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A Review of friction stirs welding plate and pipes

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Abstract : Friction Stir Welding (FSW) is a comparatively new joining process that has exhibited many advantages over traditional arc welding processes, including greatly reducing distortion and eliminating solidification. Friction stir welding used to join high strength joints aluminum pipes. The present work explains review and overview of Friction stir welding pipes and plate which contain the basic connotation of the process, mechanical properties and Suggested model in FSW process. This paper gives the review of basic concepts of Friction Stir Welding for pipes and plates on process parameters. It is established that FSW of aluminum pipes is appropriate an increasingly overripe technology with many commercial applications.

Keywords: FSW, Aluminum pipes, and plates

1. INTRODUCTION

The aluminum alloys are increasingly used in many significant industrialization areas, such as the automobile industry, aeronautic and military, because of their less density and good mechanical properties; however, the welding of aluminum alloys has always represented a great challenge for designers and technologists. Many difficulties are correlating with this kind of joint process. It is clear that earnest problems, such as tenacious oxide layer cavities, hot cracking sensitivity, and porosity, may occur when fusion welding is applied to aluminum alloys. Furthermore, the conventional techniques, such as fusion welding, often lead to significant strength deterioration in the joint because of a dendritic structure formed in the weld zone. Friction Stir Welding (FSW) was invented by Wayne Thomas at TWI (The Welding Institute), and the first patent applications were filed in the UK in December 1991. Then it was developed friction stir welding (FSW) with Khourshid and sabry in 2013. For use in welding aluminum pipes.

E.Gerçekcioglu.et.al (2014) in this process uses the non-consumable specially designed rotating tool which is incorporated into the material by granting the axial force and then explicit along the joint line to make the weld. thermal mechanical effected zone (TMAZ) is formed due to thermo-mechanical cycles and HAZ is the zone which is affected by the frictional heat produced by the shoulder.weld zone is the region formed due to the stirring action of the pin. Frictional heat generated by the tool makes the plastic deformation of material and grain boundary sliding. exaggerated heat formalization leads to tool wear which outcome in the lack of material in the tool. lack of tool material will be formed as an embodiment in the weld region. Feed rate, material flow, and heat relocate corroboration the tool wear to emerge along the weld direction.

A M Khourshid and I. Sabry(2013) in this study effect Friction stir welding for pipes on Al 6063 alloy. The tool rotation 485 to 1400 rpm with a traverse speed 4 mm/min was applied. The Mechanical properties of welded joints were investigated using different mechanical tests including destructive test. Based on the stir welding experiments conducted in this The resultant microstructure was characterized using optical microscopy.

Kovacevic (2003) In this paper friction stir welding (FSW) is a comparatively new welding operation that may have considerable advantages compared to the fusion operation as follow: joining of conventionally non-fusion weld able alloys, cut-price deformation and afflicted mechanical properties of weld able alloys joints due to the pure solid-state joining of metals. In this paper, a three-dimensional model based on finite element analysis is used to study the thermal history and thermo-mechanical operations in the butt-welding of aluminum alloy 6061- T6.

Ibraheem Sabry et al. (2013).The aim of this work determines the feasibility to weld two pieces of aluminum pipe by friction stir welding process and study the effect on the mechanical properties of welding joints. Special welding fixture fixed on conventional drilling machine has been conducted to attempt this welding and a group of welding parameters. The tool rotational speeds 485 to 1400 rpm with a traverse speed 4mm/min were applied. in this study the results show that aluminum pipe (6061) can be welded by (FSW) process with a maximum welding efficiency (78.7%) in terms of ultimate tensile strength, using 1400 (RPM) rotational speed, 4 (mm/min) traveling speed.

Cavaliere et al. (2005) in this study the investigated the mechanical and micro structural properties of dissimilar 2024 and 7075 aluminum sheets joined by friction stir welding (FSW). The two sheets, aligned with perpendicular rolling directions, have been successfully welded; successively, the welded sheets have been tested under tension at room temperature in order to analyze the mechanical response with respect to the parent materials.

Kovacevic (2005) In their paper thermo-mechanical simulation of friction stir welding can prophesy the transitory temperature area, active stresses progressing, forces in all the three dimensions and may be elongated to determine the residual stress. The thermal stresses shape a main portion of the total stress progressing during the process.

Driver a (2005) In this paper, a three-dimensional thermo mechanical model for Friction Stir Welding. Established on the velocity area classically used in fluid mechanics and mix heat input from the tool shoulder and the plastic strain of the bulk material, the semi-analytical model can be used to take out the strains, strain rates, and valuation of the temperatures and micro-hardness in the various weld zones. The outcome is in perfect convention with experimental measurements complete on an AA2024- T351 alloy friction stir welded joint.

Ahmed. M. El-Kassas et al. (2015) in this study effect to the mechanical properties in order to demonstrate the feasibility of friction stir welding for joining Al 6061 aluminum pipes with different thickness 2 to 4mm, rotational speeds 485 to 1400 RPM and a traverse speed 4 to 10 mm/min was applied. This work focuses on two methods such as artificial neural networks(ANN) using software (Pythia) and response surface methodology (RSM) to predict the tensile strength, the percentage of elongation and hardness of friction stir welded 6061 aluminum alloy. An artificial neural network (ANN) model was developed for the analysis of the friction stir welding parameters of Al 6061aluminum pipe. Response surface methodology (RSM) also developed and the values obtained for the response Tensile strengths, the percentage of elongation and hardness are compared with measured values.

Zhang et al. (2007) explain the 3D material flows and mechanical countenance under different operation parameters by using the finite element method based on solid mechanics. The experimental outcome is also given to study the effect of operation parameters on joining properties of the friction stir welds. Numerical outcome set forth that the tangent flow shapes the prime part in the material flow. The shoulder can accelerate the material flow on the upper semi of the friction stir weld.

Hwang (2010) in this study aimed to experimentally scout about the thermal history of a work piece sustain. Friction Stir Welding (FSW) encompass butt joining with pure copper C11000. In the FSW experiments, The convenient temperatures for a prosperous FSW operation were found to be between 460 ◦C and 530 ◦C. These experimental outcome and the operation control of temperature histories can offer advantageous knowledge for an FSW based operation of copper joining.

Hotel a (2010) Studied that the post-welding stress state, strain history and material situation of friction stir welded joints are predominately strongly exemplify when used in hidden modeling analyses, typically by desert
one or extra of the features above. But, it is apparent that the status after welding does effect the weld execution. The objective of this paper is to powwow some of the major struggles that arise when taking both the post-welding material case and stress-strain state into calculation in a calculation structural analysis

Kanwer S. Arora et al. (2010) in this paper, effective friction stir welding of aluminum alloy 2219 using an adapted milling machine communicates. The downward or forging force was found to be suitable for shoulder diameter and rotational speed whilst longitudinal or welding force on welding speed and pin diameter. The tensile strength of welds was safely affected by welding speed and shoulder diameter whilst welding speed mightily affected percentage elongation.

Hwang et al. (2010) experimentally reconnoiter the thermal history of a work piece endure Friction Stir
Welding (FSW) include butt joining with pure copper C11000. In the FSW experiments, K-type thermocouples were used to registration the temperature history at different locations on work piece. This data, concerted with the preheating temperature, tool rotation speeds and tool moving speeds allowed parameters for a prosperous weld to be determined.

S. Rajakumar et al. (2011) Friction-stir welding (FSW) operation is an emerging solid state joining operation in which the material that is existence welded does not melt and modify. This operation uses a non-consumable tool to generate frictional heat in the border surfaces. The FSW operation and tool parameters play a prime say in to be decided the joint strength. Joint strength is affected by grain size and hardness of the weld nugget region. Hence, in this investigation, an endeavor was made to evolve experiential relationships to foresee grain size and hardness of weld nugget of friction-stir-welded AA6061 aluminum alloy joints. The experiential relationships are progressing by response surface methodology mix FSW tool and process parameters. A linear regression relationship was also determined between grain size and hardness of the weld nugget of FSW joints.

Elangovan et al.(2012) The investigators in this paper concentrate on the growth of an effective methodology to determine the optimum welding situation that maximizes the strength of joints created by ultrasonic welding using (RSM) coupled with genetic algorithm (GA).RSM is applied to create a functional analytical model for welding strength in terms of welding parameters namely pressure, weld time, and

amplitude. Experiments were behaved as per central composite design of experiments for macula and seam welding of 0.3- and 0.4-mm-thick Al sample. An effective second-order response surface model is developed utilizing experimental measurements. Response surface model is moreover connected with GA to optimize the welding conditions for wished for weld strength.Optimum welding conditions produced from GA are verified with experimental results and are found to be in perfect approval.

Mariano et al. (2012) in this review on friction stir welding (FSW) modeling with a characteristic concentrate on the heat obstetrics due to the approach situation between the FSW tool and the work piece. A credible FSW operation modeling consists on the fine tuning of some operation and material parameters. Generally, these parameters are accomplished with a base on experimental data. The numerical modeling of the FSW operation can assist to realize such parameters with minimal potential and with the economic characteristic.

ZHANG (2012) in this studied the thermal modeling of underwater friction stir welding (FSW) was preceding with a three-dimensional heat transport model. The evaporate advantage of water was analyzed to lighten the fringe situations of underwater FSW. Temperature following properties of the material was believed for the modeling. For underwater joint, the high-temperature classified area is dramatically tightened and the welding thermal twirl in various zones is effectively striped in disparity to the normal joint.

Bhatt (2013) In this paper we spotted that Friction stir welding (FSW) of AA6061-T6 aluminum alloy has been an endeavor to outdo limitations of fusion welding of the same. The FSW tool, by not existence wasted, manufactures a joint with the dominant characteristic of high joint strength and minimize distortion and non-attendance of metallurgical defects. operation parameters such as tool rotational speed, tool traverse speed and axial force and tool dimensions play a significant role in earning a particular temperature allocation and next viscosity distribution within the material being welded; the former dominant the mechanical properties and posterior the flow stresses within the material in turn.

Guo (2013) Studied in this paper effect the Dissimilar AA6061 and AA7075 alloy have been friction stir welded with an assortment of different operation parameters. In special, the effects of materials situation and welding speed on the material flow, microstructure, micro hardness apportionment and tensile property of the joints were exact. It was discovered that the material mixing is much more effective when AA6061 alloy was located on the progress side and multiple vortexes centers created vertically in the nugget. l computational model.

Alaa-El Hammady (2016). In this study, AL6061\Sic particles plates were welded as comparable alloy joints using (FSW) treat. In order to research the effect of rotation speeds 710, 910, 1120 and 1400 RPM and travel speeds 16 and 20 mm/min on mechanical properties and microstructure. The mechanical tests were carried out in the welded field. Vickers hardness profile and tensile tests of the joints as a metallurgical investigation, Optic Microscopy were used for base and weld zones. The outcome acquired out of FSW weld qualifications reduction with excess the volume fraction of SiCp.

CONCLUSIONS

- The lower paper has been thorough in the area of welding pipes by FSW.
- The present work explains review and overview of Friction stir welding pipes which contains the basic connotation of the operation, mechanical properties and Suggested model in FSW process.
- In the experiments, it could be decided that the welding was ambidextrous to aluminum pipes, subsequently, a welded seam could be successfully pat. When preparing the welded joints the strength properties of the welded seams were safely affected

REFERENCES

[1]Dawes, C.J.; and Thomas, W.M.: "Friction Stir Process Welds Aluminum Alloys," Welding Journal, pp. 41–45, March 1996.
[2] A.M.Khourshid, I.Sabry "Friction stir welding study of aluminum pipe", International Journal of mechanical engineering and robotics research, Vol. 2, No. 3, **2013**, pp 331-339
[3] Gerçekcioglu E, Eren T, Yýldýzlý K, Kahraman N and Salaam E, "The Friction Behavior on the External Surface of the Friction Stir Welding of AA6063-T6Tubes" **2005**.
[4] A.M.Khourshid, I.Sabry "analysis, and design of Friction stir welding", International Journal of mechanical engineering and robotics research, Vol. 2, No. 3**, 2013**, pp 233-241
[5] C.M. Chen, R. Kovacevic ∗, Finite element modeling of friction stir welding—thermal and thermo-mechanical analysis, International Journal of Machine Tools & Manufacture 43 (2**003**) 1319–1326, Received 12 May 2003; accepted 10 June **2003**.
[6] P. Cavaliere, R. Nobile, F.W. Panella, A. Squillace. Mechanical and micro structural behavior of 2024–7075 aluminum alloy sheets joined by friction stir welding. International Journal of Machine Tools &Manufacture 46 (**2006**) 588–594.
[7] P. Heurtier a, M.J. Jones b, C. Desrayaud a, J.H. Driver a,∗, F. Montheillet a, D. Allehaux c, Mechanical and thermal modelling of Friction Stir Welding, Journal of Materials Processing Technology 171 (**2006**) 348– 357, Received 16 April **2004**; received in revised form 1 January 2005; accepted 6 July **2005**.
[8] A.M., El-Kassas, A. M. Khourshid, and I. Sabry, Integration between artificial neural network and responses surfaces methodology for modeling of friction stir welding. Internat. J. Adv. Engg. Res. & Sci. (IJAERS),**2015**. 67-73.
[9] Takehiko Watanabe, Hirofumi Takayama, Atsushi Yanagisawa. The joining of aluminum alloy to steel by friction stir welding. Journal of Materials Processing Technology 178 (**2006**) 342–349.
[10] Z. Zhang & H. W. Zhang. Springer-Verlag London Limited 2007 Material behaviors and mechanical features in the friction stir welding process, Received: 8 February 2006 / Accepted: 19 June 2006 / Published online: 3 February **2007**.
[11] A.M., El-Kassas, A. M. Khourshid, and I. Sabry, Optimization of friction stir welding parameters for joining Aluminum pipes using regression analysis. International Journal of Civil, Mechanical and Energy Science (IJAMES).**2016**

[12] Hui-jie ZHANG, Hui-jie LIU, Lei YU, Thermal modeling of underwater friction stir welding of high strength aluminum alloy, Trans. Nonferrous Met. Soc. China 23(2013) 1114_1122, Received 23 February **2012**; accepted 26 June **2012**.
[13] J.H. Hattel a,*, K.L. Nielsen b, C.C. Tutum a, The effect of post-welding conditions in friction stir welds:From weld simulation to ductile failure, European Journal of Mechanics A/Solids 33 (2012) 67e74, Received 28 September 2010,Accepted 22 October 2011,Available online 23 November **2011**.
[14] Kanwer S. Arora & Sunil Pandey & Michael Schaper &Rajneesh Kumar Effect of process parameters on friction stir welding of aluminum alloy 2219-T87, Springer-Verlag London Limited 2010, Received: 2 December 2009 / Accepted: 31 January 2010 / Published online: 20 February **2010**.
[15] Y.M. Hwang∗, P.L. Fan, C.H. Lin, Experimental study on Friction Stir Welding of copper metals, Journal of Materials Processing Technology 210 (2010) 1667–1672, Received 15 January 2010, Received in revised form 8 April 2010, Accepted 31 May **2010**.
[16] S. Muthukumaran & Kumar Pallav &Vikas Kumar Pandey & S. K. Mukherjee. A study on the electromagnetic property during friction stir weld failure, Springer-Verlag London Limited 2006, Received: 19 March 2006 / Accepted: 10 October **2006** / Published online: 12 December 2006. [15] S. Rajakumar & C. Muralidharan & V. Balasubramanian. Statistical analysis to predict grain size and hardness of the weld nugget of friction-stir-welded AA6061-T6aluminium alloy joints, Springer-Verlag London Limited 2011Received: 29 October 2009 / Accepted: 17 March 2011 / Published online: 20 April **2011.**
[17] K. Elangovan, V. Balasubramanian.Influences of tool pin profile and welding speed on the formation of friction stir processing zone in AA2219aluminium alloy. Journal of materials processing technology 2 0 0 (**2 0 0 8**) 163–175.
[18] Diogo Mariano Neto & Pedro Neto. Numerical modelings of friction stir welding process: a literature review.
[19] Hui-jie ZHANG, Hui-jie LIU, Lei YU, Thermal modeling of underwater friction stir welding of high strength aluminum alloy, Trans. Nonferrous Met. Soc. China 23(2013) 1114_1122, Received 23 February 2012; accepted 26 June 2**012**.
[20] Bo Li a, Zhenhua Zhang a, Yifu Shen a,⇑, Weiye Hub, Lei Luo a, Dissimilar friction stir welding of Ti– 6Al–4V alloy and aluminum alloy employing a modified butt joint configuration: Influences of process variables on the weld interfaces and tensile properties, Materials and Design 53 (**2014**) 838–848, Received 26 May 2013,Received in revised form 5 July 2013,Accepted 7 July 2013,Available online 18 July **2013**.
[21] H.J. Liu a,⇑, J.C. Hou a,b, H. Guo a, Effect of welding speed on microstructure and mechanical properties of self-reacting friction stir welded 6061-T6 aluminum alloy, Materials and Design 50 (2013) 872–878, Received 22 January 2013,Accepted 30 March 2013,Available online 11 April **2013.**
[22] Alaa-El Hammady "Friction stir welding of Aluminum Metal Matrix Composites" International Journal of Civil, Mechanical and Energy Science (IJCMES), Vol-2, Issue-4, July-Aug, **2016**.