DESIGN, FABRICATION AND TESTING OF A SEMI-AUTOMATIC WELDING FIXTURE FOR CIRCUMFERENTIAL JOINING CYLINDERS USING MIG WELDING

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To my believed "Allah s.w.t"

And to my beloved mother and father

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ABSTRACT

This paper presents the systematic approach of design, fabrication and testing of the circumferentially joining on welding fixture which is being carried out at Kolej Kemahiran Tinggi MARA Balik Pulau (welding fabrication) and PPKM, Kampus Kejuruteraan USM Nibong Tebal, Pulau Pinang (destructive testing). The MIG welding unit is used to make a circumferential joining on tank and piping which are fixed onto the welding fixture and a several parameters setting of voltage, current and travel speed (rotational speed) is used for fabrication setup. The ASME (American Society of Mechanical Engineers) Code VIII (Pressure Vessels and Piping) is applied based on circumferential welding methodology standard. The research are focused to the structure produce by emphasis on the mild steel (0.16 – 0.29% carbon) as the common tank and piping materials. The fabrication fixture with constant speed of rotation by revolved the tank or pipe is developed as a dynamic structure with electrical adjustable speed control motor. The joint of mechanical properties are determined by means of static tensile test, impact test and hardness test. The correlation between the welding joint and destructive testing is evaluated of its welding joint structure by using microscope.

ABSTRAK

Kertas kajian ini menggunakan pendekatan sistematik terhadap rekabentuk, fabrikasi and ujian terhadap penyambungan secara lilitan pada perkakasan kimpalan yang mana dilaksanakan di Kolej Kemahiran Tinggi Mara Balik Pulau (untuk fabrikasi kimpalan) dan di PPKM, Kampus Kejuruteraan, Universiti Sains Malaysia, Pulau Pinang (untuk ujian dan analisa). Unit kimpalan MIG digunakan untuk menghasilkan kimpalan lilitan pada tangki dan paip yang mana dipasang diatas perkakasan kimpalan dan beberapa pelarasan parameter terhadap voltan, arus dan kelajuan gerakan (kelajuan putaran) digunakan sebagai penetapan fabrikasi. Piawaian ASME (American Society of Mechanical Engineers) Kod VIII (Kebuk Tekanan dan Pemaipan) digunakan berdasarkan kaedah piawaian kimpalan lilitan. Kajian ini memfokuskan terhadap struktur yang dihasilkan menggunakan keluli lembut (0.16 – 0.29% karbon) sebagai bahan asas tangki dan paip. Peralatan yang difabrikasi, mempunyai kelajuan putaran yang seragam dengan memutarkan tangki atau paip, yang menghasilkan struktur dinamik melalui pelarasan pada motor jenis kawalan kelajuan. Penyambungan terhadap sifat-sifat mekanikal ini ditentukan menggunakan ujian penegangan statik, ujian hentaman dan juga ujian kekerasan. Perhubungan diantara penyambungan kimpalan dan ujian destruktif ini dinilai dari segi struktur kimpalan oleh sambungannya menggunakan mikroskop.

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H	-	Height
W	-	Width
L	-	Long
Amp	-	Ampere (Current)
ø	-	Diameter
V	-	Voltage
L	-	Liter
T	-	Thickness
N	-	Rotational velocity
π	-	Phi = 3.142
K	-	Relay
CW	-	Clockwise
CCW	-	Counter-clockwise
ASME	-	American Society of Mechanical Engineering

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CHAPTER 1

INTRODUCTION

1.1 Introduction

A common tank and piping is a product with the cylindrical shape designed to hold gases or liquids at pressure substantially different from the ambient pressure. The pressure differential is potentially dangerous and many fatal accidents have occurred in the history of their development and operation. Consequently, their design, manufacture and operation are regulated by engineering authorities backed up by laws. Generally, almost any material with good tensile properties that is chemically stable in the chosen application can be employed (Pressure vessels, Encyclopedia).

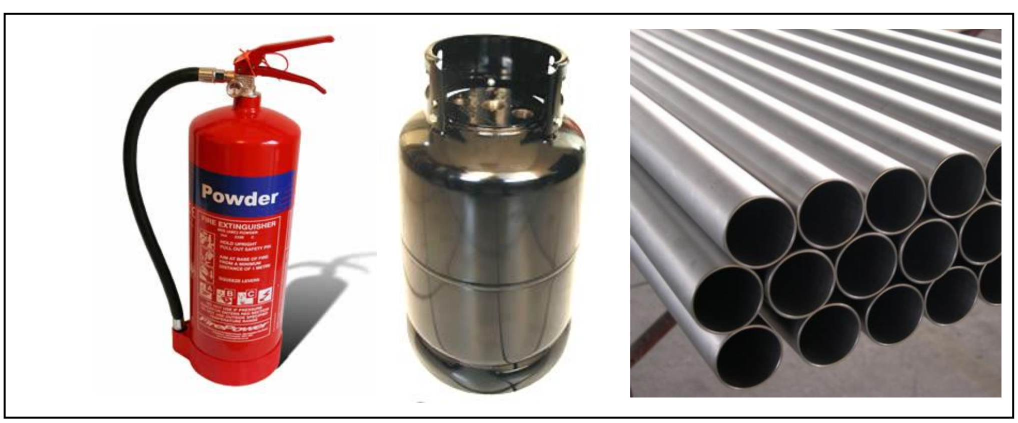

Figure 1.1 General common tanks and piping (Tanks, Encyclopedia)

Many tanks and piping are made by steel. To manufacture a spherical tank as an example, forged parts would have to be welded together. Some mechanical properties of steel are increased by forging, but welding sometimes reduces these desirable properties. In case of welding, in order to make the tank meet international safety standard, the selecting of fabrication standard is being used (Martha A. Baker, 1995).

To apply a welding process for common tank fabrication, the cylinders of the tank are usually made from flat plates which are rolled and then welded along longitudinal joints. In the other hand, circumferential joints are used to attach end closures to the cylinder, and to weld together rolled plates for along the tank if plate size availability or rolling machine capacity is restricted. Weld types are usually different for longitudinal and circumferential joints, and therefore the joint stresses in a tank must satisfy the requirements (Larry Horath, 2001).

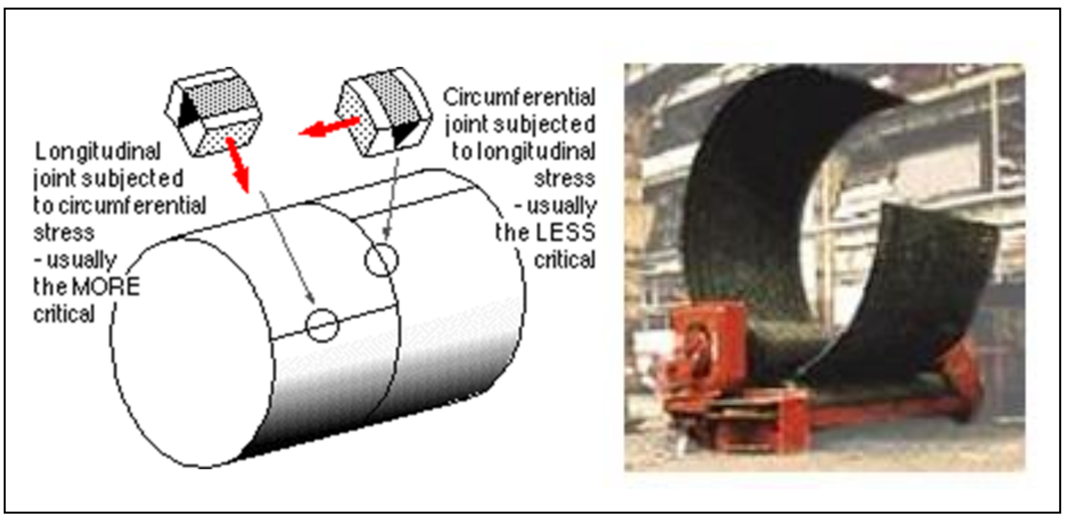

Figure 1.2 Longitudinal and circumferential joints of tank (Pressure Vessel, Encyclopedia)

The circumferential joint of the cylindrical shape are being controlled as it fixed on the fixture for constant speed of rotation. The output of joining is a pair of workpiece with same thickness and diameter.

The general welding parameters in fabrication of tanks and piping are usually depends on weld techniques which consist voltage, current (ampere) and travel speed(mm/min). More specifically, the welding equipment using the Metal Inert Gas (MIG) will consider also the wire speed feed factors. The performance of wire feed system can be crucial to the stability and reproducibility of MIG welding.

For the welding voltages or arc voltages, is determined by the distance between the tip of the electrode and the workpiece. In the constant voltage system, the welding voltage is controlled by the arc length held by the welder and the voltage sensing wire feeder. To sure the constant speed of welding, the support jig is being developed. The other parameters called welding current has the great effect on the deposition rate, the weld bead size and shape, and the penetration of the weld (Martha A. Baker, 1995)

The standard of designed and fabrication of the tank and piping are accordance with the ASME Code Section VIII. The specific requirements apply to several classes of material used in pressure vessel construction, and also fabrication methods such as welding, forging and brazing (J.Philip Ellenberger, P.E, 2004)

The present work is devoted towards establishing a model of constant welding fixture which created the outcome of workpieces by welding effect through the different parameters setting on the MIG welding unit. The investigation on the tensile strength, hardness and impact test while viewing the structure under the microscope will be carried out.

1.2 Objective

The main objective of this project is to design, fabricate and test a welding fixture for welding the cylinder circumferentially using MIG process. A specified welding standard and procedures was used to evaluate the welding quality.

1.3 Scope of project

The scope of work is clearly define the specific field of the research and ensure that the entire content of this thesis is confined the scope. It will be:

i. The MIG Welding set (Miller Migmatic®383) will be employed.
ii. Mild steel will be used as the workpiece material.
iii. The common tank and piping which has a cylindrical shape will be used.
iv. The specified welding standard and procedure will be applied.
v. A welding quality will be evaluated based on the destructive testing to the workpiece. (Tensile test, impact test and hardness test)

1.4 Problem statement

The evaluation to determine the exact parameters used on Metal Inert Gas (MIG) welding system for tank and piping fabrication with steel material is a necessary requirements to promote the proper circumferential joint. How does the setting of voltage, current and travel speed causes the good joint in a subjected of circumferential site of tanks and piping. The questions work out with:

i. What are the relevant parameters should be used to determine the good of welding bead and welding width?
ii. What is the best method to use to sure the concentration of welding would be done?
iii. What type of fixture should be use to get the constantly welding process?
iv. What are the best evaluations to use to determine the result of welding based on parameters setting?