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REVIEW OF PARAMETERS OF FRICTION STIR PROCESSING ALONGWITH REINFORCEMENT OF COMPOSITION OF ALUMINIUM AND TUNGSTEN CARBIDE

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***Abstract*— Friction stir processing (FSP) is a novel technique used for the enhancing the mechanical and metallurgical properties of the material and also to make composites of the material.In this study, an attempt is made to synthesize the composites of AA6063 and tungsten carbide particles with 5 µm particle size were added reinforcement. The tool shoulder is varied from 16 mm to 20 mm. The other parameters such as tool rotational speed of 1400 rpm and transverse speed of 50 mm/min are kept constant. The friction stir processing tool is made of high chromium high carbon steel with a pin length of 4 mm and pin diameter of 6 mm is used. The 18 mm shoulder diameter produces much finer grain size with tungsten carbide reinforced particles rather than the tools having shoulder 16 mm and 20 mm diameter.. The maximum tensile strength and micro hardness achieved is 260 N/mm^2 and 135 Hv respectively. In case of the tool having 16 mm diameter produces less amount of heat due to lesser contact with the workpiece material and the tool having 20 mm diameter, over heat the workpiece material due to more contact area with the workpiece and causes no proper plastization and flow of the material within the processed zone by friction stir processing and produces courser grain size.**

***Keywords*- Friction Stir Processing, Microstructure, Nugget, Aluminium**

I. INTRODUCTION

Friction stir processing (FSP) is a materials lprocessing technique based on the principle of friction stir welding (FSW) process, where a non-consumable rotating tool having a shoulder and pin is plunged into the surface of a work piece and is moved forwarded in the direction perpendicular to the plunged. Friction stir processing (FSP) is used to transform a heterogeneous microstructure to a more homogeneous, refined microstructure. Friction stir processing (FSP) is a novel micro structural modifications technique; recently it has become an efficient tool for homogenizing and refining the grain structure of metal sheet. Friction stir processing is believed to have a great potential in the field of super plasticity. Results have been reported that FSP greatly enhances super plasticity in many Al alloy. Friction stir processing offers many advantages over conventional and other newer. One of the most important and unique features of FSP is that FSP is a single step process, while other techniques require multiple steps which make FSP easier and less time consuming. In addition, FSP uses a simple inexpensive tool, and a readily available machine such as a milling machine can be used to conduct the process. Other advantages of FSP are that it is suitable for automation, and it is also environmentally friendly since no gases or chemical are used. These features together make FSP easier, less expensive, and so preferable over other processing techniques.

II. LITERATURE REVIEW

The researches in the field of Friction Stir Process a number of Parameters are used by different researcher and calculate the effect of parameters on FSP. Many researchers investigated and formulated the effect of friction stir processing which has produced composites layer on Aluminum, Steel, Nickel, Copper and Titanium alloy. **Kwon et al. (2003)** obtained the hardness and tensile strength of the friction stir processed 1050 aluminum alloy . During his experiment hardness and tensile strength increased significantly which results in some failure. His results showed that at 560 rpm, the hardness tensile strength increased as a result of grain refinement by up to 37% and 46% respectively compared to the as-received material. **Itharaju et al. (2004)** tried to to relate the resulting grain sizes to the generated forces in friction stir processed 5052 aluminum sheet. The resulting average grain size of the FS processed AA5052 sheet were between 1.5 and 3.5 μm depending on the process parameters, compared to 37.5 μm for the unprocessed sheet, which mean that great refinement has been achieved. **T. Kanimozhi et al. (2011)** observed the friction Stir processing of AA6082 alloy with various proportion of Silicon –Graphite composite was carried out in this experiment and their hardness value is measured. The maximum hardness of 140 BHN was obtained with the processing speed of 60 mm/min at 500 rpm.

The reinforcement percentage was 8% Si and 0.5% Gr hybrid composite Defect-free. **S. Jerome et al. (2012)** studied the effect of rotational speed on surface composite developed by single pass FSP with groove design, the average hardness along the top surface was found to increase by 22.72%. **Gupta et al. (2013)** studied that surface composite based on AL5083 matrix reinforced with nano-sized silicon carbide particles have been fabricated by Friction stir processing (FSP). The hardness is maximum at center (155 HV) of processed zone at 60 mm/min and 500 rpm. **D. Dharmpal et al. (2013)** studied the effect of reinforced particlesby using friction stir processing with 6 mm thick plate. The wear resistance of FSPed sample is inferior to that observed for 5083Al in spite of its higher hardness at 1200 rpm and 40 mm/min. **D. Deepak et al. (2013)** fabricated the aluminium and silicon surface composites by using the friction stir processing. It represented that the doping of 5083Al with hard SiC particles through FSP leads to significant increase in hardness of the surface composite produced on FSPed sample layer. **R. Srinivasuet al. (2014)** observed that the friction stir processing of cast A356 Aluminium alloy is done to improve the surface properties of the aluminium with B_4C particles. **S.R.Babuet al. (2014)** observed the role in producing a defect free processed zone. The tool shoulder diameter of 18 mm produced the defects such as tunnels, voids and pin holes in the processed region for different parameter variations in 6 mm thick plate. With increase in the tool shoulder diameter beyond 18mm but less than 24 mm, a defect free processed zone was observed for variation in the process parameters in 6mm thick plate. As the thickness of workpiece is reduced, the defects in the friction stir processed zone of 1.5 mm thick plate is completely eliminated. A fine grain of average grain size less than 10μm was observed in the nugget region. **H.S. Arora et al. (2014)** studied about controlling the length scale and distribution of ductile phase in metallic glass composites through Friction Stir Processing. The average size of dendrites was reduced by almost a factor of five (from 24 m to 5 m) for the highest tool rotational speed of 900 rpm. FSP results in increase the hardness and modulus for both the amorphous matrix and crystalline phase. In this study the explained the interaction of shear bonds in amorphous matrix with the strain-hardened dendrite phase. They made a new strategy for microstructure design in metallic glass composite. **N.Yuvarajet al. (2015)** the friction stir processing (FSP) is used to fabricate AA5083 aluminum alloy with reinforced layers of boroncarbide (B4C). The Micro and nano sized B_4C reinforced particles were used. The result shows that tensile strength of the specimen exhibited better mechanical properties than the base metal. The wear properties were improved by addition of B4C nano particles in comparison with B4C micro particle. **V Gangwar, Vivek, SS Ahamad, S Ali (2016)** universal horizontal Milling Machine is used to weld the parts together during the process of FSP. The rotational speed is varied from 1200 rpm to 1500 rpm while the welding speed is kept constant at 25 mm/min. The dimensions of the parts are (100mmx50mmx6mm) which are welded to form a butt joint. The experimental results proved that the highest tensile strength of the welded joint **Nidhi Sharma(2017)** is capable of joining two dissimilar materials such as aluminium and copper. Due to much dissimlairties between aluminium and copper , defects were there. The strategies on mechanical properties, microstructure and formation of defects during dissimilar.

III. CONCLUSION

In thesis AA6063/WC composite is fabricated by friction stir processing which is widely used in automobile industry aircraft industry and ship manufacturing.

Conclusions are as follows;

- The Tensile strength, Yield strength and micro hardness are the properties, which were affected by tool shoulder diameter, tool pin profile and tungsten carbide particles.
- Tensile strength, yield strength and hardness have optimum value with cylindrical left hand threaded tool at 18 mmn but percentage elongation and impact strength is more with square pin tool as compare to cylindrical left handed threaded pin tool and cylindrical taper pin tool and optimum value is obtained at 20 mm.
- Tensile strength, yield strength and micro hardness are increased by doping of tungsten carbide reinforced particles. But percentage elongation and impact energy decreases.
- Tensile Strength and Micro hardness of the material is more in case of tool having 18 mm shoulder diameter due to the homogeneous distribution of the reinforced particles in the processed zone.

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