influenced the result of tensile strength of welding material. The design of experiment by using Taguchi Method was created, the signal to noise ratio was used to study the welding parameter effect to tensile strength of the welding part.

DEDICATIONS

This project was dedicated to my parents, Mr. Nasrudin Bin Abdullah and Mrs Suriati Binti Ibrahim, all my siblings and my friends. Not to forget, to my supervisor Mr. Mohd Hairizal Bin Osman. Thank you for your idea and support so that the report can be completed successfully.

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TABLE OF CONTENT

LIST OF TABLE

LIST OF FIGURES

LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

ANOVA	-	Analysis of Variance
Al	-	Aluminium
MIG	-	Metal Inert Gas
GMAW	-	Gas Metal Arc Welding
HAZ	-	Heat Affected Zone
SMAW	-	Shielded-Metal Arc Welding
OA	-	Orthogonal Arrays
DoE	-	Design of experiment
S/N	-	Signal-to-Noise ratios
AISI	-	America Iron and Steel Institute
ASTM	-	American Standard Testing and Material
UTS	-	Ultimate Tensile Strength
DF	-	Degree of Freedom

CHAPTER 1

INTRODUCTION

1.0 Introduction

This chapter includes the background of the study, problem statement, objective and scope. This chapter is an initiation to the whole project about joining low carbon steel 1020 using Metal statement, objectives that is expected to be achieved and the scope of the study that is going to be conducted.

1.1 Background of study

Low carbon steels generally contain less than 0.25% carbon and cannot be strengthened by heat-treating. The low carbon material is relatively soft and weak, but has outstanding ductility and toughness. In addition, it is machinable, weld-able, and is relatively inexpensive to produce. Low carbon steel is widely used in high volume screw machine parts applications, such as shafts, spindles, pins, rods, sprocket assemblies, and an incredibly wide variety of component parts. Robotic Metal Inert Gas (MIG) welding, also known as Gas Metal Arc Welding (GMAW) is a commonly used, high deposition rate process that involves feeding a wire continuously toward the heated weld tip. It is considered a semi-automatic welding process. MIG welding is one of the most popular forms of welding in industrial applications and is an easy process to integrate to a robot system. MIG welding provides a faster process than other forms of welding, especially when robots are incorporated. The first robot welding machine established is when the automotive industry began using robots extensively for spot welding. This welding machine was used widely because it gave better result than manpower itself. The accuracy and precision of robot welding give the best output.   MIG welding robots are capable in all position, this factor helps the welding system to be more flexible, higher quality welds can be and more efficient processes are just some of the advantages of MIG welding automation. The factor of safety for the welder is also increases as it is safe from dangerous fumes, higher quality welds can be improved and the efficiency of the welding process can be enhanced. Tensile test is also known as tension test is probably the most fundamental type of mechanical test that can be performing on welding part to see the strength of welding area. Tensile tests are simple, relatively inexpensive, and fully standardized. By pulling on something, you will very quickly determine how the material will react to forces being applied in tension.

1.2 Problem Statement

In welding process, the parameter is one of the important factors that affect the welding strength. The parameter consists such as voltage, welding speed and welding pattern. By using Taguchi Method, we are going to achieve the optimize parameter for welding low carbon steel 1020 using four variables at three levels. Different kind of parameter will produce different result, so the parts that have been welded will be tested using tensile test machine. The best parameters will be presented with a good result of tensile test.

1.3 Objective

The objective of this project includes the main point of the research and the result that we can get from the research. These are the following objectives:

I. Examine the strength of the welding area for the different specimen using different parameter.
II. To examine the factor that gives more contribution on welding strength
III. To determine the optimum welding parameter for joining Mild Steel plate 1020.

1.4 Scopes

Firstly, cut the raw material to the needed dimensions is 140mm (length) x 130mm (width) x 6mm (thickness). On every pair of plate, there will be a groove (30˚). The welding parameter will be setup on the machine, there will be nine samples with different parameter. The welding process is fully conducted using MIG robot welding. After the welding process, each of the samples will go through the tensile test. The result for each plate with different parameter will be examined.

Table 1.1: Type of parameter

PARAMETERS	LEVELS			OBSERVED VALUES (MPa)
Voltage (V)	21	22	23	Tensile Strength
Welding Speed (m/mm)	4.5	5.5	6.5	
Welding Pattern	Straight	Triangle	Spiral	

Table 1.2: Experimental layout using Taguchi Method

Part	Voltage	Welding speed	Welding pattern
1	21	4.5	Straight
2	22	5.5	Triangle
3	23	6.5	Spiral
4	21	4.5	Spiral
5	22	5.5	Straight
6	23	6.5	Triangle
7	21	4.5	Triangle
8	22	5.5	Spiral
9	23	6.5	Straight

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

In this chapter, it consists of literature review by the previous researched based on articles, books, journal and other sources. The explanation of this chapter included about the Metal Inert Gas (MIG) Welding, welding parameter, and material of mild steel and design of the experiment. It covers all the information that has been used in this research and project.

2.1 Joining Technology

Joining process is processes which combine two parts to become one part, this technology usually used in manufacturing process as it is one of the most processes that can upgrade strength of one part. Several parts is also too big to make it as one part, so joining process could takes place and combine the small part into something big such as underground pipeline. The manufacturer cannot produce such a long pipeline using one process, so they make it in small part and join the parts using joining process. The other reasons the products that using joining process can be disassembled for maintenance likes engine's part. The most familiar joining process that involve in joining process is welding, brazing, soldering, adhesive bonding and mechanical fastening.

2.1.1 Welding

Welding process usually takes place in joining metal because it required a high temperature during the process. Two or more parts are joined permanently at their touching surfaces by a suitable application of heat. Usually used a filler material as a molten material to form a joint between the parts.

2.1.2 Brazing

Brazing is different from welding because it does not melt the base metal. Brazing process takes place by melting the filler and flowing through the gap of the part. The filler metal flows into the gap between close-fitting parts by capillary action. The filler metal is brought slightly above its melting temperature while protected by a suitable atmosphere, usually a flux. It then flows over the base metal and is then cooled to join the work pieces together (Groover, Mikell P., 2007).

In a journal from 1989, Scwartz state that high quality brazed joints requires that parts be closely fitted, and the base metals exceptionally clean and free of oxides. Cleanliness of the brazing surfaces is also important, as any contamination can cause poor wetting flow. The two main methods for cleaning parts, prior to brazing, are chemical cleaning and abrasive or mechanical cleaning. Other than that, the other consideration that has to take control while brazing is the effect of temperature and time on the quality of brazed joints. When the temperature of the braze alloy increasing, the alloying and wetting action of the filler metal increases as well.

For the filler materials, variety of alloys are used for brazing depends on the applications method. Usually, it made up of three metal to form an alloy that give the desired properties. The filler material usually come out in rod, ribbon,