UNIVERSITI TEKNIKAL MALAYSIA MELAKA

STUDIES ON SURFACE CLEANING METHOD FOR BEST STRENGTH OF SPOT WELDING

This report is submitted in accordance with the requirement of Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Manufacturing Engineering Technology (Process and Technology) with Honours

by

NOOR JULIZA BINTI JUNAIDI

B071310965

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I hereby, declared this report entitled “Studies on Surface Cleaning Method for Best Strength of Spot Welding” is the result of my own research except as cited in references.

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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 Manufacturing Engineering Technology (Process and Technology) with Honours. The member of the supervisory is as follow

……

(Mr Hanizam bin Hashim)

ABSTRAK

Kimplan rintangan titik kebiasaanya digunakan di dalam industry automotif, ini disebabkan kerana manfaatnya dari segi kelajuan yang tinggi,hasil pemasangan yang tinggi, dan sesuia dalam automasi. Keutuhan permukaan pada sesuatu bahan mempunyai kesan yang langsung kepada kekuatan penyambungan dalam kimpalan titik. Untuk mendapatkan kekuatan yang terbaik untuk kimpalan titik,kaedah pembersihan memberi kesan kepada kekuatan. Dalam kaedah pembersihan, terdapat 3 jenis pembersihan yang digunakan iaitu pembersihan kimia dengan turpentin, pembersihan kimia dengan sabun dan pembersihan mekanikal dengan kertas pasir. 3 ujian digunakan dalam projek ini iaitu mengunakan ujian penurunan untuk menganalisis sudut hubungan untuk menyelidik permukaan tenaga pada permukaan pembersihan, ujian tegangan untuk menganalisis kekuatan pada penyambungan kimpalan titik dimana beban maksimum yang boleh dikenakan sebelum sampel itu terpisah dua atau retak dan ujian pandangan menggunakan caliper untuk mengukur garis pusat nugget (mm) pada sampel. Dengan membuat analisis, kaedah pembersihan yang sesuai dapat ditentukan. Bahan yang digunakan dalam kajian ini adalah aluminium. Akhirnya, perbezaan keputusan menunjukkan kaedah pembersihan menggunakan Turpentine adalah yang terbaik untuk permukaan Aluminium.

ABSTRACT

Resistance spot welding is usually used in the automotive industry, because it has the benefit which is high-production assembly lines, high speed, and suitability for automation. The surface integrity of the material surface has direct impact to the joining strength in spot welding. To have best strength of spot welding, the cleaning methods affect the strength. The objective of this project is to study on the surface cleaning method for best strength of spot welding. In the cleaning method, there are 3 type of cleaning which are chemical cleaning by turpentine, chemical cleaning by soap and mechanical cleaning by sandpaper. 3 test are used in this project which is using drop test to analyze the contact angle to investigate the surface energy of cleaning surface, tensile test to analyze the strength of spot welding joining which maximum load that can be applied before the specimen is rupture or tears apart and visual test using calliper to measure the nugget diameter (mm) of the specimen. By doing the analysis, the suitable cleaning method can be determined. The material used in this study is Aluminium. Finally, the comparison result shown the cleaning by using turpentine is the best for the aluminium surface.

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DEDICATIONS

Dedicated to my beloved father, Junaidi bin Awi and my beloved mother, Saadiah binti Narawi

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Alhamdulillah, thank you Allah because of His blessing, I finally complete and finish my final year project successfully.

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$CC1_4$	-	Carbon tetrachloride
C_2 HCI_3 .	-	Trichloroethylene
kVA	-	Kilovolt-amp
kA	-	Kilo ampere
s	-	Second
%	-	Percent
Hz	-	Hertz
V	-	Voltage
A	-	Ampere
^oC	-	Degree Celsius
^{o}	-	Degree
mm	-	Millimetre
mm^2	-	Square millimetre
m/s	-	meter per second
kg	-	kilogram
in	-	inch
M Pa	-	Mega Pascal
daN	-	Decanewton
α	-	Alpha

CHAPTER 1
INTRODUCTION

1.0 Introduction

This chapter will explain about the general information of the study, background, problem statements, objectives, and scope.

1.1 Background

Spot welding (RSW) is a process in which contacting metal surfaces are joined by the heat obtained from resistance to electric current flow. Work-pieces are held together under pressure exerted by electrodes. Thickness of sheets range typically is in the 0.5 to 3mm (0.020 to 0.12 in). Two shaped copper alloy electrodes to concentrate welding current into a small "spot" and to simultaneously clamp the sheets together used in the process. The metal will melt and form the weld if forcing a large current through the spot. A lot of energy can be delivered to the spot in a very short time (about ten milliseconds.) is the attractive feature of spot welding. (Edward Smith et al, 2012)

The measure of heat (energy) delivered to the spot is determined by the resistance between the electrodes and the amplitude and length time of current. To match the sort of electrodes, sheet's material properties, and its thickness, the measure of energy is chosen. Metal won't melt or will make a poor weld if applying too little energy. Metal will melt too much if applying too much energy, eject molten material, and make a hole instead of a weld. The energy delivered to the spot can be controlled to deliver solid welds is another attractive feature of spot welding. (Edward Smith, 2012)

Two cleaning method are use which is mechanical and chemical method. Mechanical means such as wire brushing, shot blasting or grit blasting, grinding with emery paper or cloth-(These are widely used. They are effective in removing oxide layer, coatings and sand particles.)Chemical methods of cleaning include treatments with acid (pickling), alkaline cleaning, and cleaning with organic solvents. The common organic solvents for this purpose are kerosene, carbon tetrachloride ($CC1_4$) and trichloroethylene (C_2 HCI_3). These solvents dissolve oil, grease and paints.

1.2 Problem statement

Automotive industry uses resistance spot welding of it excellent joining strength and quick process. Surface cracks, internal cracking and a bad appearance is the physical effects of spot welding. The problems regarding in the spot welding are surface integrity of the material surface has direct impact to the joining strength. The main problem that must be solved is how to get the highest strength of spot welding by using best cleaning methods.

1.3 Objective

1. To study on the surface cleaning method for best strength of spot welding.
2. To investigate the surface energy of cleaning surfaces using drop test.
3. To establish the correct cleaning process dealing with spot welding

1.4 Scope of the project

The work scope of this project is to study the surface cleaning method. This focus area is done based on the few aspect which are only one material that is aluminium material and 1mm thickness that will be use in this study. 10 sample of each cleaning method before weld will be test by using drop test and 10 sample of each cleaning method will undergo spot welding process which make it become 5 sample after welding(sample will be weld by perform lap joint using spot welding) will test by using tensile test. This study can be divided into 3 cleaning methods which are study cleaning method based on mechanical approach for example cleaning with sand paper. There will be also using cleaning method based on chemical approach which is organic solvents-turpentine and soap.

CHAPTER 2

LITERATURE RIVIEW

2.0 Introduction

The purpose of this literature is to discuss the related case studies associated to the topic to help students in completing the objective. Books, journals, and articles were used including the internet in order to understand everything about this. In this chapter we will be going through the resistance spot welding, principle cleaning method. Besides that we are going to discuss about material mild steel sheet metal.

2.1 Welding

Welding is a sculptural process of joining two or more pieces of materials either same or dissimilar to achieve complete coalescence. Usually this is achieved by using heat and pressure. Today, welding is used widely for fabrication such as pressure vessels and boilers, ships, bridges, railway coaches, pipeline, automobile bodies, water turbines and press frames. This also includes fertiliser and chemical plants. Classification of welding process is shown as figure 2.1 below.

Master Chart of Welding and Joining Processes and Master Chart of Allied Processes

(This Annex is not part of ANSI Z49.1:2005, *Safety in Welding, Cutting, and Allied Processes*, but is included for informational purposes only.)

Master Chart of Welding and Joining Processes

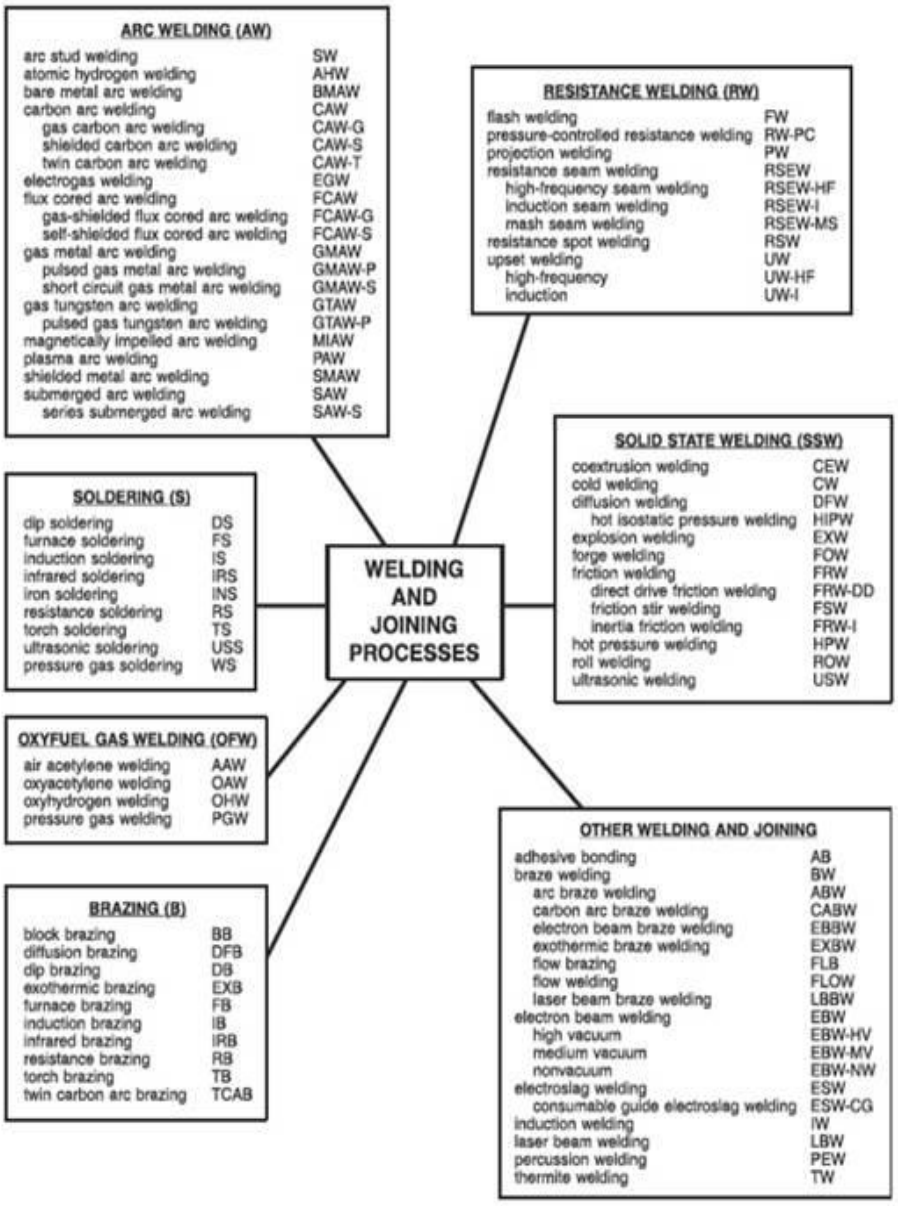

Figure 2.1: Classification of Welding and Joining Processes

2.2 Resistance spot welding

One of the oldest welding processes in use in the industry is called resistance welding. The combination of heat, pressure, and time produce the weld .The resistance of the material to be welded to current flow that causes a localized heating in the part is what implies the resistance welding. The tongs and electrode tips produce pressure through which the current flows, holds the part to be welded tight, during, after the welding current time cycle. The material thickness and type, the amount of current flowing, and the cross-sectional area of the welding tip contact surfaces will determined amount of time current flows in the joint. The Figure 2.2 below show how each parts of the resistance spot welding are determined. (Miller,2012)

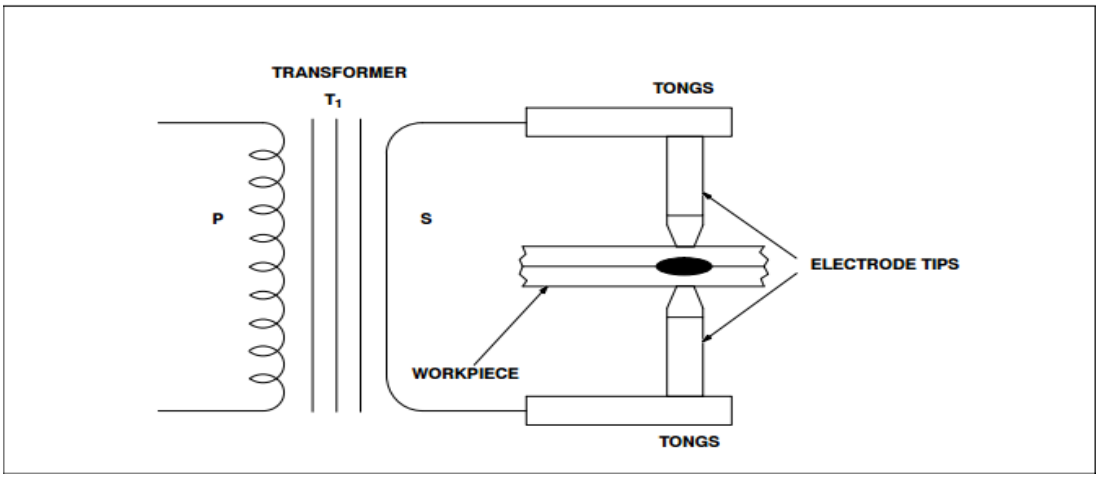

Figure 2.2: Resistance Spot Welding with work piece

2.3 Principle of the resistance spot welding

In order to accomplish the resistance welding, the current is caused to flow through electrode tips and the separate pieces of metal to be put together. Weld is formed by the localized heating in the joint which is caused by the resistance of the base metal to electrical current flow. The actual weld nugget is formed internally in relation to the surface of the base metal which makes the resistance spot weld unique and different. The Figure 2.3 below shows a resistance spot welding.

Figure 2.3: Resistance Spot Welding

The resistance of the joint surfaces to electrical current flow will make the interface of the weld joint heated thus producing the resistance spot weld nugget. It is important thing to make sure the current must flow. During the making of the weld the pressure of the electrode tips on the workpiece holds the part tight meaning in close and intimate contact. Despite of that, the resistance spot welding machines are not constructed as force clamps to pull the workpieces together for welding. (Miller, 2012)

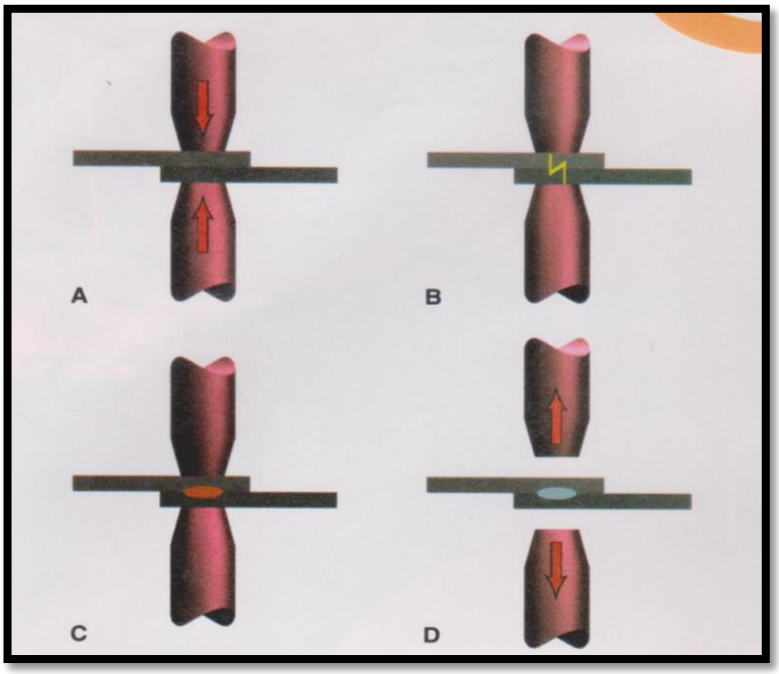

Figure 2.4: Steps in making spot weld

There are a few steps in making spot weld as shown in Figure 2.4 above. The metal is clamped between the electrodes under pressure in picture A. Picture B shows how the process current flows. Weld nugget is formed in the picture C and picture D display how the electrodes are removes after the weld become solid. (William A. Bowditch, 2005)