Optimization of Resistance Spot welding Process Parameters For Joining Steel DP590 And BH180

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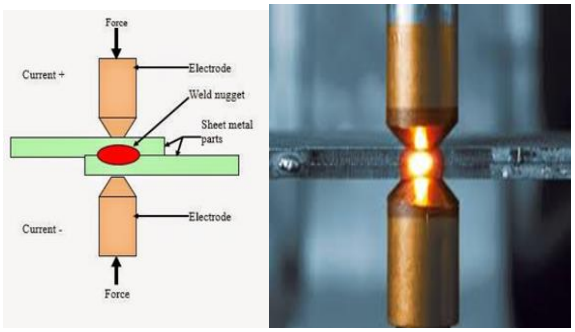
Abstract- *The aim of this research work has been to study dissimilar metal joint using a RSW process. It is obvious that RSW process is very difficult to weld the two dissimilar metals. Dissimilar welding is used to fabricate the automotive body, metal furniture, bus and railway bodies etc. due to automatic and fast process, but failures occur frequently due to low tensile strength and Poor microstructure of the weldment so optimization of the process parameter is done. This tensile strength of weld specimen is most commonly affected due to welding process parameters so in this research work Increase of tensile strength, Microstructure refinement, optimum weld dimensions are carried out.*

Keywords- HAZ, Resistance spot welding,Tensile strength, Optimization.

I. INTRODUCTION

Resistance spot welding is a joining process widely used in automobile body manufacturing. Steels, aluminum alloys, and magnesium alloys are widely used metals in car bodies. However, it is difficult to weld these dissimilar metals and achieve good joint quality, due to their inherent disparate properties. This may be improved by accurate setting of control parameters and The Quality of weld mainly depends on mechanical properties of the weld metal and heat affected zone (HAZ), In this research work the Multi objective optimization of welding process parameters for obtaining greater weld strength with good mechanical properties of dissimilar metals like steel DP590 and BH180 is done. So, Welding force or pressure, voltage, current, time are taken as controlling variables. The objective of this study is to determine the effect of various control parameters on the nugget size and tensile shear strength of dissimilar metal. Resistance spot welding (RSW) is a welding process in which two or more similar or dissimilar overlapping metal sheets are placed between two water-cooled copper alloy electrodes and large electrical current is passed through them for a controlled period of time under controlled pressure. The electrodes compress the base metals together and the electrical resistance at the metals interface causes a localized heating. When the flow of current ceases, the electrode force is maintained while the weld metal rapidly cools and solidifies. The cooling is achieved by heat conduction via the two water-cooled electrodes, which serve as efficient heat sinks, and also radially outwards through the sheets. The weld is normally formed in a fraction of a second and the electrodes are retracted after each weld is formed.



Working principle of RSW

However, the resistance spot welding between the two kinds of materials accompanies some difficulties, because of the large difference in physical and thermal properties between bake hardening and steel, and the formation of brittle reaction products at the welding interface. Hence, solid state welding methods have been studied in the last few years to acquire a sound joint, such as explosion welding, diffusion welding, friction stir welding. Although the joints obtained by the above means show reasonable performance to a certain extent, the joint shape and size are restrained by equipment configuration and capacity Spot welding has applications in a number of industries, including automotive, aerospace, rail, white goods, metal furniture, electronics, medical building and construction. But it is primary use is in the manufacture of automobiles, where the average car has some 5,000 spot welds. The rise of coated steels, high strength steels, and most recently hot stamped steels and aluminum in the automotive industry have presented challenges to this simple but effective joining method

INPUT PARAMETERS USED IN SPOT WELDING FOR OPTIMIZATION

1. Welding Current-

The amount of weld current is controlled by two things:

- The setting of the transformer tap switch determines the maximum amount of weld current available.
- The percent of current control determines the percent of the available current to be used for making the weld.

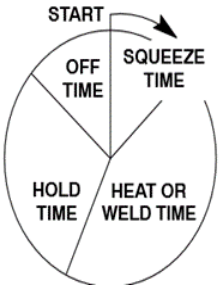
Normally low percent current settings are not recommended because it may harm the quality of the weld. The weld current should be kept as low as possible. When determining the current to be used, the current is steadily increased until weld spatter occurs between the metal sheets. This indicates that the correct weld current has been reached. The temperature rises rapidly at the joined portion of the metal where the resistance is greatest if the current becomes too great internal spatter will result.

2. Hold Time-

Time that pressure is maintained after weld is made.

3. Squeeze Time-

Time between pressure application and weld



4. Welding Force-

The effect of pressure on the resistance spot weld should be carefully considered. The primary purpose of pressure is to hold the parts to be welded in intimate contact at the joint interface. This action assures consistent electrical resistance and conductivity at the point of weld. The tongs and electrode tips should NOT be used to pull the work pieces together. The resistance spot welding machine is not designed as an electrical "C" clamp! The parts to be welded should be in intimate contact BEFORE pressure is applied.

Investigations have shown that high pressures exerted on the weld joint decrease the resistance at the point of contact between the electrode tip and the work piece surface. The greater the pressure the lower the resistance factor.

Proper pressures, with intimate contact of the electrode tip and the base metal, tend to conduct heat away from the weld. Higher currents are necessary with greater pressures and, conversely, lower pressures require less amperage from the resistance spot welding machine. This fact should be carefully noted, particularly when using a heat control with the various resistance spot welding machines.

II. LITERATURE REVIEW

MD. ABDUL KARIM, Et.al [2020] This paper presents a comprehensive study of the metallurgical challenges of welding dissimilar metals. It also describes the important factors in dissimilar welding which need to be considered for automotive applications.

J.ADV. MANUF, et.al [2020] The experiments carried out on two turn different, a conventional turn and a turn with numerical control The work presented in this paper is an overview of optimization methods applied in evaluation of optimal of resistance spot welding parameters and parameters effects. Taguchi or Moora methods and analysis variance (ANOVA) extensively used in optimization of RSW presents an efficient technique to optimize the welding parameters in order to have best quality of joining.

TANMOY DAS, Et.al [2019] Resistance spot welding of dissimilar materials (AISI-1008 steel and aluminium-1100 alloy) by adding an inner layer of graphene nano platelets (GNPs) is reported in this study. This GNP layer is incorporated in the steel plate by drop-coating technique and the coated steel and the aluminumplates were joined by the resistance spot-welding method. The weld strength depends predominantly on the time/current used for the welding, a maximum enhancement of ∼124 % is obtained for GNP coated samples in comparison to that of the bare one.

INT J ADV MANUF TECHNOL [2017] In this research work, twodifferent stainless steels, i.e., AISI 316LandDSS2205(dissimilar materials), are welded together by RSW process, and the effect of process parameters on tensile sheer strength of weld nuggets is investigated Welding current majorly dictates the tensile shear strength followed by the heating cycles while the least effective response factor is electrode tip diameter.

K.S. BANG, Et.al [2016] presents in his paper named Effects of welding parameter on tensile strength of weld metal that Welding Current, Welding voltage, Travel speed. will definitely affects Tensile strength, pcm value, Microstructure of weldments and he proved that when Heat below 2.1 kj/mm, Then tensile strength increases. When heat goes above 2.1 kj/mm then tensile strengthdecreases.

GAJANAN S. GAIKWAD1, et.al[2016] This paper has presented an overview on the effect of resistance welding process parameters on the response variables like tensilestrength, nugget width. It is highly efficient welding method that is particularly well suited for automated production lines and mass production. i. The resistance welding process is highly rely on the process parameters viz. welding current, welding time, electrode force, welding speed in case of seam welding, electrode geometry and dimension. ii. Welding current has significant effect on the response variable than other parameters. Electrode force, welding time, welding speed are least influencing process parameters. iii. Materials which are difficult to weld like aluminium also weld by resistance welding.

HAIQIANG LONG [2016] Effect of holding time on microstructure and mechanical properties of resistance spot welds between low carbon steel and advanced high strength steel. The effect of holding time on microstructure, hardness and mechanical properties of unequal thickness weld joints between low carbon steel and advanced high strength steel is investigated in the present work.

LIHU CUI, et.al[2015] presents the data of effects of welding parameters on properties of the joint such as current on the nugget size and tensile shear strength of the joint where analyzed. welding current is the main factors influencing the resistance heat. The result shows nugget diameter firstly increased with the welding current increasing, and then tended to a constant date with the welding current further increasing. And with the welding current increasing, the tensile shear load firstly increased and then decreased. The maximum tensile shear load reached 1.5 KN at 12 kA welding current.

MANOJ RAUT, et.al [2014] The experimental studies were conducted under varying electrode forces, welding currents, and welding times. The welding parameters were determined by Taguchi Method of L18 orthogonal array has used to perform the experiment. The the quality is best judged by nugget size and joint strength. Hence suggested the Resistance Spot Welding (RSW) is among the oldest of the electric welding method that used in the industry and it is useful and accepted method in joining metal.

V.S. GADAKH, et.al [2013] in the paper of springer about Optimization of welding process parameters using Moora method. the affecting parameters 1 current. 2.Voltage. 3.Speed. These parameters affect the resulting parameters like 1.Bead width. 2. Reinforcement. 3.Penetration. UTS and by using the method of the Moora method 1. Very simple and easy to implement. 2.It can provide better and accurate method to achieve goals. These are the results.

FATIH HAYAT [2010] Resistance Spot Weldability of Dissimilar Materials: BH180-AISI304L Steels and BH180-IF7123 Steels.In this study, resistance spot weldability of 180 grade bake hardening steel (BH180), 7123 grade interstitial free steel (IF7123) and 304 grade austenitic stainless steel (AISI304L) with each other was investigated. Here electrode pressure and weld current were kept constant and weld time is varied.As a result of the experiment, it was determined that with increasing weld time, tensile shear load bearing capacity (TLBC) increased with weld time up to 25 cycle and two types of tearing occurred.

III. WRITE DOWN YOUR STUDIES AND FINDINGS

From the above study it has been found that no study has been done on the RSW for joining the two dissimilar metals like Steel DP590 and BH180, and from the Previous work one thing is clear that there is very few work in the area of optimization of welding process parameters like Welding current, Heat generation, Welding force, welding time and Surface condition to work distance on the attributes like refinement of Micro structure, Weld dimensions, tensile properties and Heat affected zone means multi objective optimization Now it is the time to articulate the research work with ideas gathered in above steps by adopting any of suitable approaches

IV. PROBLEM STATEMENT

The aim of this research project has been to study dissimilar metal joint using a RSW process. It is obvious that RSW process is very difficult to weld the two dissimilar metal like Steel and Bake hardening. Dissimilar welding is used to fabricate the automotive body, metal furniture, bus and railway bodies etc. due to automatic and fast process, but failures occur frequently due to low tensile strength and Poor microstructure of the weldment so optimization of the process parameter is done. This tensile strength of weld specimen is most commonly affected due to welding process parameters so in this project work Increase of tensile strength, Microstructure refinement, optimum weld dimensions are carried out.

V. POSSIBLE OUTCOMES

From the review paper study, it is found that when the welding current, depth of penetration, HAZ increases, the tensile strength decreases, but when welding speed increases, the tensile strength also increases. When we will increase, Optimization was done to find optimum welding conditions to maximize tensile strength and percentage of elongation of welded joints.

REFERENCES

[1] Arivazhagan, N., Singh, S., Prakash, S., Reddy, G. M.: Investigation on AISI 304 Austenitic Stainless Steel to AISI 4140 Low Alloy Steel Dissimilar Joints by Gas Tungsten Arc, Electron Beam and Friction Welding. In Materials and Design 2011. Elsevier, p. 3036–3050. ISSN 0261-3069.

[2] Krishnaprasad, K., Prakash, R. V.: Fatigue Crack Growth Behavior in Dissimilar Metal Weldment of Stainless Steel and Carbon Steel. In Engineering and Technology, 2009, p. 873–879.

[3] Marashi, P., PouranvariM., Amirabdollahian, S., Abedi, A., Goodarzi, M.: Microstructure and Failure Behavior of Dissimilar Resistance Spot Welds between Low Carbon Galvanized and Austenitic Stainless Steels. In Materials Science and Engineering, 2008, Elsevier, p. 175–180. ISSN 0921-5093

[4] Torkamany, M. J., Sabbaghzadeh, J., Hamedi, M. J.: Effect of Laser Welding Mode on the Microstructure and Mechanical Performance of Dissimilar Laser Spot Welds between Low Carbon and Austenitic Stainless Steels. In Materials and Design, 2012, Elsevier, p. 666–672. ISSN 0261-3069.

[5] DeltaSpot Resistance Welding. In Fronius [online]. 2011 [cit. 2012–03–30]http://www.fronius.com/new/deltaspot

[6] Houman Alipooramirabada Et. Al, 'Investigating the effects of welding process on residual stresses, microstructure and mechanical properties in HSLA steel welds' Journal of Manufacturing Processes 28 (2017) 70–81.

[7] Jamasri, Ilman, M. N., Soekrisno, R., Triyono: Corrosion Fatigue Behavior of Resistance Spot Welded Dissimilar Metal Welds between Carbon Steel and Austenitic Stainless Steel with Different Thickness. In Procedia Engineering, 2011, Elsevier, p. 649–654. ISSN 1877-7058.

[8] Ranfeng Qiu,Shinobu satonaka, Chihiro Iwamoto, Effect of interfacial reaction layer continuity on the tensile strength of resistance spot welded joints between bake hardeningand steels, Materials and Design. 30 (2009) 3686-3689.

[9] Weihua Zhang, Daqian Sun, Lijun Han, Wenqiang Gao and Xiaoming Qiu, Characterization of intermetallic compounds in dissimilar material resistance spot welded joint of high strength steel and aluminum alloy, ISIJ International, 2011, 51, (11), 1870–1877.

[10] K. Devendranath Ramkumar Et. Al (2016) 'Development of pulsed current gas tungsten arc welding technique for dissimilar joints of marine grade alloys. Journal of Manufacturing Processes.

[11] Benák, M. ; Turna, M.; Palcek, P.; Nesvadba, P. Study of explosion welding of Mg alloy with aluminum, Defect and Diffusion Forum, v 297-301, p 1177-1182, 2010, Diffusion in Solids and Liquids V [5] Bulkov, A.K.; Peshkov, V.V.; Petrenko, V.R.; Balbekov, D.N. Stryguin, A.I. Effect of technological parameters on the process of diffusion welding of titanium, Welding International, v 28, n 3, p 222-227, March 2014

[12] Zhang, Teng; He, Yu Ting; Shao, Qing; Hou, Bo; Gao, Chao, Study on residual stresses and fatigue properties of friction stir welding joint, Advanced Materials Research, v 884-885, p 374-377, 2014, Biotechnology, Chemical and Materials Engineering III

[13] Eiazadeh H, HamediM, Halvaee A, et al. New parametric study of nugget size in resistance spot welding process using finite element method [J]. Materials and Design, 2010, 31(1):149-157

[14] Ranfeng Qiu, Shinobu Satonaka, Chihiro Iwamoto, Effect of interfacial reaction layer continuity on the tensile strength of resistance spot welded joints between bake hardeningand steels, Materials and Design. 30 (2009) 3686-3689.

[15] Nan Wang, Tomiko Yamaguchi and Kazumasa Nishio, Interfacial microstructure and strength of aluminum alloys/steel spot welded joints, J. Japan Inst. Met. Mater. 2013, 77(7), 259-267.

[16] Weihua Zhang, Daqian Sun, Lijun Han, Wenqiang Gao and Xiaoming Qiu, Characterization of intermetallic compounds in dissimilar material resistance spot welded joint of high strength steel and aluminum alloy, ISIJ International, 2011, 51, (11), 1870–1877.

[17] Bulkov, A.K.; Peshkov, V.V.; Petrenko, V.R.; Balbekov, D.N. Stryguin, A.I. Effect of technological parameters on the process of diffusion welding of titanium, Welding International, v 28, n 3, p 222-227, March 2014

[18] Zhang, Teng; He, Yu Ting; Shao, Qing; Hou, Bo; Gao, Chao, Study on residual stresses and fatigue properties of friction stir welding joint, Advanced Materials Research, v 884-885, p 374-377, 2014, Biotechnology, Chemical and Materials Engineering III

[19] Eiazadeh H, HamediM, Halvaee A, et al.New parametric study of nugget size in resistance spot welding process using finite element method [J]. Materials and Design, 2010, 31(1):149-157

[20] Shahverdi H R, Ghomanshchi M R. Shabestari S, et al. Microstructure analysis of interfacial reaction between molten aluminium and solid iron [J]. Journal of Materials Processing Technology, 2002, 124 (6): 345-352

[21] Dancette S, Fabregue D, Massardier V, Merlin J, Dupuy T, Bouzekri M (2011) Experimental and modeling investigation of the failure resistance of advanced high strength steels spot welds. Eng Fract Mech 78:2259–2272

[22] ZhangW,SunD,HanL,LiY(2015) Optimized design of electrode morphology for novel dissimilar resistancespotweldingofbake hardening and galvanized high strength steel. Mater Des 85:461– 470

[23] Campilho RDSG, Pinto AMG, Banea MD, Silva LFMD (2012) Optimizationstudyofhybridspot-welded/bondedsingle-lapjoints. International Journal of Adhesion & Adhesives 37:86–95

[24] HamidinejadSM,KolahanF,KokabiAH(2012)Themodelin gand process analysis of resistance spot welding on galvanized steel sheets used in car body manufacturing. Mater Des 34:759–767