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Experimental Optimization of Independent Parameter to Take Optimum Value of Dependent Parameter of Electric Arc Welding on Mild Steel(C, Mn, Si) With E6013 Electrode

Shubham Mathur[1], Alok Barnwal[2]

[1]*Integral University, Mechanical Engineering,*
Dasauli, P.O. Bas-ha Kursi Road, Lucknow – 226026, India

[2] *Integral University, Mechanical Engineering,*
Dasauli, P.O. Bas-ha Kursi Road, Lucknow – 226026, India

***Abstract*- Welding is practiced in almost all industries. the quality of electric arc welding is affected by the input parameters such as welding speed and heat input rate etc.is reported earlier Hiizu et-al [9].in this study we have done experimentally to show the optimum value of heat input rate and welding speed, corresponding to which mechanical properties such as tensile strength, hardness and impact strength shows the max. value within experimental range of input parameter.**

Keywords: **Independent parameters (welding speed, current, voltage) Dependent parameter (Tensile strength, hardness, Impact strength)**

I. INTRODUCTION

Welding technology has obtained access virtually to every branch of manufacturing, to name a few, ships, rail road equipments, building construction, boilers, launch vehicles, pipelines, nuclear power plants, aircrafts, automobiles, pipelines. Welding technology needs constant upgrading and with the widespread applications of welding.

Welding is one of the most important and versatile means of fabrication available to industry. Welding is used to join hundreds of different commercial alloys in many different shapes. Actually, many products could not even be made without the use of welding, for example, guided missiles, nuclear power plants, jet aircraft, pressure vessels, chemical processing equipment, transportation vehicle and literally thousands of others. Many of the problems that are inherent to welding can be avoided by proper consideration of the particular characteristics and requirements of the process.

Proper design of the joint is critical. Selection of the specific process requires an understanding of the large number of available options, the variety of possible joint configurations, and the numerous variables that must be specified for each operation. If the potential benefits of welding are to be obtained and harmful side effects are to be avoided, proper consideration should be given to the selection of the process and the design of the joint.

Generally, the quality of a weld joint is strongly influenced by process parameters during the welding process. In order to achieve high quality welds a good selection of the process variables should be utilized, which in turn results in optimizing the bead geometry.

Welding time and joint preparation are among the most important factors dominating the cost and productivity of welding.

Table 1: CHEMICAL COMPOSITION OF MILD STEEL

Element	% Weight
Carbon	0.25%
Manganese	0.4%-0.7%
Silicon	0.1%-0.5%

II. WELDING QUALITY INFLUENCING PARAMETERS

Welding Current

Welding current is the most influential variable in arc welding process which controls the electrode burn off rate, the depth of fusion and geometry of the weldments. Welding current is most important variable affecting melting rate, the deposition rate, depth of penetration and the amount of base metal melted. Current are taken as a constant value of 200A over whole process.

Welding Voltage

This is the electrical potential difference between the tip of the welding wire and the surface of the molten weld pool. It determines the shape of the fusion zone and weld reinforcement. High welding voltage produces wider, flatter and less deeply penetrating welds than low welding voltages. Depth of penetration is maximum at optimum arc voltage.

Welding Speed

Speed of welding is defined as the rate of travel of the electrode along the seam or the rate of the travel of the work under the electrode along the seam. Some general statements can be made regarding speed of travel.

III. EFFECTS OF WELDING SPEED ON DIFFERENT PARAMEET

Fig 1: Signifies effect of vartiation in welding speed

Object Ready for Welding

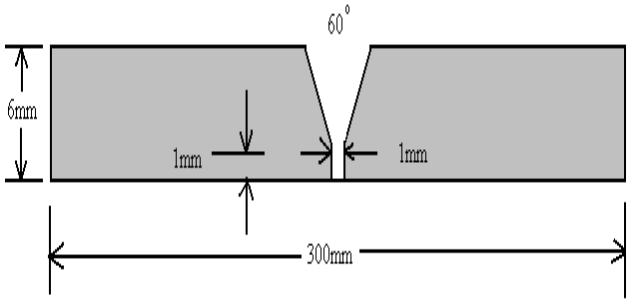


Fig 2: Work Piece

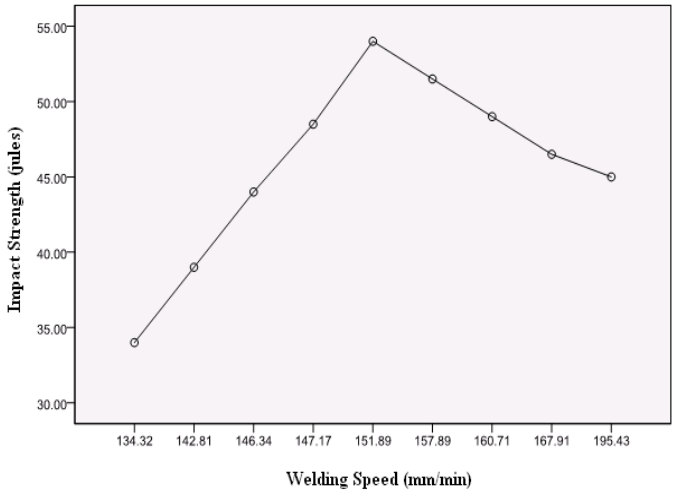
The work piece used for observation are in dimentions as metioned in the fig 2.

IV. OBSERVATION OF FILLING OPERATION FOR WELDING SPEED

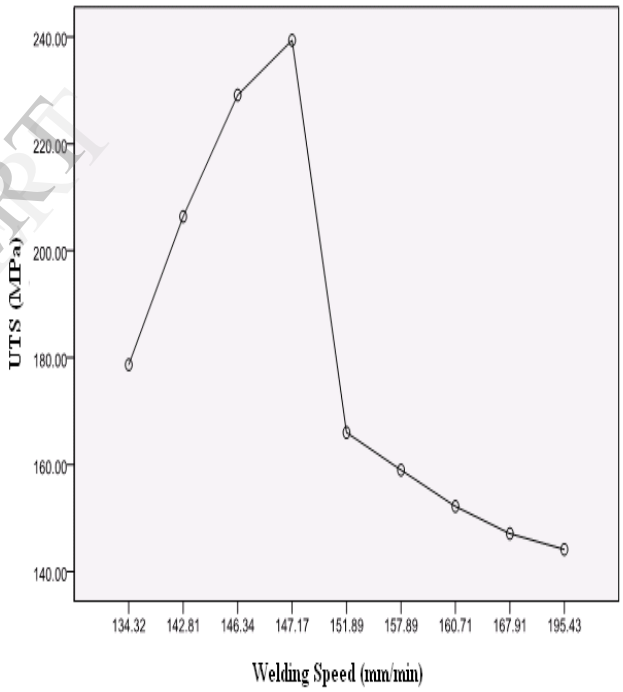
It begins to decrease linearly after this point .increasing the speed travel and maintaining constant arc voltage and current increase ultimate tensile strength (UTS) until an optimum speed is reached at which ultimate tensile strength (UTS) is maximum.Increse the speed beyond this optimum results in decreased ultimate tensile strength (UTS).

Table2: Observation of welding speed-UTS-BHN-Impact strength

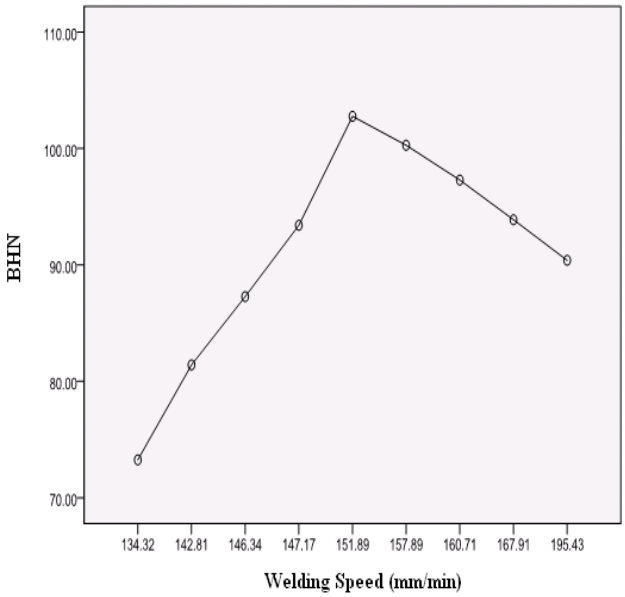
Welding speed(mm/min)	UTS (J/mm)	BHN	Impact Strength (joule)
134.32	180.00	73.00	34.30
142.81	208.24	82.24	39.20
146.34	232.54	88.20	44.50
147.17	240.00	94.50	48.34
151.89	167.50	104.45	54.54
157.71	159.20	101.67	52.75
160.91	152.50	98.97	49.36
1167.43	145.38	95.34	47.20
195.43	142.46	92.40	46.45



Graph 2A: Impact strength vs. Welding speed



Graph 2B: UTS vs. Welding Speed



Graph 2C: BHN vs. Welding speed

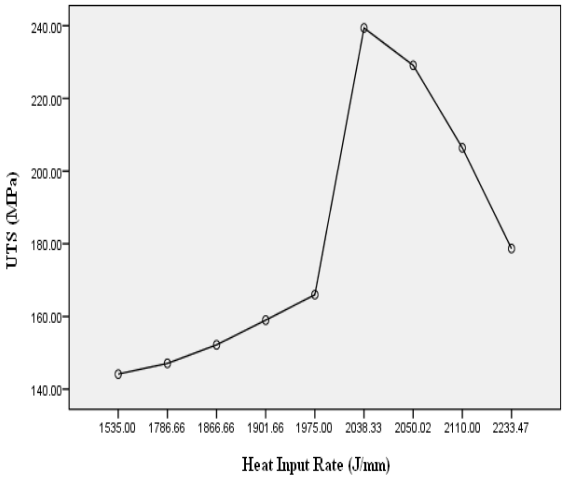
So it can be concluded from experimental analysis that for the mild steel specimen having dimension 300mm×30mm×6mm optimum ultimate tensile strength (UTS) can be achieved by considering the welding parameter as welding speed 147.17 mm/min with current 200A, arc voltage 25V, and electrode (E6013) diameter 3.15mm.

V. EFFECT OF HEAT INPUT RATE ON DIFFERENT PARAMEETER

The effect of heat input rate on tensile strength and elongation is obvious. With the decreases of heat input, the tensile strength and elongation of joints are enhanced obviously. The effect of heat input on hardness of joint was investigated. The hardness of fusion zone is slightly than that of base metal but the difference is not obvious.

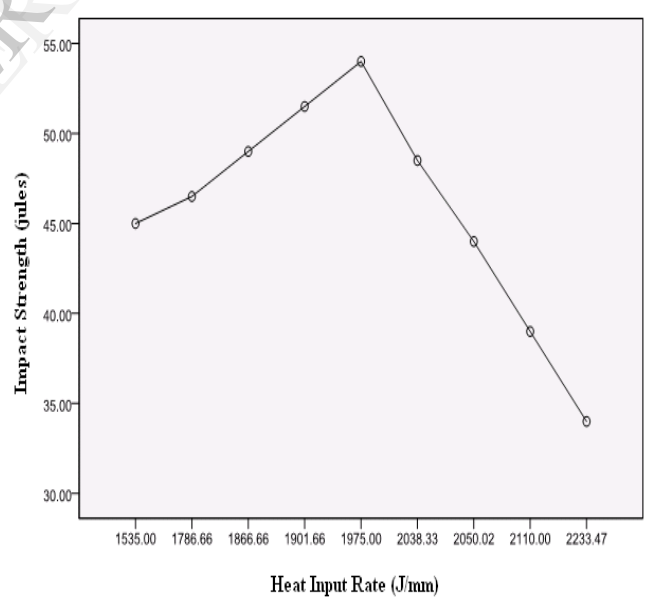
Table 3: Heat input rate UTS BHN Impact Strength

Heat input rate(J/mm)	UTS (MPa)	BHN	Impact Strength (joule)
1535.00	144.00	90.8	45.00
1786.66	146.24	93.7	47.34
1866.66	149.35	98.5	49.54
1901.66	159.50	100.8	52.50
1975.00	164.56	102.5	54.85
2038.33	240.00	93.5	49.20
2050.02	230.20	86.56	44.50
2110.00	208.52	82.70	38.20
2233.47	168.50	73.45	33.36

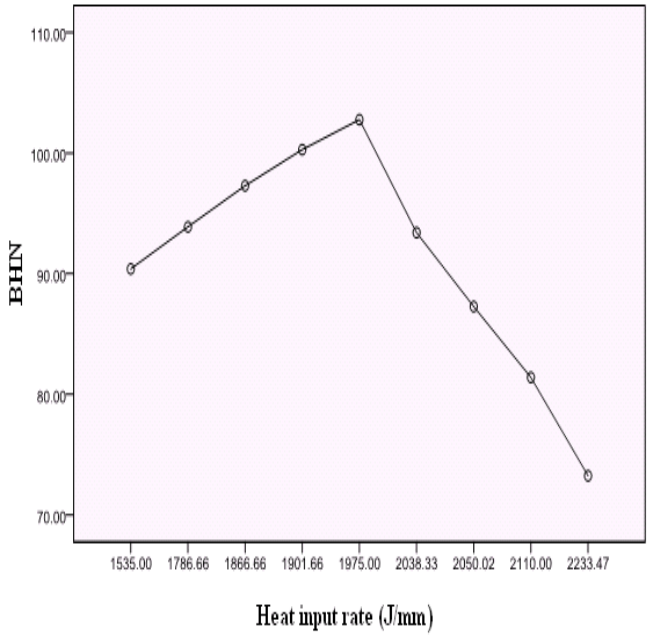


Graph 3A : UTS vs. Heat Impact

From the above analysis, it is evident that their occurs maximum ultimate tensile strength (UTS) occurs at heat input rate of 2038.33J/mm. Greater the ultimate tensile strength(UTS) better the weldability. So optimum ultimate tensile strength (UTS) can be obtained with heat input rate as 1369.68J/mm.



Graph 3B: Impact Strength vs. Heat Input rate



Graph 3C: BHN vs. Heat Input rate

It gives the same graphical analysis as discussed above. The welding speed 151.89 mm/min gives the best result for both BHN and impact strength and the maximum BHN and impact strength are occurs at heat input rate of 1975.00 J/mm so the optimum values of mechanical properties i.e. BHN and impact strength can be obtained with heat input rate as1975.00 J/mm.

FUTURE SCOPE

If this investigation carries forward then we can compute what the welding speed if we need perfect strength of weld joint. In the present study we use manual arc welding but when automatic welding machine were used than better precision and accuracy may achieved as better control on voltage, current is possible.

In our study voltage and current is constant but with variation mechanical properties may vary. The mechanical properties is also vary by varying different welding parameter i.e. Electrode size, bevel height and bevel height etc.

CONCLUSION

In this study an attempt is made to investigate the effect of welding speed and heat input rate parameters on mechanical properties of the welded joint. With this objective, several test specimens were welded with varying welding speed and variety of possible joint configurations. We found the variations in impact strength, hardness and tensile strength first increases with welding speed upto the value 151.89 mm/min.than decreases further. similarly variation in impact strength, hardness and tensile strength with heat input rate increases initially upto the max value of correspondin to optimum value of heat input rate which is 2038.33(j/mm) and then decrease further.

REFERENCES:

[1] Abdullah Al-Faruk, Md. Abdul Hasib, Naseem Ahamed And Utpal Kumar Das, 2008, Prediction Of Weld Bead Geometry Penetration In Electric Arc Welding Using Artificial Neural Networks. International Journal of Mechanical and Mechatronics Engineering, Volume. 10, No. 4, pp.23-28.

[2] Ahmed Khalid Hussain, Abdul Lateef, Mohd Javed, Pramesh.T, 2010. Influence of Welding Speed on Tensile Strength of Welded Joint in TIG Welding Process. International Journal of Applied Engineering Research, Dindigul, Volume.1, No. 3, pp.518-527.

[3] A.R. Bahman and E.Alialhosseini. 2010, Change In Hardness, Yield Strength and UTS of Welded Joints Produced In St37 Grade Steel. Indian Journal of Science and Technology, Volume. 3, No. 12, pp.1162-1164.

[4] Ayo Samuel Afolabi, 2008, Effect of Electric Arc Welding Parameters on Corrosion Behaviour of Austenitic Stainless Steel In Chloride Medium, Metallurgical And Materials Engineering Department, Federal University of Technology Au J.T. Vol.11 No.3, pp.171-180.

[5] Bipin Kumar Srivastava, S P Tewari,Ankur,Jyoti Prakash, 2010, A Review on Effect of Arcwelding Parameters on Mechanical Behaviour of Ferrous Metals/Alloys. International Journal of Engineering Science and Technology, Volume. 2, No.5, pp.1425-1432.

[6] Doherty J., 1978, The Relationships Between Arc Welding Parameters And Fillet Weld Geometry For MIG Welding With Flux Cored Wires. Welding Institute Report, pp-82.

[7] Herodotus. 1986, The Histories Welding. Oxford University Press. Book one, pp.1- 25.

[8] H.J.Liu,H. Fujii, M. Maedaa, K. Nogi, 2003, Tensile Properties And Fracture Locations of Friction-Stir-Welded Joints of 2017-T351 Aluminum Alloy. Journal Materials Processing Technology, pp. 692–696.

[9] Hiizu Ochi Koichi Oqawa,Takeshi Sawani,Yoshiaki Yamamot,Ryoji Tsnjino, Yasuo Suga, 2003, Evaluation of Tensile Strength And Fatigue Strength of SUS3 Stainless Steel Friction Welded Joints. Proceeding 10th International Offshore & Polar Eng Conf, Vol.4, pp.209-213.

[10] H R Ghazvinloo and Honarbakhsh Raouf, 2010, Effect of SFCAW-G Parameters on Weld Width and Tensile Properties of Weld Metal in Low Carbon Steel. Journal of Applied Science, pp.1-6.

[11] Jiang Qinglel Liyajang,Wang Juan And Zhanglei, 2011, Characterization on Strength And Toughness of Welded Joint. For Q550 Steel. Indian Academy of Sciences. Vol. 34, No.1, pp.161-167.

[12] J. Swenson Adonyi, Y., 1999, Weldability Testing of Steels and Physical Simul- ations. ASME Sources Technology Conference, Houston, pp 1-3.

[13] Kazakov and N.F, 1985, Diffusion Bonding of Materials. University of Cambridge, pp.1-10.

[14] Kim Is, J.S.Sons, C.E.Park, I.J.Kim And H.H.Kim, 2005, An Investigation Into And Intelligent System For Predicting Bead Geometry In GMA Welding Process. Journal of Materials Processing Technology, Volume. 159, No.1, pp. 113-118.

[15] Lee Ji, Um Kw, 2000, A Prediction of Welding Process Parameters By Prediction of Back-Bead Geometry. Journal of Materials Processing Technology , Volume. 108, No.1, pp.106-113.

[16] Liu Liming, Miao Yu Gang, Song Gang, Liang Gouli , 2004, Effect Of Heat Input on Microstructure And Properties of Welded Joint In Magnesium Alloy AZ31B.Trans Non Ferrous Material Science China, Volume.14, No.1, pp.88-92.

[17] M.Dunier, Ivandi, I.Samard, 2008, Selection of Arc Welding Parameter of Micro Alloyed HSLA Steel. Metalurgija, Volume .47, No. 4, pp 325-330.

Author Profile

Shubham Mathur, I am currently pursuing Bachelor of Technology in Mechanical Engineering Final year Student from Integral University, Lucknow, India. I'm a creative thinker. I like to explore alternative solutions to problems and have an open mind about what will work best. I am a keen learner. I have inclination towards solving practical industrial problems. Enthusiasm towards new endeavors and passion towards my work are my motivational factors. I like to commit myself towards my work. I love the challenges of my life and believe that they help me to learn something new and improve myself as well.

Alok Barnwal, I am a very passionate man when it comes to applying knowledge to real world problems. I am currently pursuing Bachelor of Technology in Mechanical Engineering Final year from Integral University I am a good leader, with excellent communication skills. I'm a people person. I really enjoy meeting and working with a lot of different people. I'm a perfectionist. I'm a creative thinker. I like exploring alternative solutions to problems and have an open mind about what will work best. I enjoy solving problems, troubleshooting issues, and coming up with solutions in a timely manner believe in honesty and try to get my tasks more organized. Humility and ambition is what I always follow.