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Tensile Test of Conventional and Overlap Joints Aluminum Alloy H20-H20 Welded by Friction Stir Welding

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Abstract: Friction Stir Welding (FSW) is a new developed method that mechanical stirring between two parts of work piece and tool cause welding.in this method we can welding materials that previously was not wieldable like aluminum alloys. FSW is a perfect method for manufacturing the complex shape hollow products.orbital FSW also has a wide application in steel pipe maintenance in oil industries by using robotics type CNC machines.In previous investigation I performed vicker hardness test by CNC milling machine to aluminum alloy H20 and H20 In this paper we using same CNC milling machine for welding the same aluminum alloys in both conventional and overlap work pieces and after that using Tensile test on the welded joints and compare the results and make conclusion. Obviously due to the wide application of overlap joints of aluminum alloys in industries the results will help us howto increase or decrease the overlap depth in different position and /or different joint required characteristics.

Key words: Aluminum alloy H20 · Friction stir welding(FSW) · Tensile test · Vickers hardness test

INTRODUCTION

Friction Stir Welding (FSW) is a new welding method who done by CNC milling machines and compare to conventional welding methods can use by different types of metals specially different types of aluminum alloys. FSW can apply for same or different types of materials like brass, mix copper and titanium as well as aluminum.also we can using wide different type of machine in different type of application and material areas longitudinal, horizontal, vertical, like manufacturing the floor panel of modern train or ships also it has wide application in new automotive industries

The principal of FSW base on penetrating a tool in to the joint surface after adjusting process in CNC milling machine(feed of the process) due to the type of materials and tool shapealso rotational speed and travel speed of the process are the second and third main process characteristics. All will adjust after tool, machine and material documents consideration. In complex applications the CNCmachine need to programed by CAM methods accurately, while in simple applications it usually using a simple CNC machine programing in a linear path in the case that we want to weld both side the joint we just turn the work piece and use the same program in the reverse direction [1].

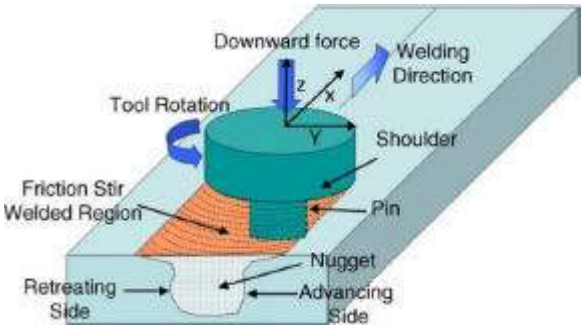

Fig. 1: FSW schematic diagram [2]

one of the common joint in mechanical engineering design is overlap joints the nature of the problem is how can we decide the type of joint in primary design for different application. previous work in this field all compare welded joint with different tools and different materials work piece. in this project we want to compare the mechanical properties of conventional and overlap joint the result will help design process in different

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situation. Excessive welding heat input, of any high load may cause the peak load and energy absorption capability significantly reduce. Maladjustment of the process parameter may cause change in pullout failure location from base metal to weld nugget edge due to severe indentation.[3]corrosion Resistance of aluminum alloy H20 is very good also its strength is good and it has a wide application in industries.it is a kind of structural alloy it has wide application in platform manufacturing and its machinability is excellent with a good control in grain structure. these characteristics make aluminum alloy H20 excellent for FSW process[4].

MATERIAL AND METHODS

The CNC MILLING MACHINE BMV 45 used for this project in a work shop inBalanagarHyderabad India.

No	Part name	Specification
1	3-axis machine center	Spinner
2	Model	BFW45
3	Spindle driver	Servo motor
4	Spindle range	10-6000 RPM
5	Tool holder	ISO 40
6	Cutting fluid	NR
7	Tool	HSS
8	Work piece	Aluminum Alloy H20 and H20
9	Movement	610*450
10	Bed size	800*500

Fig. 3: CNC milling machine specification

We used speed 1000RPM feed 20 mm and travel speed 20mm/m for the process.Also we used Aluminum Alloy H20 and H20In this investigation.

CNC Program: We perform the process of welding by following program in our CNC milling machine that mentioned before.we used the same program but by reverse direction for the back side of the weld joints. the CNC program is as following:

- 00010(DIA 16.0EM 45 DEGEREE TIP CUTTER)
- N01 (FRICTION STIR WELDING)
- N02 (DATE 11-01-2010 TIME 20:15:08)
- N03 G0G17G40G49G53G80G90
- N04 G5.1Q1R10
- N05 G91G28Z0
- N06 M03S950
- N07 G90G54X0.0Y0.0
- N08 G43H6Z50
- N09 G1Z2F800
- N10 G1Z-3.8F16
- N11 X170

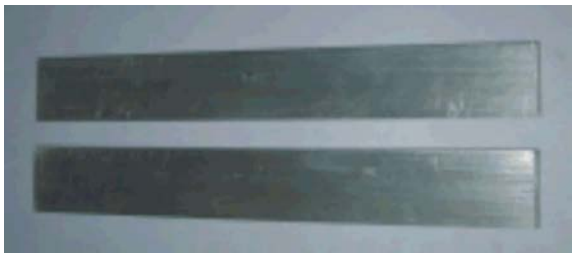

Fig. 4: Aluminum alloy plate

And the dimension of joint as following:

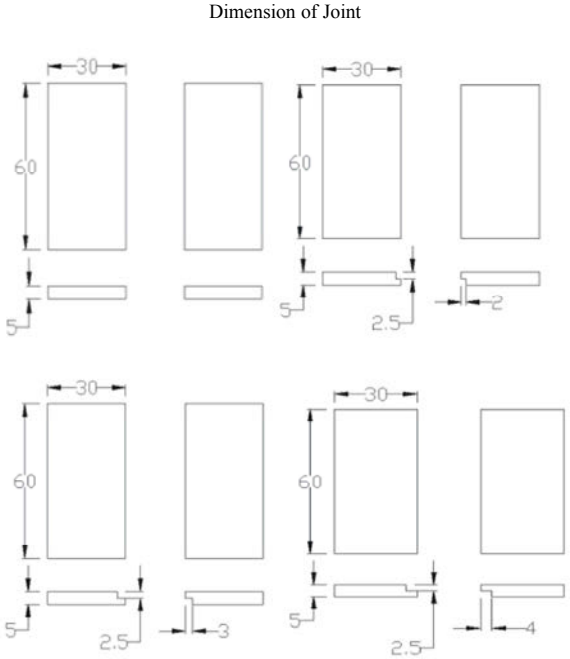

Fig. 5: Work piece demansions(conventional and overlap joints, overlap joints with different depth)

The workpiece samples photo as following:

- N12 G0Z50.0M09
- N13 M05
- N14 G91G28Z0
- N15 G5.1Q0
- N16 M3

Tensile Test Procedure: Tensile test perform by universal testing machine it should be perform in temperature between 10 to 35 c if S is Cross-sectional area and F is the maximum force then [5]:

$$\text{tensile strength} = R = F/S \quad (1)$$

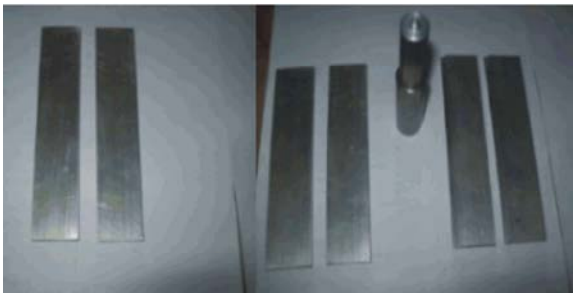

Fig. 6: Workpice samples

Fig. 7: Conventional (ordinary)and overlap joint FSW samples

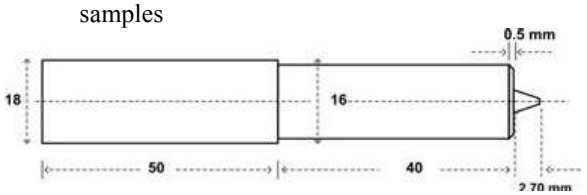

Fig. 8: Tool geometry

The process parameter ptimization have a direct influence in welded joint quality It was found that rotating speed of pin, feed rate and the profile of the pin had significant effects on the strength of the welded-joints. When the real strain and tensile curves of the welded samples connected by increasing the rotating speed of the pin and feed rate were examined, high heat generation was observed [6].

The most important item in process parameter that have the approximately 50 percent influence on weld quality is pin length parameter or tool geometry and it has more influence on quality performance of weld. [7] the tool geometry in this project is as following:

The tool type is triangular and the tool material is High speed steel (Wc-Co).

general failure modes which can occur during tensile-shear test represented as following:

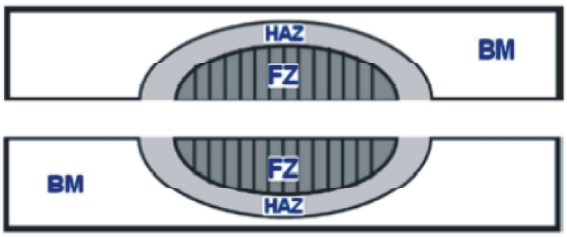

Fig. 9: Schematic representation of general failure modes which can occur during tensile-shear test.[8]

Typical universal testing machine plot as following

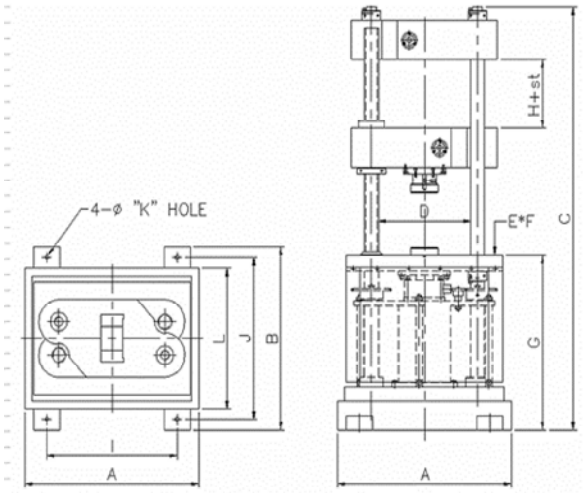

Fig. 10: Typical universal testing machine

We use universal testing machine model DTU-9000HCA in this investigation

Fig. 11: Universal testing machine DTU-9000HCA

RESULT AND DISCUSSION

In this investigation we weld both side of joints by first conventional joint and after that by overlap joint with 2mm, 3mm,4mm in previous investigation we performed vicker hardness test for all conventional and overlap joint prepared by FSW with same material and tool and work procedure and respectively the result show in charts 1 to 4.Vickers hardness number varied by changing the Distance from the weld start position in center but there is not a meaningful relationship between them.

In this paper we performed tensile test for same conventional and overlap joints.The results of the tensile testing shown in chart 5.at the end we can compare both tensile test and vicker hardness test numbers together this evaluation will help us in design process in different design situation. and help us better understanding of FSW mechanical properties in conventional joint and on the other hand in different overlap depth. better tensile characteristic will help when the welded joint under more horizontal load and bigger vicker hardness will help us when the welded joint under more vertical load. These seems to be important in design process we suppose that all numbers evaluated in optimal process parameter items. Like the main FSW process parameter rotational speed depth of FSP and travel speed. effect of welding parameters on the microstructure of welded joint also is one of the items that directly have important influence on welded joint quality and mechanical properties[9] Weld dilution is an important feature of weld bead geometry

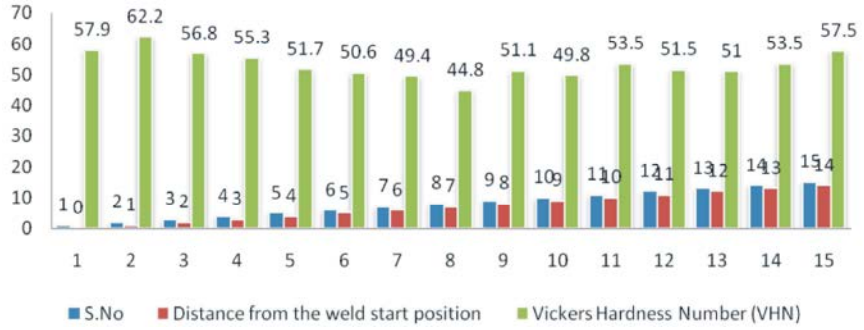

Chart 1: Distance from the weld start position Vs Vickers Hardness number (VHN)Conventional Joints

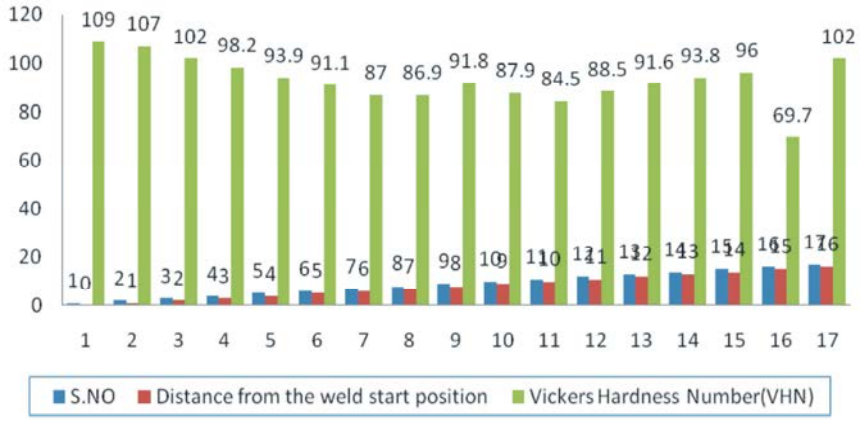

Chart 2: Distance from the weld start position Vs Vickers Hardness number (VHN)2 mm overlap distance weld joints

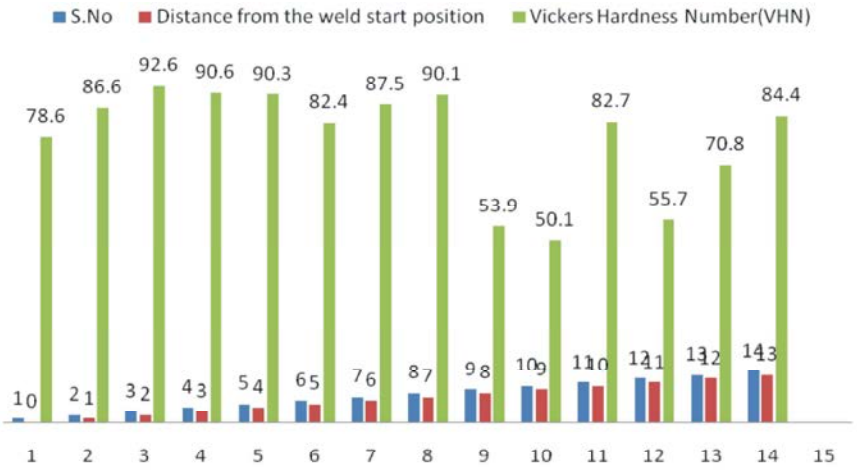

Chart 3. Distance from the weld start position Vs Vickers Hardness number (VHN)3 mm overlap distance weld joints

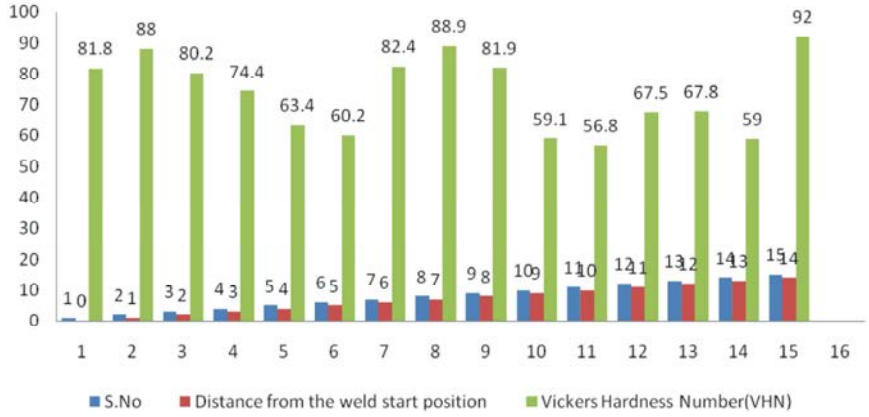

Chart 4. Distance from the weld start position Vs Vickers Hardness number (VHN)4 mm overlap distance weld joints

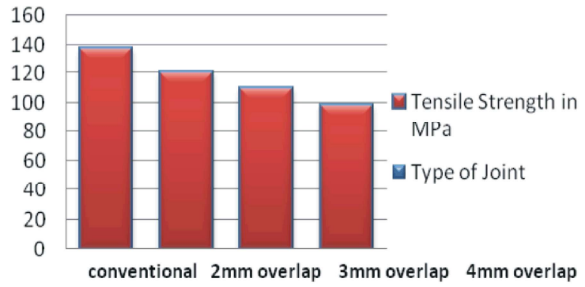

Chart 5: Tesile s trength of conventional and overlap joints diagram.

that determines the mechanical and chemical properties of a welded joint this may be another factor that is important in process parameter optimization. Mathematical models were developed in order to predict weld dilution as a function of process parameter that can be independently controlled and measure during any conventional or nonconventional welding processes [10].

CONCLUSION

FSW successfully done by CNC milling machine BMV 45 with acceptable quality. the mechanical properties of FSW vary by changing the position or distance from the center (weld position).FSW successfully done by similar work piece of aluminum alloy H20-H20 in both conventional and overlap joints.Thevickers number varied by position of the joint (distance from weld center) and the hardness number is about 75 percent of aluminum alloy H20 (parent material).Conventional joint weld have the better tensile strength properties than overlap joint also Tensile Strength in MPa decreasing by lap distances MM increased in overlap joints.This results suggest that during the design process when the joint will under high vertical position load and hardness qualification required that is better touse overlap joints on the other hand when the joint is under horizontal load and tensile qualification required that is better to design conventional joint.

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REFERENCES

1. Mishra, R.S. and Y.Z. Ma, 2005. Friction stir welding and processing. Mater.Sci., A. Eng., 50: 1-66.
2. Uzun, H., 2007. Friction stir welding of SiC particulate reinforced AA2124 Aluminum alloy matrix composite. Materials and Design, 28: 1-2.
3. Pouranvari, M. and E. Ranjbarnoodeh, 2011. Resistance Spot Welding Characteristic of Ferrite-Martensite DP600 Dual Phase Advanced High Strength Steel-Part III Mechanical Properties. World Applied Sciences Journal, 15: 1521-1522.
4. Thomas, W.M., E.D. Nicholas, J.C. Needham and M.G. Murch, 2008. Friction stir butt welding, pp: 45-46.
5. Hussain, A.K. and S.A. Pasha, 2010. Evaluation Of Parameters Of Friction Stir Welding For Aluminum Aa6351 Alloy. International Journal of Engineering Science and Technology, 2: 5977-5984.
6. Küçükrendeci, H. and H. Küçük, 2013. Effects of Rotating Speed and Feed Rate on Mechanical Behaviors in EN-AW6060 Aluminum Alloys Bonded by Using Friction Stir Welding. World Applied Sciences Journal, 22: 577-582.
7. Kumar, R., M. SivaPragash and S. Varghese, 2013. Optimizing the Process Parameters of FSW on AZ31B Mg Alloy by Taguchi-Grey Method. Middle-East Journal of Scientific Research, 15: 161-167.
8. Pouranvari, M. and E. Ranjbarnoodeh, 2011. Resistance Spot Welding Characteristic of Ferrite-Martensite DP600 Dual Phase Advanced High Strength Steel-Part II Failure Mode. World Applied Sciences Journal, 15: 1528-1529.
9. Küçükrendeci, I. and H. Küçük, 2013. Effect of Welding Parameters on Welding Microstructurein EN AW-6060 Aluminum Alloy Combined with Friction Stir Welding Process.World Applied Sciences Journal, 22: 300-306.
10. Thiru, S., C.L. Huat, K. Jusoff and S. Hemavathi, 2013. Prediction and Measurement of Weld Dilution in Robotic CO Arc Welding. World Applied Sciences Journal, Special Issue of Engineering and Technology, 21: 23-30.