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"THE PREHEATING INFLUENCE ON FRICTION STIR WELDING - REVIEW"

KEYWORDS: friction stir welding; temperature distribution; pin angle; preheating

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ABSTRACT Advanced materials are generally requires an exceptional joining techniques for sound joint quality. Any new material has always been considered as a high point in a research and development, particularly for material that has widespread applications. The joining processes like diffusion bonding are considered in this literature review, Though these processes are competent of joining a variety of materials in the aerospace and other industrial applications. The effects of preheating on temperature distribution is studied and review is to blaze the progress made in this area and to make remarkable submission for future work.

Introduction:

Friction stir welding (FSW) is a recently emerged solid-state joining technology patented by the Welding Institute (TWI) in 1991 [1]. A rotating cylindrical shouldered tool plunges into the butted plates and locally plasticizes the region around the separation line during its movement and correspondingly results in the stirring of the material in the nugget and two work pieces are finally joined together. In this process, the heat is originate from the friction between the welding tool and the welded material, which causes the welded material to soften at a temperature. The softened material underneath the shoulder is further subjected to extrusion by the tool rotational and transverse movements. It is expected that this process inherently produces a weld with less residual stress and distortion as compared with the fusion welding methods, since no melting of the material occurs during the welding. Friction stir welding (FSW) is applied extensively in industry for joining of nonferrous metals especially aluminum. Some of research papers are being discussed in this review.

R. Keivani.et.al, In this investigation, FSW has been extensively studied for most nonferrous alloys specifically those materials which are difficult-to-fusion-weld alloys. The temperature analysis and heat transfer phenomenon during this process were been concentrate for the study.

CONFIGURATION OF TOOL, WORKPIECES

In investigation ,Copper C11000 workpieces with dimensions of 60 mm×20 mm×3.1 mm were been prepared. welding tool made of SKH9 high-speed steel and comprised of a shank, shoulder, and pin was used during the welding. After a preheating time, the welding tool was forcibly translated along the joint line until the end of the line and finally moved back while the spindle continued to turn. The spindle of this self-designed FSW apparatus can spin with rotational speeds from 400 to 1200 r/min, and the fixture table, driven by a servomotor, can move at speed from 20 to 60 mm/min. A concave part close to the shoulder was specially designed to prevent massive heat loss from the shoulder to the shank of the tool. An inclination angle of 1°, with respect to the welding tool and the normal vector of the workpiece, was set before welding to allow the tool to smoothly traverse the workpiece.

Thermocouples A K-type grounded thermocouples with a sheath diameter of 1 mm were used for temperature measurement. A digital thermometer, TM-747D, was used to connect four thermocouples to a personal computer that contained a data acquisition system installed to record the temperature histories during FSW. Two of the four thermocouples were placed on the advancing side, and the other on the retreating side. The appropriate distances between the tips of the thermocouples and the joint line were kept. This process were been helped to measure the temperature on the both sides of weld.

PREHEATING EFFECT The temperature increase due to preheating while for initial times of welding .which further related to plunging step the differences between the curves are large. Now this can be likely to the affect the yield strength. As the initial temperature increases, the yield strength decreases. and as a result less forming force is required for deformation during FSW process and consequently less friction stress and heat are generated. Initially heating of workpiece is to low temperature, the generated heat is high, for the workpiece initially heated to high temperature, the produced heat is low. Therefore, the effects of two parameters, namely initial temperature and produced heat during FSW process, for time beyond the plunging step counterbalance each other and the differences among the temperature histories are low.

It can be concluded that although preheating results in high initial temperature of workpieces, but as lower heat is produced during welding process, it does not affect the temperature distribution along the weld line largely.

Omid Ali Zargar, An investigation Includes the influence of preheating in mechanical properties like Vickers Hardness and Tensile Strength of friction stir welded (FSW) joint of Aluminum Alloy H20 and H20 conventional joint in three different preheating temperature 150c -200c -250c. the previous investigation on this aluminum alloy shows that the surface condition of welds was not satisfactory specially in the back of the welded joint. The preheating process should improve the mechanical properties like Tensile and hardness properties. Friction stir feed 20 mm and travel speed 20mm/m with triangular tool welding base on the principal of welding cause by heat in this investigation (Tool material was High speed steel generated by friction the work pieces back side always have lower welding characteristic and quality. The welding process of the aluminum is increasingly used Basic thermal model includes diffusive heat transfer in the different industries. The use of this welding process the work pieces and that backing plate, convective heat requires a good understanding of the microstructure transfer in the work pieces caused by the material flow, generated by the rapid temperature rise in the HAZ heat generation at the tool, heat loss to the ambient air (heat affected zone).in some applications before using the and heat transfer between the work pieces and the any traditional welding process, the aluminum were heat backing plate [4]. Therefore the preheating process may treated at different temperatures. after the welding, it has improve the weld joint mechanical properties.

Experimentation The rotational speed of about 1000 RPM was been used on CNC milling to welding the work piece of aluminum. Friction stir feed 20 mm and travel speed 20mm/m with triangular tool welding base on the principal of welding cause by heat in this investigation (Tool material was High speed steel generated by friction the work pieces back side always (Wc-Co).

Table Friction stir welded joint aluminum alloy H20-H20Tensile Strength in MPa.[2]

Type of Joint	T.S.(MPa)
Friction stir welded joint without preheating	138
Friction stir welded joint with 150 C preheating	189
Friction stir welded joint with 200 C preheating	212
Friction stir welded joint with 250 C preheating	231

Preheating generally increase Vickers Hardness Number and therefore hardness qualification of the welding process beside this preheating increase Tensile strength of the weld joints quite considerably. therefore preheating recommended both when the friction stir welded joint under horizontal or vertical high loads.

M. Merklein et.al, Steel aluminium Tailor Welded Hybrids are still mentioned to be difficult to be joint as intermetallic phases appear during melting welding techniques. These phases are the reason for failure of the joint during loading or forming. Tensile tests were performed to achieve mechanical properties of joints, which were welded by systematic variation of process parameters. Finally deep drawing tests are conducted to demonstrate the formability of laser assisted friction stir welded steel aluminium joints.

Joining steel and aluminium with melting welding technologies leads to the challenge, that intermetallic phases appear, which influence the product life of the welded assemblies negative. Friction stir welding is an alternative welding technology operating in the solid phase during joining. The main solution was offered by preheating the steel blank with a laser beam. laser assisted friction stir welding will be presented as well as results of joining investigations, e.g. regarding the mechanical properties and forming behaviour, which were achieved for steel aluminium blanks in a butt joint configuration.

Laser assisted friction stir welding

The preheating of the steel sheet is realised by a laser spot, which is generated by the diode laser LDL. This preheating of the steel plate near the joining zone lowers the yield stress of the steel, which ensures wearless joining using a nickel-base alloy tools.Materials used for the presented investigations are the deep drawing steel DC04 and the precipitation hardenable aluminium alloy AA6016 T4 in sheet thicknesses of about 1 mm, which are mainly used for automotive car body components.

Investigation and analysis The main three process parameter, as the welding feed, the rotational speed of the tool and the laser power, have to be varied systematically in order to determine process parameters guarantying best mechanical properties of these welded parts during tensile tests. This is done by statistical means according to the design of experiments [2] and will determine the combination of parameters, with whose the best tensile strength and elongation at fracture of friction stir welded joints are achievable. During carrying out the tests the first achievement was that the experiments can be executed only by locating DC04 on the advancing side and AA6016 on the retreating side of the joint.

In brief ,the high potential of laser assisted friction stir welded steel aluminium Tailored Hybrids in a sheet thickness of about 1 mm, which were joint in a butt joint configuration. Even of this thickness they feature good possibilities to be assembled in automotive industry. By the means of statistical investigations a parameter field has been established in order to varying systematically the main process parameter welding feed, rotational speed and laser power. Tensile tests of these welded blanks confirm high tensile strength of up to 200 MPa, which corresponds about 80 % of the tensile strength of unaffected aluminium base material.

Conclusion

The preheating process should improve the mechanical properties like Tensile and hardness properties. The effect of preheating on temperature distribution along the weld line, due to the effect of generating heat during FSW process, is minor. Preheating generally increase Vickers Hardness Number, weldability, welding feed ,hardness and to reduce the wear at the tool .therefore conditions of the welding process nearby this preheating increase Tensile strength of the weld joints quite considerably.

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