AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

WELDABILITY (CRACK SUSCEPTIBILITY) OF SOME TYPES OF MEDIUM CARBON STEEL

THESIS

Submitted to Faculty of Engineering

Ain Shams University

In Partial Fulfilment of the

Requirements for The Degree of

Master of Science

In

Mechanical Engineering

(Design and Production Engineering)

BY

MOHAMED EZZAT ABDEL-HAMEED KHALLAF

B.Sc., Mechanical Engineering, 1969

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APPROVAL SHEET

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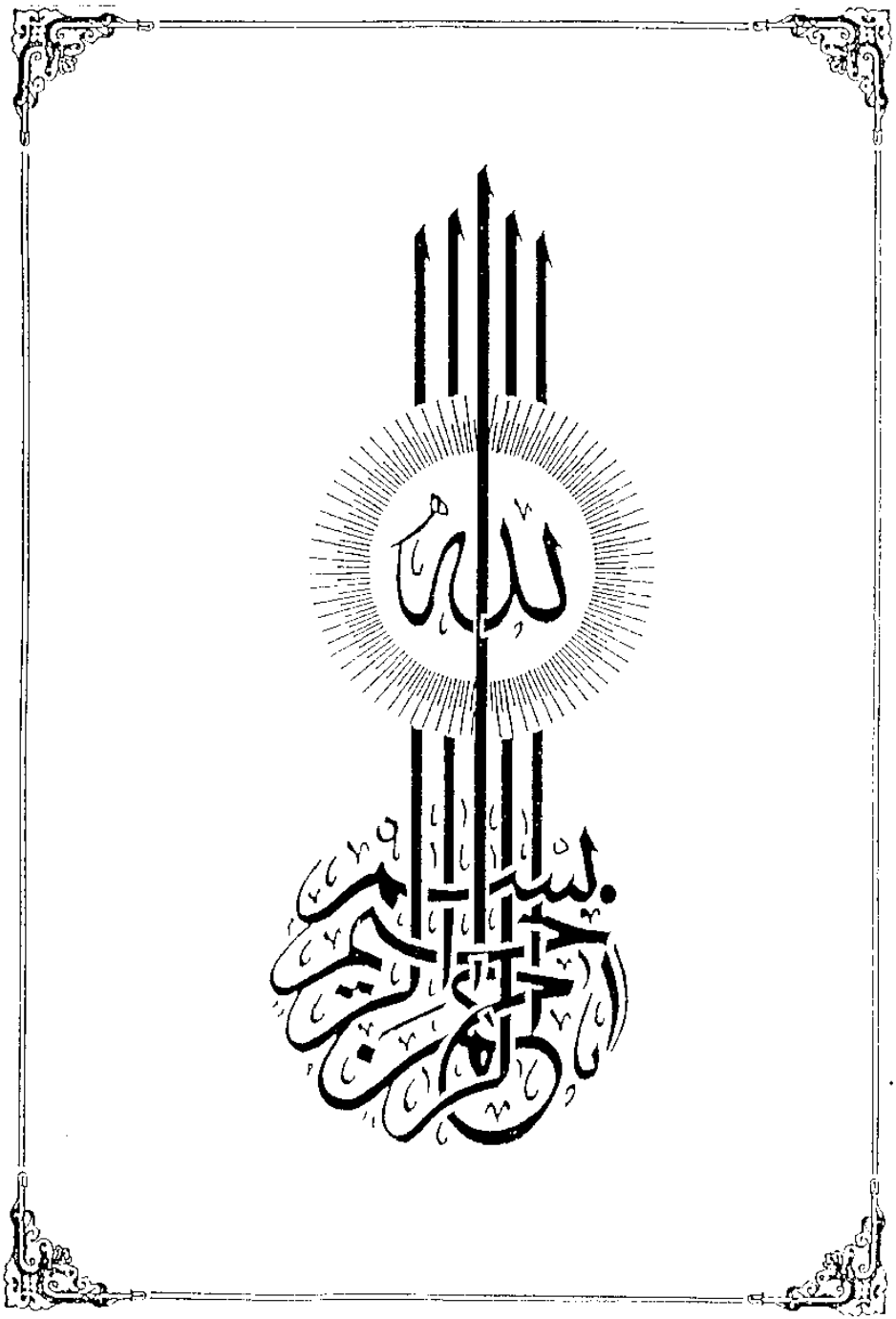

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STATEMENT

This thesis is submitted to Ain Shams University for the Degree of master of Science in Mechanical Engineering .

The work included in this thesis is carried out by the auther under the supervision, and is analysed and completed in Departement of Production Engineering, Ain Shams University.

No part of this thesis has been submitted for a degree or a qualification at any University or Institution.

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SUMMARY

The aim of this work is to study the following effects:

1-Effect of submerged arc welding process variables (welding current, travel speed and wire feed rate) on cracking susceptibility of medium carbon steel welded joints.

2-Effect of the reduction ratio of rolled plates, and also effect of the plate thickness on cracking susceptibility. Effects of these variables on the material cracking susceptibility are obtained using transvarestraint test technique.The crack length was taken as measure of cracking susceptibility.

The research includes the following stages:

I-Determining the effect of the welding variables individually on cracking by keeping all other variables constants, using samples having the same reduction ratio.

II-Studying the effect of the same variables on another group of samples having a different reduction ratios and having the same thickness.

III-Studying the effect of thickness and reduction ratio simultaneously by using another group of samples having different thicknesses and reduction ratios.

Some of the main results attained throughout this work are:

1-Cracking susceptibility increases with increasing the current due to the increase of the heat input, which tends to increase the penetration which consequently increases the carbon content

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INTRODUCTION

The submerged arc welding process is one of the most familiar and important welding processes. It is characterised by the high deposition rate, uniform weld bead, heavily welded sections, as well as its economic use.

Many previous leteratures were found to deal with and improve the process for many applications. The process is capable for the welding of a wide range of the steels, e.g, low , medium and high carbon steels or alloy steels.

The importance of carrying out the present research is to study the applicability of the process for the locally produced medium carbon steels, which are used in manufacturing different kinds of machines spare parts. These spare parts are frequently required for heavy industries in Egypt and are not available, they are special spare parts,e.g. gears of large dimensions and spare parts of complicated designs.

The industrial policy is oriented nowadays to manufacture these expensive spare parts instead of import it.

The Egyptian iron and steel company is the pioneer manufacturer of these parts in Egypt.

As it is well known, the high and medium carbon steels has a great problem in welding, due to their great tendency to hot cracking. The aim of the present work is to deal with and study this problem, which usually obstruct the verification and development of the locally spare parts manufacturing or even the mere use of these steels. Specially that none had investigated

this problem in the application of submerged arc welding process for medium carbon steel.

The different kinds of the hot cracks are well studied through the previous literatures. A special cracking testing device is designed and manufactured in the same way like the transvarestraint test principle.

The welding parameters such as welding current, welding travel speed and wire feed rate, are through wide working ranges investigated to predict their effects on cracking susceptibility. More and above, the plate conditions such as thickness and its reduction ratio are also studied to determine their influences on the cracking tendency.

CHAPTER 1

LITERATURE SURVEY

1.1 Submerged arc welding process

Submerged Arc Welding (SAW) is an arc welding process in which the heat for welding is supplied by an arc developed between a consumable electrode wire and a workpiece. The arc is shielded by a layer of granular and fusible flux, which covers the molten weld metal and the base metal near the joint, it also protects the molten metal from atmospheric contaminations.

1.1.1 Principles of operation

In the submerged arc welding process, electric current flows through the arc and the weld pool, which consists of molten flux and molten weld metal. In addition to act as a protective shield, the flux cover may supply deoxidizers and scavengers that react chemically with the molten weld metal. Figure (1.1) shows a submerged arc welding set up. Submerged arc welding is adaptable to both semi-automatic and fully-automatic operations.

In semi-automatic welding, the welder manually controls the rate of travel by guiding a welding gun that feeds the flux and the electrode to the joint. In fully-automatic welding, the equipment automatically feeds and guides both electrode and flux along the joint and controls the rate of deposition

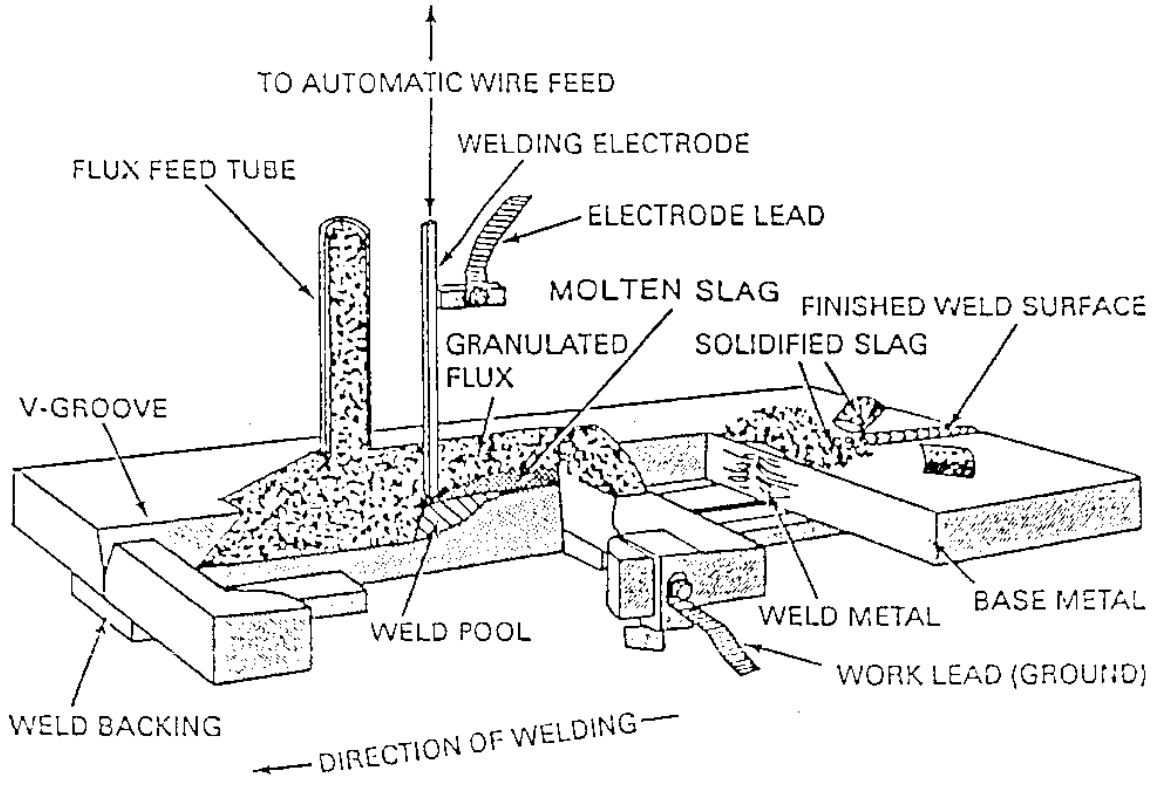

Fig.1.1 -Submerged Arc Welding Process. (60)