Study of Mechanical Properties on Thick Titanium Alloy (Ti - 6Al- 4V) Multi-Passes Weld

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Abstract—The aim of this study "Experimental study of Mechanical Properties on Thick Titanium Alloy (Ti – 6al – 4v) Multi-passes Weld", is to assess the effect of heat input by GTAW process of mechanical properties on thick titanium alloy. Titanium alloy (Ti-6Al-4V) is alpha-beta alloys type when properly treated, have an excellent combination of strength and ductility. They are stronger than the alpha or the beta alloys. Furthermore, a heavy thickness application of titanium is being increasingly utilize. GMAW is recommending joining titanium and titanium alloys. It is less than costly, required skills and experience, and applications are widely especially compare with other welding processes. 200cm Ti-6Al-4V alloy pleats were prepared, and divided to four pieces (500 mm long, 200 mm widths and 15 mm thickness) each two pieces multi passes welded by GTAW process. Optimum selection of parameters such as Welding speed (mm/s), Welding voltage (V), Welding current (A) adapted as inputs and Ultimate tensile (MPa) Impact Strength (J), Hardness (HRC), as outputs. All weldment pass through requirement tests. For that, after welding process, the welding plate's specimen prepared for tensile test, impact tests, and hardness test. Thirty specimens fabricated for each test. The analysing of the mechanical properties as tensile strength, impact and hardness, of titanium weldment find slightly lower than in the base metal.

Keywords—Mechanical Properties, Tensile test, Impact test, Hardness test, Titanium Alloy, GTAW.

I. INTRODUCTION

In a lot of the engineering applications, titanium takes over heavier, less serviceable or less cost-effective materials. Designs created with the properties provided by titanium often produce dependable, economic and more durable systems and components[1]. Ugur Esme et al,[2] were carried out investigated the multi-response optimization of tungsten inert gas welding (TIG) welding process for an optimal parametric combination to yield favorable bead geometry of welded joints using the Grey relational analysis and Taguchi method. Sixteen experimental runs based on an orthogonal array of Taguchi method were performed to derive objective functions to be optimized within experimental domain. The objective functions have been selected in relation to parameters of TIG welding bead geometry; bead width, bead height, penetration, area of penetration as well as width of heat affected zone and tensile load. S. Krishnanunni et al, [3] found that the effect of welding condition on hardness of pure titanium material. Butt welding of thin pure Ti sheets is prepared by TIG welding using argon gas as the shielding gas. Amount of shielding gas and number of passes are taken as the variables in welding conditions. It was found that the maximum value of hardness is obtained corresponding to shielding gas flow rate of 7 l/min and 4 numbers of welding passes. Raghuvir Singh et al, [4]were carried out investigated the effect of TIG welding parameters like welding speed, current and flux on depth of penetration and width in welding of 304L stainless steel has been studied. From the study it was observed that flux used has the most significant effect on depth of penetration followed by welding current. Optimization was done to maximize penetration and having less bead width. GTAW welding will be an important joining method for titanium and its alloys with their increasing applications in aircraft, aerospace, marine, automotive industries, electronics, military, and other industries. Some important GTAW processing parameters and their advantage and effects on weld quality are explained. The microstructure and metallurgical defects faced in GTAW welding of titanium and its alloys, such as porosity, cracking, HAZ, and penetration are good. Mechanical properties of welds such as tensile, hardness, fatigue strength, Impact and other properties are excellent. Given titanium's lightness, strength, and resistance to corrosion and high temperatures, its most common use is in alloys with other metals for constructing aircraft, jet engines, and missiles. Its alloys also make excellent armor plates for tanks and warships. It is the primary metal used for constructing the stealth aircraft that are