PREFACE

Welding is a process of joining two or more pieces of the same or dissimilar materials which are melted together by the application of heat or pressure or both and with or without adding a filler material to obtain monolithic structures (Connor 1987). Often a filler material is added to facilitate coalescence. The assembled parts that are joined by welding are called weldments. Welding is primarily used in metal parts and their alloys. Recent technologies behind welding have enormously created opportunities to add more value to welded structures and products. Few typical examples are automobiles, aircraft, ships, locomotives, space shuttles, and offshore platforms, to name but a few. As these structures are predominated by metals, the quest for the use of metals in manufacturing innovative products by utilizing welding as the main joining process is highly indispensable. The component requirements in the aircraft, missile, automobile, electronics, and nuclear, aerospace, and commercial fields have given rise to many new and demanding service conditions. To meet the stringent requirements of these exacting operations, it is not only necessary to develop new materials but also methods to fabricate them into useful engineering components. One such fabrication technique is the fusion welding process.

A6061 and A6063 aluminium alloys possess some unique properties like a light in weight and high strength to weight ratio. They are becoming the most popularly used medium-strength aluminium alloy in aerospace, marine, automobile, and agriculture, structural industries. With the increased use of aluminium alloys in industries, a reliable joining technique needs to be developed for the effective utilization of aluminium alloys. Metal Inert Gas Welding (MIG) is the most extensive gas shielded arc welding processes used in the joining of aluminium and its alloys due to their preferable flexibility and economy. But there are few problems like low welding speed, partial

penetration, and lack of the deposited metal that occurred during this process. The high solubility of hydrogen and other atmospheric gases in the molten state and the formation of the oxide layer are the major problems associated with this kind of joining process. Hence in this research, an attempt was made to increase the welding speed, reduce the porosity, and maximize the mechanical properties of the MIG welding joints by the different welding parameters. In this investigation, different gas flow rates at different working conditions

Bead on plate welding is performed on A6061 and A6063 aluminium alloy plates at different combinations of input parameters like Welding Current (I), Voltage (V), and Gas flow rate (l/m). MIG joints were fabricated using an inert gas with the help of automated welding machines. The joints were evaluated by conducting tensile tests using the universal testing machine and interface hardness was found using Vickers hardness testing equipment. Microscopic examinations and characterizations of the joints were done using Optical Microscopy (OM), X-ray radiography, Scanning Electron Microscopy (SEM), and X-Ray Diffraction (XRD) techniques.

Aluminium and its alloy have a very wide area of application i.e. aerospace, automobile, and structural industries. The present investigation aimed to study the effect of MIG welding on microstructural and mechanical properties of A6061 and A6063 aluminium alloy. The characteristics of the fusion zone are typical coarse columnar grains structure because of the prevailing thermal conditions during weld metal solidification. In this work, plates of 5mm thickness have been used as the base material for preparing single pass butt welded joints at different-different current values. The filler wire used for joining the plates is AA4043 (Al-5%Si by wt.) grade aluminium alloy. From this investigation, it was found that the hardness of the fusion zone was degraded significantly due to the usage of lower hardness filler metal. The

precipitation evolution in the heat-affected zone was characterized by XRD which improves the tensile properties of the welded A6061 and A6063 alloy.

Organisation of the thesis-: The thesis is classified into 5 chapters.

Chapter 1 gives a brief introduction to the various types of welding processes, their classifications, materials and their applications. It also describes the GMAW Process and its components in detail. The material chosen for this investigation and the problems encountered in the welding of aluminium alloys are briefly discussed. The motivation of the research work and outline of the thesis are also presented in this chapter.

Chapter 2 reviews the various literatures of GMAW pertaining to the present investigation. A brief survey is carried out on the welding of AA6061 and AA6063 aluminum alloys. Based on the available literature effect of process parameters on bead profile characteristics have been reviewed. Further, literatures related to optimization and prediction techniques of bead profile characteristics have been reviewed and presented. Literatures related to the discussion of the scope and objectives of the present investigation on GMAW joints have been discussed.

Chapter 3 discusses the materials and methods experimental adopted for this investigation. In this chapter the entire work flow chart and its various tests are also presented. It also deals with the chemical and mechanical properties of the base material. A detailed description of the experimental set up, different types of alternating shielding gases, welding procedure and testing methods are also presented.

Chapter 4 enumerates the effect of welding parameters such as current, voltage, gas flow rate and heat input on mechanical and metallurgical properties of GMAWed joints respectively.

Chapter 5 summarizes the results obtained for achieving the objectives of the present investigation are drawn as important conclusions from various experimental investigations conducted. This chapter also briefs the possible future scope of the present investigations.