International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 04 Issue: 10 | Oct -2017 www.irjet.net p-ISSN: 2395-0072

REVIEW ON TIG WELDING ANG AND A-TIG WELDING ON ALUMINUM ALLOYS

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ABSTRACT- *In investigation an attempt has been made to study the experimentation of welding AA 5456 aluminum alloy weld through the tungsten inert gas welding process and A-TIG welding process. Most commonly used method for welding aluminum alloy is Tungsten Inert Gas welding process. Taguchi method is employed to optimized the TIG welding process parameter of AA5456 Aluminum alloy weld for increase the mechanical properties. Microstructure of all the weld were studied and mechanical properties are to be correlated.*

Key words：AA5456 aluminum alloys, TIG welding, A-TIG welding.

1.INTRODUCTION

TIG welding is a process where parts are joined together by application of heat generated due to an arc stuck between a non- consumable Tungsten electrode and the job in presence of shielding gas. TIG welding is applied to weld sheet, tube , pipe, plate , and castings. Such fabricated products are used in ship building, power generation aerospace, and other industries. TIG welding process may use a filler material. Generally , a single pass autogenesis TIG weld is used to welds material up to 3mm thick. The penetration is least in case of TIG welding. Due to the lack of penetration capability of TIG welding but owing to the fact the welded surface of this process is free from slag and any other inclusion. Activated Flux TIG welding is a unique joining process and is also called fluxed zone TIG. The number of activated flux which are used in TIG welding to improve the weld penetration. The A TIG process aids to increase the penetration in thick materials such as plates or pipes by single pass without any edge penetration or use of filler metal. The weld penetration in A-TIG process improves twice or thrice to that of the conventional TIG welding process. The microstructure , shape and mechanical properties of the weld are also improved by the process.

TIG welding is an arc welding processes that produces coalescence of metal by heating them with an arc between a non- consumable electrode and the base metal. The initial strength of the non-heat treatable aluminum alloys depends primarily upon the hardening effect of alloying elements such as silicon, iron, manganese and magnesium. These elements increase the strength either as dispersed phase or by solid solution strengthening. The non-heat treatable aluminum alloys have effects on welding when the heat input is increased, i.e. the width of the heat affected zone (HAZ) is increased and the minimum reduction in the mechanical properties are observed. Pure aluminum has good working and forming properties, high resistance to corrosion, low mechanical strength, and high ductility. Alloys 5XXX series with more than 3.0% magnesium are not recommended for elevated temperatures above 150 F because of their potential for sensitization and subject susceptibility to stress corrosion cracking. The purpose of the investigation is to optimized the pulsed TIG welding process and A-TIG welding process parameters for increase the mechanical properties. Taguchi method is a systematic approach to design and analyze experiments for improving the quality characteristics. Taguchi method permits evaluation of the effects of individual parameters independent of other parameters and interactions on the identified quality characteristics, i.e. ultimate tensile strength, yield strength, hardness, etc. Nowadays, Taguchi method has become a practical tool for improving the quality of the output without increasing the cost of experimentation by reducing the number of experiments.

Welds are made with the use of obtained optimum condition, and these welds are subjected to cold planishing process. The roll planishing is an effective process in which weld is passed between two steel rollers. During the planishing kl operation, the internal stresses which are induced during welding are relived and the grains are deformed. Hence, the mechanical properties of the welds have been improve.

TABLE-1

Chemical composition of the base material and filler material (wt %)

AL-Mg (AA 5456 Aluminum alloy) (base material)	Mg	Si	Cu	Cr	Mn	Zn	Ti	Fe	Al
5356 Alloy (filler material)	5.3 5.0	0.3 -	0.1 -	0.35 0.12	0.65 0.12	0.10 -	0.20 0.13	0.40 -	Bal Bal

2. LITERATURE REVIEW

kumar, S.Sundarrajjan (2008), investigate the Optimization of pulsed Tungsten Inert Gas welding process parameters on mechanical properties of AA 5456 Aluminum alloy weldments. In this Selection of base material 2.14mm, thick Al-Mg AL alloys with 5356 filler material the base metal sheets of dimension 250 mm 150 mm 2.14 mm have been prepared and butt joints were made using the experimental. An automatic TIG welding machine has been employed for conducting the welding experiments. Prior to welding, the base metal sheets were pickled with a solution of NaOH and HNO_3, wire brushed, and degreased using acetone and finally preheated to 100 C. The sheets to be welded were kept on steel backing bar and ends were clamped to maintain the alignment and gap. Specimens for tensile testing were taken at the middle of all the joints and machined to ASTM E8 standard. It is observed that, there is 10–15% improvement in mechanical properties after planishing. This is due to fact that, internal stresses are relieved or redistributed in the weld. The behavior of the welded joints at the optimum condition (i.e. $P_2B_1S_2F_2$) of process parameters is attributed to increase an amount of Mg_2Al_3 precipitates that are formed in the aluminum matrix [1].

Akilesh kumar singh(2016), investigates the study of the techniques to improve weld penetration TIG welding. The parameters like current, torch speed, arc voltage, arc gap, electrode diameter, electrode tip, and flux improve penetration as well as weld quality are the selection TIG welding process to improve the weld penetration.

A-TIG welding weld pool is governed by various types of forces namely Buoyancy force, Margonic convection and Lorentz force. In this he conclude that A TIG welding achieves significant improvement in penetration compared to conventional TIG [2].

p.shailesh,A.kumar(2008) investigates the optimization of magnetic arc oscillation process parameter on mechanical propertie of AA5456 aluminum alloy weldments. Selection of base material 2.14mm, thick Al-Mg AL alloys with 5356 filler material. This paper reviews the taguchi method for optimization of aluminum alloy AA55456 [3].

Tiago Vieira da cunha ,Anna louise voigt , investigates and study the analyze of RMS current and mean welding in pulsed Tungsten Inert Gas welding process. A base metal of steel specimen SAE 1020 with dimensions 100mm x 200mm x 63.5mm was used. Result shows that the no significant variation in the penetration values obtained in the test with pulsed current. The width of weld beads increased as the amplitude of current pulse increased. It results RMS current value is equal to the mean current value [4].

R.S. Vidyaruthy, D.K. Dwievedi deals with the analyse of activating flux tungsten inert gas welding for enhanced weldpenetration. In A-TIG shielding gas protect the weld zone and electrode from oxidation and control the electrode by cooling effect. Tells the base metal affects the penetration depth and width of weld during TIG welding [5].

Y.L. XU, Z.B. DONG (2007) investigate the weld shape variation in A-TIG welding process by application of heat transfer and fluid flow. In this experiment it shows the increase of active flux on the weld bead to increase the penetration of the weld pool at first and decrease step by step. From the former investigation it can be learned that the main reason of the difference is the existence of the oxygen in the flux in A-TIG welding that probably changes the arc distribution and oc/ot distribution, which means the heat source distribution and the Marangoni convection on the top surface of the weld pool are changed in this process [6].

QIHAOCHEN,SANBAO LIN(2017) Investigate the study of grain fragmentation in ultrasonic assist TIG welds of pure aluminum. The microstructural characteristic of pure aluminum Tungsten arc welds fabricated under ultrasonic fields were studied by continuous and fixed-point welding. The results showed that the applied ultrasound can break and then refine the grains of the welds. Factors influencing in a pure aluminum of grain fragmentation welds fabricated with ultrasound were examined. The ultrasonic input amplitude and welding current have a considerable influence on grain fragmentation. The relationship between the amplitude and fragmentation is nonlinear, whereas that between the welding current and fragmentation is linear [7].

3. EXPERIMENTAL DETAILS

The TIG welding were carried out of the base metal sheets of dimension 250 mm 150 mm 2.14 mm have been prepared and butt joints were made using AA5456. An automatic TIG welding machine has been employed for conducting the welding experiments. Prior to welding, the base metal sheets were pickled with a solution of NaOH and HNO_3, wire brushed, and degreased using acetone and finally preheated to 100 C. The sheets to be welded were kept on steel backing bar and ends were clamped to maintain the alignment and gap. The micro hardness was measured at an interval of 0.5 mm across the weld, 1 mm across the heat affected zone and 1.5 mm across the unaffected base metal.

4.RESULT

Welding speed and pulse frequency resulted in fine equated grain structure.

4.1 Microstructure analysis

The microstructures at the weld center of pulsed welds using the experimental layout are shown in Fig.1. From these figures, it is evident that, the samples welded by using the condition i.e. Pm5 (peak current – 80 A, base current – 40 A, welding speed – 230 mm/min, and pulse frequency – 4 Hz) resulted in fine equiased grains compared to other conditions. It is also observed that a fine interdendritic network of aluminum with much of the Mg_2Al_3 eutectic (dark) precipitates near grain boundaries. It is evident that at higher frequency, the thermal and mechanical disturbances might be more which is due to fact that the weld pool resonant frequency is closer to the experimental frequency of operation, i.e. at 4 Hz. Similar trends have been observed in the literature. The microstructure observation of the condition set i.e. Pm4 (peak current – 70 A, base current – 50 A, welding speed – 230 mm/min, and pulse frequency – 2 Hz) is resulted in coarse grain structure. It might be expected that the thermal and mechanical disturbances would be less at lower frequencies. From the observation of the weld microstructures, it is clear that, the combination of peak current, base current,

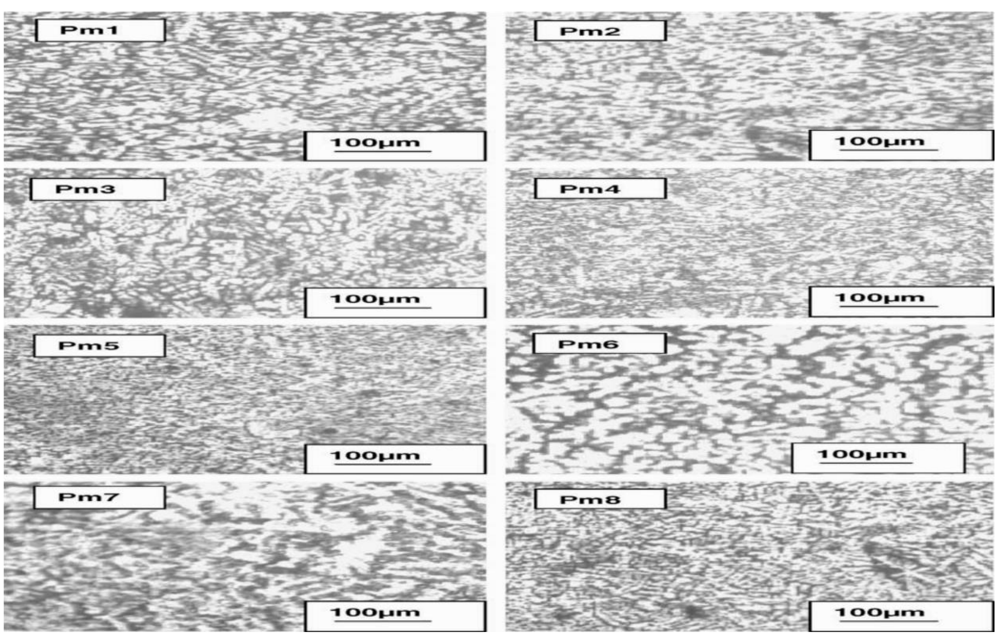

Fig.1. Microstructures at the weld centre of pulsed TIG welds

5. CONCLUSIONS

The influence of TIG welding and A-TIG welding parameters on microstructures and mechanical properties of TIG welded on aluminum AA 5456 were analyzed using optical microscopy and tensile testing The following results are to be obtained.

1. The influence of pulsed welding parameters such as peak current, base current, welding speed, and frequency on mechanical propertie such as ultimate tensile strength (UTS),percent elongation, yield strength, and hardness of AA 5456 Aluminum alloys weldment have been studied and the following conclusions are obtained.

2. The same optimum combination (i.e. $P_2B_1S_2F_2$) is observed in all the mechanical properties of welds. The behavior of the welded joints at the optimum condition (i.e. $P_2B_1S_2F_2$) of process parameters is attributed to increase an amount of Mg_2Al_3 precipitates that are formed in the aluminum matrix. In addition, the metallographic analysis reveals a fine grain structure at the weld centre, which results in higher mechanical properties.

3. It is observed that, there is 10–15% improvement in mechanical properties after planishing. This is due to fact that, internal stresses are relieved or redistributed in the weld.

4. Regression equations were developed to predict the quality characteristics, i.e. percent elongation ultimate tensile strength, yield strength, and hardness within the selected range of parameters.

5. The practical benefit this study is that, with use of obtained optimum condition increases the mechanical properties and developed regression models are useful for the automation of the process.

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