International Journal of Research in Advent Technology, Special Issue, March 2019
E-ISSN: 2321-9637
3rd National Conference on Recent Trends & Innovations In Mechanical Engineering
15th & 16th March 2019
Available online at www.ijrat.org

Effect of Heat Input on Tensile Strength of Multipass SS316L Using GTAW Process

Harinadh Vemanaboina[1], K.B.G. Tilak[2], M. A. Salman Hussian[3],

[1,2,3]*Department of Mechanical Engineering, Nalla Narasimha Reddy Group of Institutions, Hyderabad, Telangana, India.*

Abstract *:* Stainless steel weldments are widely in automobile and structural industries. In the present study, thermography analysis is carried out for SS316L plates with multipass welded using Gas Tungsten Arc welding process. The base material filler wire composition is used for the experimentation. Two different heat input is used to analysis the effect of heat input on the strength of the weldment. The weldment is free from defects and verified through radiography techniques. Tensile strength study also carried for the weldments. The both experimental specimens are failure at base materials.

IndexTerms - Multipass welding, heat input, Tensile strength.

1. INTRODUCTION

Stainless steel have been increasingly used in the industry, due to its favorable combination of physical and mechanical properties such as low density, high strength, good corrosion, and creep resistance. Also, the Stainless steel316L, is widely employed in the aerospace industries due to the corresponding superior mechanical properties and oxidation resistance at elevated temperature. These highly versatile materials are being integrated into complex multi-component systems, to increase the design flexibility and enhance the product functionality.

Deng (2006) had contemplated the temperatures utilizing the thermocouples on the best surface of the weldment and leftover burdens dissemination in the SUS304 pipe of 6mm with multipass welding utilizing the GTAW procedure, interpass temperatures are kept up between passes. The investigations likewise incorporate the reenactments thinks about with 2D and 3D models utilizing ABAQUS. In another examination, the multipass welding of SUS304 pipe was welded with 14 goes with GTAW process, in experimentation the expanding current and welding speed is kept up steady staying three phases.

Moreira (2007) had analyzed the temperature appointment in the aluminum amalgam 6082-T6 weldment. Weldments were made using the GMAW and MIG welding techniques of 10mm thick plate. The temperatures are evaluated at the best and the base surface of the weldment using the thermocouples, infrared thermography and Fiber Bragg Grating Sensors, FBG sensor and thermocouples are with extraordinary comprehension. Sarizam (2017) had inspected the temperature movement for 9mm thick plate with a MIG welding process; the temperatures are evaluated at the best and base surface of the weldment. The temperature is destitute down with a substitute shade of globular trade mode, change stage and shower trade mode and temperature were dismembered in different techniques for each trade mode.

Vasantharaja (2015) had dismembered the mutilation and waiting stresses in the weldment with various edge plan for SS316LN of 16mm thick with A-TIG and TIG welding process. The V-groove 17 passes used to use the TIG welding process and for Y-groove joint 7 passes using TIG and 1 pass using the A-TIG. The temperature and lingering stresses disseminations of SS316L was examined for butt joints with cross breed laser-TIG welding process utilizing twofold ellipsoidal and Gaussian conveyance heat transition heat source models (harinadh 2018) the ductile leftover anxieties were seen at the combination zone, and the plate finished with compressive burdens, and the burdens are very much adjusted inside the structure.

2. EXPERIMENTATION

The multipass welding is done utilizing the gas tungsten circular segment welding process. The base material utilized for the experimentation is SS316L, and a similar piece of filler bar with a distance across of 2.4mm is utilized. The components of the base plate are with 120*60*5 mm. The single V-furrowed edge was set up with the processing procedure with an edge of 600 for the homogeneous stream of the intertwined filler wire material in weld groove planned. The Fig.2 demonstrates the multipass welding and material filled in the arrangement at the root hole of the weld joint. Table.1 demonstrates the material the filler wire piece utilized for the examinations and the warm and mechanical properties of the weldments are demonstrated the Table.2. the welding procedure parameters are appeared in table.3 and the voltage of the welding procedure was around 12-15V.

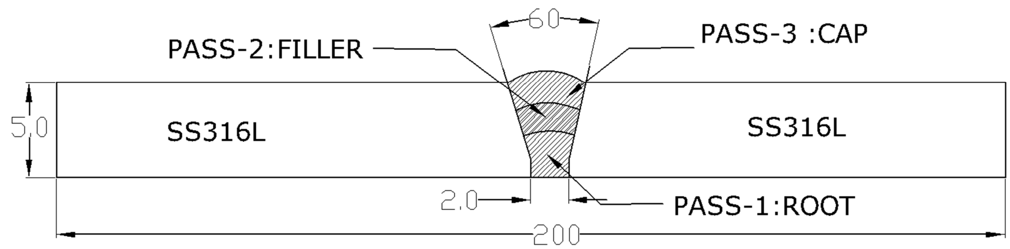


Fig 1. Dissimilar welding of Multipass GTAW process

Table 1Chemical properties of the materials

	Element (% by mass)							
Samples	Ni	C	Mn	S	Si	Cr	P	Mo
Base material SS316L	App 12.00-18.00	Max 0.03	Max 2.00	Max 0.030	Max 1.00	16.00-18.00	Max 0.045	2-3
Filler wire SS316L	11.25	0.05	1.70	0.010	0.40	19.25	0.012	2.25

Table 2 Thermal and Mechanical properties of the base materials

Material	Thermal conductivity (W/m K)	Density (kg/m^3)	Specific heat (J/kg K)	Enthalpy (J/m^3)	Yield strength (Pa)	Tensile strength (Pa)	Poisson's ratio	coefficient of thermal expansion
SS316L	21.26	7817	572	$3.09e^{09}$	$1.60e^{11}$	$1.29e^{08}$	0.3	$15.6e^{-6}$

Table 3. Experimental parameters

Trail no	Current	Gas flow rate	Root gap
	Amp	l/min	mm
1	125	10	2
2	135	10	2

3. RESULTS AND DISCUSSION

3.1. Heat input

The heat input (kJ/mm) is calculated by using the equation given in equation-1. The quality characteristic for heat input is 'Smaller the Better'. Heat input is typically calculated as the ratio of the power (i.e., voltage x current) to the velocity of the heat source (i.e., the arc) as follows:

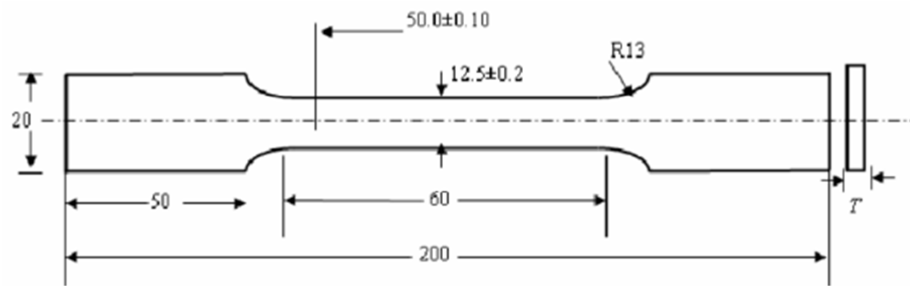
$$Q = \left(\frac{V * I * 0.06}{S} \right) \tag{1}$$

Where, Q = heat input (kJ/mm), V = voltage (V), I = current (A), and S = welding speed (mm/min). The efficiency is depending on the welding process used, with arc welding process having a value of 0.75. The lower the better-Quality characteristic is chosen for the weldments. The heat input is varied with the change of process parameters and welding speed.

3.2. Tensile strength

The welded samples of various heat input are further used for tensile strength the samples are cut using the wire Electro Discharge Machining (EDM) process as per the standard gauge length as shown in Fig. 8. The loads are increased in constant loads on the specimen. The quality characteristic chosen for tensile strength is 'Larger the Better'. The loads are applied upto the failure of the specimen. Fig. 8. (b) shows the samples after failure. In both the samples joints are is effective and the specimens is a failure at the base plate away from the fusion zone.

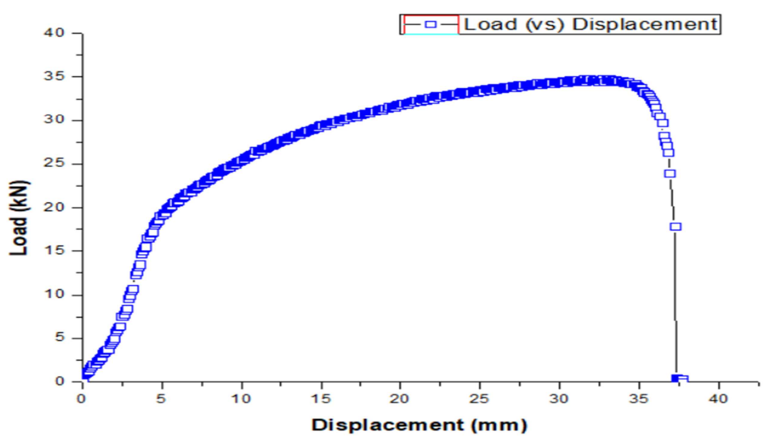
At 0.9kJ/mm heat input the tensile strength was about 567 MPa, with an ultimate load of about 34.76 kN for case-A with 44.4% of elongation and yield strength of about 416 N/mm2. In case-B of 1.02 kJ/mm heat input, the strength was about 546 MPa with 39.32 kN of the load was applied weld materials about and 49.4% of elongation and yield strength of about 390.37N/mm2.The failure takes place at the base plate. This attributes to heat input in the welding process. The tensile strength of the weldment is decreased to increases in heat put.



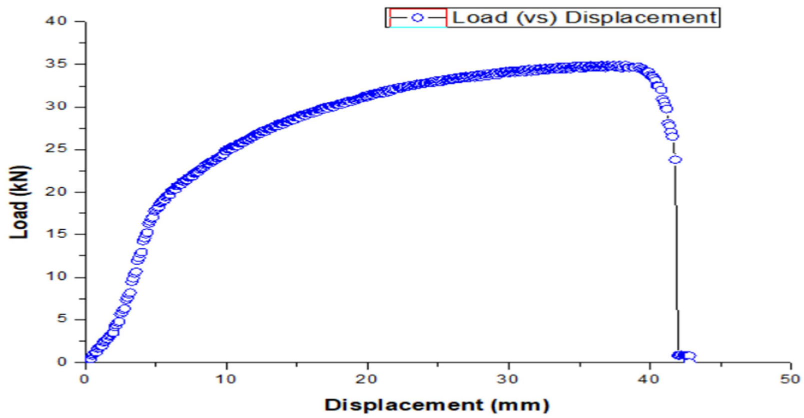
(a)

(b)

Fig 8: Tensile strength specimens (a) Gauge length of the weldment (b) failure of weld tensile samples



(a)



(b)

Fig. 9: Tensile strength in the weldments of the both varies parameters

4. CONCLUSIONS

The multipass butt joints were prepared with continuous current using GTAW process, and the weldments are free from flaws and cracks which was verified by radiography analysis. Decreased tensile strength was observed in the weldment with the increase in the heat input.

REFERENCES

[1]. Deng, Dean, Hidekazu Murakawa, and Wei Liang. "Numerical and Experimental Investigations on Welding Residual Stress in Multi-Pass Butt-Welded Austenitic Stainless-Steel Pipe." Computational Materials Science 42.2, 2008, pp.234–244.

[2]. Moreira, P M G P, O Frazão, S M O Tavares, M A V de Figueiredo, M T Restivo, J L Santos, and P M S T de Castro. "Temperature Field Acquisition During Gas Metal Arc Welding Using Thermocouples, Thermography and Fibre Bragg Grating Sensors." Measurement Science and Technology 18, no. 3, 2007, pp.877–883.

[3]. Mamat, Sarizam Bin, Titinan Methong, Shinichi Tashiro, and Manabu Tanaka. "Droplet Temperature Measurement in Metal Inert Gas Welding Process by Using Two-Color Temperature Measurement Method." Quarterly Journal of the Japan Welding Society 35, no. 2, 2017, pp.160–164.

[4]. Vasantharaja, P., M. Vasudevan, and P. Palanichamy. "Effect of Welding Processes on the Residual Stress and Distortion in Type 316LN Stainless Steel Weld Joints." Journal of Manufacturing Processes 19, 2015, pp.187–193.

[5]. Huang, R.-S., L.-M. Liu, and G. Song. "Infrared Temperature Measurement and Interference Analysis of Magnesium Alloys in Hybrid Laser-TIG Welding Process." Materials Science and Engineering: A 447.1-2, 2007, pp.239–243.

[6]. C. Meola, G. Giorleo, L. Nele, A. Squillace & G.M. Carlomagno, "Infrared thermography in the quality assurance of manufacturing systems", Nondestructive Testing and Evaluation, 18:2, 2002, pp.83-90.

[7]. Vemanaboina, Harinadh, G Edison, and Suresh Akella. "Distortion Control in Multi-Pass Dissimilar GTAW Process Using Taguchi ANOVA Analysis." International Journal of Engineering & Technology 7, No. 3, 2018, 1140.

[8]. Harinadh Vemanaboina, G. Edison, Suresh Akella, Ramesh Kumar Buddu, Simulation of Hybrid Laser-Tig Welding Process Using FEA, Journal of Engineering Science and Technology, Vol. 13, No. 6, 2018, pp.1782 - 1792.

[9]. Welding Engineering and Technology by R. S. Parmar, Edition-2, Khanna Publishers, 2010.