Chapter-1

Introduction

1.0 Welding

Welding is the one of the most widely bonding process, used to join the same or different, ferrous or non- ferrous material in various industries. It is defined as a process of joining of two similar or dissimilar metals by the application of heat with pressure, without pressure, with filler rod, without filler rod. Importance of welding process cannot be overlooked. The welding process is used in different industries such as petrochemical industries, structural industries, fabrication industries, aerospace industries, railroad industries, computer industries and many more. Welding is an old process as oldest as Egyptian civilization when forge welding was used to making the only lap joint. Welding first evolved as a technique of primary economic importance when the use of steel became widespread. Electric arc, gas welding, and resistance welding methods soon followed the development of the steel making process. In the initial phase of the development, only fusion welding was used chiefly as a means of repairing worn or damaged metal pieces. At the time of 1^{st} world war, government departments and inspection bureaus initiated research into the acceptability of the method as a primary means of bonding metals. During the 1^{st} and 2^{nd} decades the use of welding process multiplied rapidly and nowadays welding has a dominant role in the fabrication of different engineering structure.

1.1 Background of welding

Electric arc welding is one of the most important and oldest fabrication processes and plays an important role in the Industries. A widely used welding process is Manual metal arc welding (MMAW) or Shielded metal arc welding (SMAW).Electric arc welding is usually different type such as Gas metal arc welding (GMAW), Gas tungsten arc welding (GTAW), submerged arc welding (SAW) and Flux cored arc welding (FCAW) etc [1]. In electric arc welding or fusion welding process, parent plate is melted by means of heat. Sometimes, infusion welding process, a filler wire is used to the molten pool to facilitate the process, and provide bulk and toughness of welded joint. The work present in this thesis is focused on Gas metal arc welding (GMAW). The goal of welding is to find out the best possible combination of strength and toughness of

weldment. Gas metal arc welding is formerly known as metal inert gas welding [2].Gas metal arc (GMA) welding is an upgrade version of Manual metal arc (MMA) welding. GMAG welding was invented by Lyubavskii and Novoshilov in 1953.GMAW is most versatile welding technique and it is widely used in industries to weld the ferrous & non-ferrous metals such as steel, Al, Copper etc. In GMAW a continuous copper coated wire is used in the presence of a shielding gas. Shielding gas is used to avoid any contamination of molten metal from the atmosphere. GMAW process is also very energy efficient (60-80%) as compared to other joining processes, GMAW having numerous advantage in getting high quality of weld joints, the efficiency of production, flexibility and low cost. The productivity of GMAW is also higher than SMAW process. Strength and toughness of weldments are both strongly influenced by the microstructure [3-4].However, with optimal selection of Welding current, gas flow rate, Wire feed speed, and thickness of steel plates, and it is possible to obtain a weldment microstructure that provides the best mechanical properties comparable to the base steels.

1.2 Challenges

By a smooth welding process, productivity can be increased by increasing the metal deposition rate. In welding, heat input can be increased by increasing the welding current or by decreasing the welding speed. However, increasing heat input adversely affects the mechanical properties and metallurgical properties of the welded joints. To produce a sound quality of welds, it is mandatory to understand the changes that produced in the mechanical and microstructure of a weldment. Some fundamental weld metal problems that every development metallurgist must address when developing high strength of weldment. These are following:

(i) The problem of maintaining strength while increasing toughness

(ii) Maintaining ductility within the weld metal

(iii) Minimizing the influence of welding procedure

1.3 Objectives

The main objectives of present research work were:

(i) To determine the effect of different GMA welding parameters such as welding current, arc voltage, shielding gas flow rate, and welding time on the microstructure and mechanical properties of weldment of IS 2062 and AISI 304H steels.

(ii) To identify the mode of failure using SEM and co-relate with welding parameters.

(iii) To test and discuss the microstructure, and mechanical properties such as ultimate tensile strength, yield strength, toughness, and microhardness (VHN) as the response of welding process.

1.4 Scope of the thesis

The research reported in the thesis deals with the effect of GMA welding parameters on mechanical properties and microstructure of weldment of IS 2062 and AISI 304H materials welded by Gas metal arc welding (GMAW) process with copper coated wire. In this research work, data collected from experimental work were validated with the various research carried out by the different researcher for IS 2062 and AISI 304 steels under various conditions. In the course of this experimental work, the different factors that control the weldability of IS2062 and AISI 304 Steel, as well as a factor that controls the formation of acicular ferrite, grain boundary ferrite, widmanstatten ferrite, and fracture mode, were studied. Mechanical properties and microstructure of IS2062 and AISI 304 steel plates were examined. IS 2062 steel and AISI 304 steel plates welded by Gas Metal Arc welding (GMAW), using arc voltage from 25 to 28V and 20 to 23V respectively, at 7.62-11.43 m/min wire feed speed for IS 2062 and 6.35-10.16 m/min wire feed speed for AISI 304 steel, and a fixed 10-25 l/m shielding gas flow rate for both steels.

1.5 Thesis Outline

The final report "Effect of GMA welding parameters on mechanical properties and microstructure of IS 2062 and AISI 304 steels" consists of following five chapters:

Chapters 1: Introduction consists of the study, background, the challenges and main objectives of the thesis. A short overview of two different steels, master chart of welding and allied joining process, and different welding process such as shielded metal arc welding (SMAW/MMAW) process, Gas Metal Arc (GMA) welding process, GTAM, FCAW etc

Chapter 2: Deals with a comprehensive literature review of previous research carried out for IS 2062, AISI 304 steels and other materials welded by GMA welding process or by any other welding process, mechanical properties and microstructure of welded joint, and mode of fracture are discussed.

Chapter 3: Consists full deals of materials used in experimental work and experimental methods used in the present research study. In this chapter chemical, mechanical composition, mechanical properties, and applications of two steels are discussed.

Chapter 4: This chapter is focused on the result and discusses the experimental work, material composition and sizes, mechanical tests and the standard size of specimens, and the equipment used for different testing.

Chapter 5: Chapter five ends the thesis with the concluding remarks as well as recommendations for future studies