

# TO OBTAIN THE OPTIMUM PARAMETERS FOR WELDING OF COPPER AND ALUMINUM USING FRICTION WELDING TECHNIQUE

## MCDAWSON ANAK DEWK (2007271162)

A thesis submitted in partial fulfillment of the requirement for the award of Bachelor Engineering (Hons) Mechanical

> Faculty of Mechanical Engineering Universiti Teknologi MARA (UiTM)

> > JANUARY-MAY 2010



#### ACKNOWLEDGEMENT

I am very thankful and highest gratitude towards God, it is because of His blessing that I am manage to finish the intended task, which is my Final Year Project KJM660.

Contribution to the success of this project came from the many people who have helped me, directly and indirectly, with their intellectual insights, kindness and moral support.

I extended my sincere acknowledgment to my advisor, Assoc. Prof. Sunhaji Kiyai Abas and also my co-supervisor, Dr. Yupiter HP. Manurong for giving me space to learn and pursue my practical smoothly.

Not to be missed, much gratitude to my family and friends who have given me more than a hand needs directly or indirectly through my practical. Their support and patience really gave me the surplus of energy to finish this report.

Thank You.

ii

#### ABSTRACT

Friction welding is one of the most simple, economical and highly productive method to join similar and dissimilar metals. Welding dissimilar metals is one of the biggest challenges faced by manufacturers and users because of difficulty to find the suitable welding parameters to cause good bonding to happen. The aim of this project is to focus on the finding of optimum parameters of friction welding technique to desired welding quality. In the present work, pure copper was friction welded to aluminum allow (6061 Al). The diameter and length of both rods are 10mm and 60mm respectively. Surfacing is done on the copper to ensure that bonding occurred at the interface of the welded joint. Copper is the rotational part due to its hardness, while aluminum is the stationary part. Four parameters that need to be determined are the heating pressure, the heating time, the upset/ forging pressure, and the forging/ weld time, which will be obtained in sequence. On the other hand, the warm up pressure, warm up time, and the rotational speed are set to be constant. Five samples are used to determine each parameter. Various tests such as Visual Inspection, Tensile Test, Bending, Macro Structure Test, and Radiographic Test would be conducted to meet the weld quality requirement. It is found that the best optimum welding parameters between copper and aluminum are as follow; warm-up pressure =  $10 \text{kgf/cm}^2$ , warm-up time = 1 sec, heating pressure =  $45 \text{kgf/cm}^2$ , heating time = 4sec, forging pressure =  $65 \text{kgf/cm}^2$ , the, and forging time = 5sec.

iii

### TABLE OF CONTENT

	CON	CONTENT		
	PAG	i ii iii iv		
	ACK			
	ABS			
	TAB			
	LIST	vii		
	LIST	viii		
CHAPTER 1	INT	1		
	1.1	BACKGROUND	1	
	1.2	OBJECTIVE	2	
	1.3	SCOPE OF STUDY	2	
	1.4	SIGNIFICANT OF PROJECT	3	
CHAPTER 2	LITERATURE REVIEW			
	2.1	<b>REVIEWS ON WELDING TECHNIQUES</b>	4	
		2.1.1 Outlines of Welding Techniques	5	
	2.2	<b>REVIEWS ON FRICTION WELDING</b>	5	
		2.2.1 Specification of friction welding machine	6	
	2.3	COPPER (CU)	8	
		2.3.1 Characteristic of Copper	8	
		2.3.2 Weldability of copper alloy	9	
	2.4	ALUMINUM (AL)	10	
		2.4.1 Characteristic of Aluminum	10	

**`**.

		2.4.2 Weldability of copper alloy	10
	2.5	APPLICATION OF FRICTION-WELDED COPPER	12
		TO ALUMINUM	
CHAPTER 3	MET	HODOLOGY	
	3.1	SPECIMEN	13
	3.2	SPECIMEN PREPARATION	14
		3.2.1 Cutting the Specimen	14
		3.2.2 Surface preparation	15
	3.3	WELDING PROCESS	15
		3.3.1 Theories of Friction Weld	16
		3.3.1.1 Preparation on the friction welding machine	16
		3.3.1.2 Procedure involve in friction welding	17
	3.4	FRICTION WELDING DATA	19
		3.4.1 Forging pressure	19
		3.4.2 Heating pressure	20
		3.4.3 Heating time	20
		3.4.4 Forging time	21
		3.4.5 Optimum parameter	21
	3.5	REMOVING THE FLASH	21
	3.6	PREPARATION FOR NON-DESTRUCTIVE TEST	22
		(NDT) AND DESTRUCTIVE TEST (DT)	
		3.61 Visual Inspection	22
		3.62 Radiography test	23
		3.63 Tensile test	23
		3.64 Bending test	24
		3.65 Microstructure test	24
CHAPTER 4	RESU	JLT	
	4.1	COMPOSITION OF COPPER AND ALUMINUM	27
	4.2	FORGING PRESSURE	28
	4.3	HEATING PRESSURE	30