A REVIEW PAPER ON FRICTION STIR WELDING

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ABSTRACT

Friction Stir Welding is a novel solid-state joining process that is both efficient, environmental neighborly and flexible in its applications. Considered a standout amongst the most development in this age, Friction Stir Welding is utilized as a part of the joining of high strength alloys which give challenges the conventional fusion methods. As one most huge advancements to the extent metal joining is concerned, Friction Stir Welding is a green technology that requires less energy when contrasted with conventional welding techniques; no flux or gas is required thus influencing the Friction to stir Welding process environmentally sheltered. Being an efficient strategy, Friction Stir Welding process does not include the utilization of any filler metal consequently any amalgam can be joined without thought of compatibility of structure instead of conventional welding strategies where compatibility is an issue. This paper highlights the essentials of Friction Stir Welding and gives a literature review of concentrates that have been directed to enhance this procedure with an attention on dissimilar materials from metal, steel to polymers.

Key words: Friction Stir Welding, Welding, Dissimilar Materials

Introduction

Friction Stir Welding can be characterized as a solid state welding process that is connected in welding materials that are similar and dissimilar. This process is invaluable on the grounds that it prompts sound welds and does not prompt confusions including cracking which is related with fusion techniques of welding. So as to popularize the procedure of friction stir welding, research must be conveyed out for characterization and the foundation of process windows. Thus, numerous researchers have been enlivened by this procedure to endeavor joining dissimilar materials **[9].**

The researchers of the twenty-first century have concentrated to developing technologies that are environmentally cordial and this incorporates the Friction Stir Welding. The Friction Stir Welding process is a technique of solid-state joining that was created by The Welding Institute in 1991. It is a ceaseless procedure including plunging a bit a rotating tool that is uniquely formed between the butting faces of a joint. The relative movement between the substrate and the tool produces frictional heat making a plasticized region around the part of the tool that has been inundated **[13].** This procedure utilizes a non-consumable rotating tool which comprises of a stick that stretches out beneath a shoulder which is constrained into the adjacent mating edges.

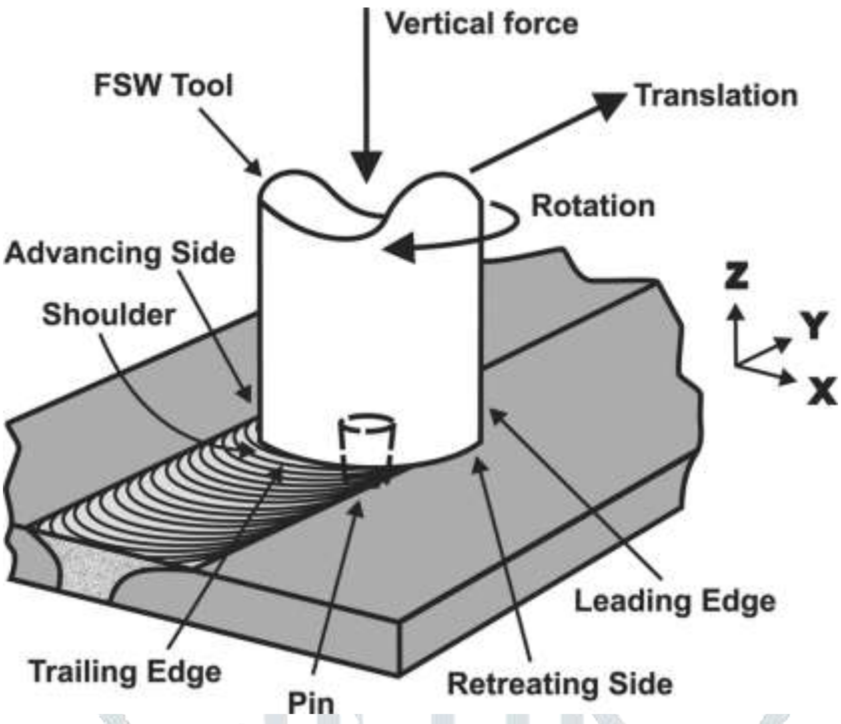

Fig 1 : friction stir welding process(Mubiaya and Akinlabi,2003).

The combination of the forging action, the stirring action, and the heat input create a flow in the material which frames a solid-state weld. The joints of the Friction Stir Welding have distinctive parts as highlighted in figure 2. These parts incorporate the unaffected material, the heat affected zone, the weld nugget and the thermo-mechanically affected zone. The Unaffected material is from the weld and is the material that has not yet been deformed. On the other hand, the heat-affected region is close to the weld focus and the material in these regions has encountered the thermal cycle changing its microstructure and mechanical properties **[3].** There is no plastic deformation in the heat affected zone. The thermo-mechanically affected zone is the part where the Friction Stir welding to has deformed the material and where the heat has additionally affected the material. The weld nugget alludes to the region that was at first involved by the tool **[14]**

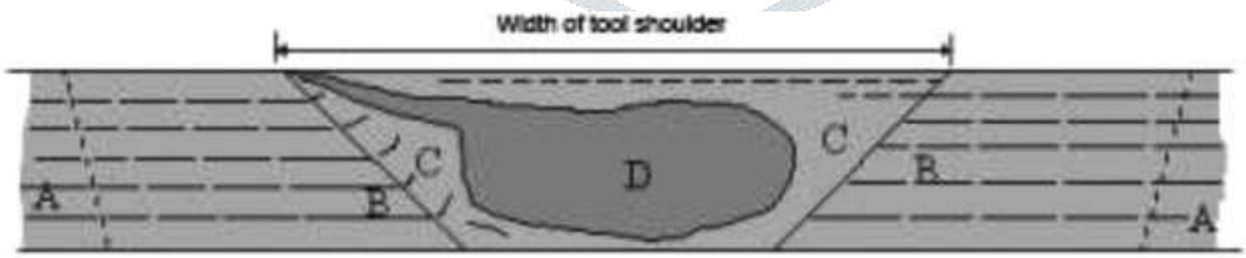

Figure 2: Cross-section of Friction Stir welded material (Mubiaya and Akinlabi, 2013).

A is the unaffected material, B is the heat-affected zone, C is the thermo-mechanically affected zone while D is the weld nugget. The oversimplified idea driving Friction Stir Welding is the insertion of a non-consumable rotating tool that has an exceptional plan turn into abutting edges of plates to be joined and at that point transverse along the joint line.

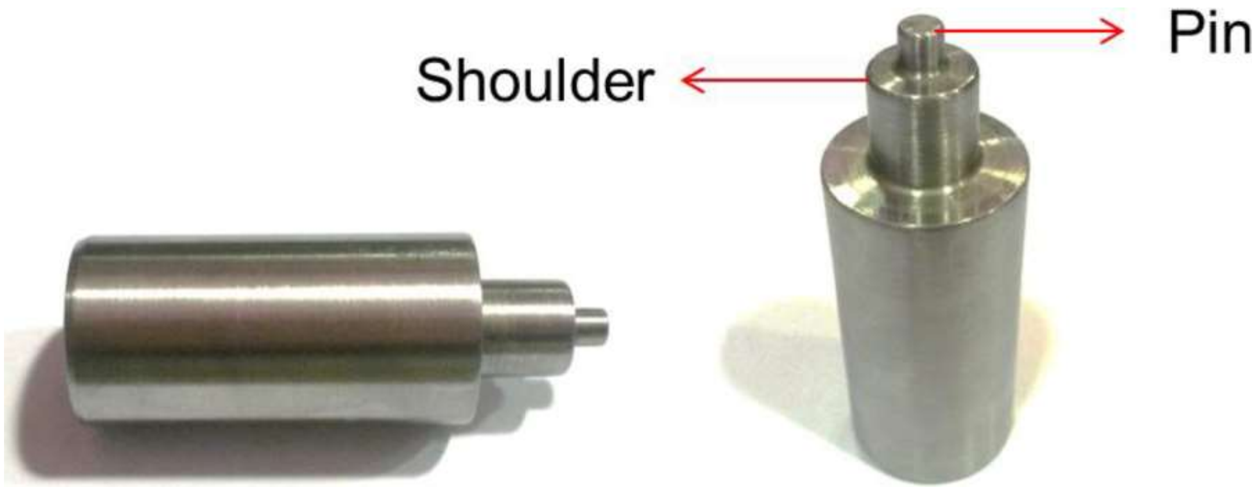

Figure 3: The Friction Stir Welding Tool (Mubiaya and Akinlabi, 2013)[13].

This tool (figure 3) capacities to heat the work pieces and to move the material to create the joint. The heating comes to fruition from the friction between the work piece, the tool and the plastic deformation of the work piece. The heating too softens the materials situated around the stick. The tool pivot and interpretation subsequently result in the development of the material from the front of the stick to the back of the stick **[12].** Subsequently, amid this procedure, a joint is shaped in 'solid state'. Amid the Friction Stir Welding process, the material experiences intense plastic deformation because of the elevated temperatures. This leads to the creation of a fine and equiaxed crystallized grains **[5].** The coming about fine microstructure has great mechanical properties **[1]**

Methodology

To explore the researches that have been directed on Friction Stir Welding, a review of the pertinent literature was embraced. While Friction Stir Welding offers more efficient and environmentally cordial alternative contrasted with the conventional fusion techniques, endeavors have been coordinated to enhancing this technique. This paper reviews distributed works of researchers whose research endeavors was gone for expanding the relevance of Friction Stir Welding of dissimilar material.

Results

Meran (2006) [7] explored the joint properties of plates made of brass by friction stir welding. The test in fusion welding of brasses is no debate. The issue emerges from the evaporation of zinc amid the procedure of fusion welding. **Meran** led an exploratory investigation with a perspective of finding an answer for this issue. His research finding demonstrated that friction stir welding is the arrangement, particularly when managing brass plates of 3 mm thickness. These Aluminium matrix composites (AMC'S) combine the characteristics of metal matrix along with the characteristics of SIC reinforcement which improve in superior mechanical, thermal expansion and tribological characteristics **[12].** His decision was that evaporation of copper and zinc that influences the welding to process troublesome does not happen in friction stir welding. This is a result of the melting point of the metals isn't come to amid the welding procedure.

Li et al. (2009) [6] presented electric resistance in Friction welding. This is a technique that includes consolidating electrical resistance with friction welding to build the joint quality and to spare vitality. In their work, **[6]** utilized martensitic stainless steel and austenitic stainless steel valve rods (4mm diameter) as base metals. Their discoveries showed that electrical resistance friction welding is appropriate in joining slim rods in an astoundingly brief timeframe which is a test in field welding alone. All things considered, electrical resistance heat supported friction welding is great for joining rods that are 4mm in diameter.

Dashatan et al. (2012) [2] led an examination on the feasibility of Friction Stir Spot Welding on two unique polymers in particular acrylonitrile butadiene styrene and polymethyl methacrylate in their investigation, **[2]** utilized an enhanced tool having two extra plates in influencing lap to joint welded samples. The welding parameters on the mechanical properties of the samples were additionally decided. The parameters considered incorporate tool plunge rate, tool rotational speed and the dwell time .To acquire the impact of the parameter on the weld strength, signal-to-noise ratio and the variance analysis was basic. The discoveries demonstrated that welding acrylonitrile butadiene styrene to polymethyl methacrylate was attainable and that the procedure parameters impactedthe strength of the weld. A basic procedure parameter was observed to be the tool plunge rate. It was demonstrated that the weld strength was expanded by diminishing the plunge rate while expanded dwell time improved the weld strength. For the parameter including the tool revolution, it was watched that there was a specific optimum rotational speed where the strength of the weld achieved a most extreme esteem. *Taguchi experimental design Method determined the parameter setting whereas the importance level of the parameter on Hardness, Tensile strength, Impact energy was resolute by means of analysis of variance (ANOVA), analysis of signal to noise (S/N) ratio used to obtain optimum parameter set [11]*.

Discussion

The test emerging from the fusion of brass including the evaporation of zinc amid the welding procedure was highlighted. It was watched this was a test when the customary fusion strategies were utilized. Be that as it may, this issue was not experienced when Friction Stir Welding was utilized in light of the fact that this technique does not utilize high temperature subsequently the melting point of the metals isn't come to amid the welding procedure **[7].** Aside from sparing the energy required for welding material, Friction Stir Welding likewise beats the issue of evaporation experienced amid welding.

While Friction Stir Welding keeps an efficient and environmentally safe technique contrasted with the conventional techniques **[7],** it is imperative that endeavors be made to enhance to enhance the nature of the joints. it is the obligation of researchers to embrace such endeavors. Henceforth, when combined with friction welding, the electrical resistance was found to enhance the nature of the joint **[6].**

Among the research endeavors coordinated at this technique, researchers are entrusted with prescribing measures to build the materialness of the Friction Stir Welding technique. Consequently, fruitful research endeavors have demonstrated that Friction Stir Welding could likewise be connected to polymers including acrylonitrile butadiene styrene and polymethyl methacrylate [**2**]. Moreover research has demonstrated that some procedure parameters can be manipulated keeping in mind the end goal to enhance the properties of the subsequent welds. These properties incorporate the tool plunge rate, dwell time and the tool pivot speed. A decrease of the plunge rate and the expansion in dwell time was found to improve the weld strength. Then again, a specific optimum tool turn speed was found to prompt the most extreme weld strength.

Conclusion

Friction Stir Welding offers a modest, efficient, flexible and environmentally well disposed alternative when contrasted with the conventional fusion techniques of welding. This paper has highlighted the mechanism of this technique yet in addition the basic research endeavors that have bestowed altogether expanding its application. Aside from sparing the energy required for welding material, Friction Stir Welding additionally beats the issue of evaporation experienced amid welding **[7].**

Friction Stir Welding conquers the issue of evaporation since it operates under temperatures that are well underneath the melting point of copper and zinc. Fusing the segment of electrical resistance will enhance the nature of joints **[6].** Friction Stir Welding is achievable with polymers as was watched for acrylonitrile butadiene styrene and polymethyl methacrylate **[2]** and process parameters including plunge rate, tool turn speed and dwell time could be manipulated to upgrade the weld strength of the weld.

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