
FSW

FRICTION STIR WELDING

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Friction Stir Welding

WHAT IS FSW ?

Friction Steel Welding is a revolutionary Solid-State Joining Process extensively employed in the fabrication of aluminium alloys due to its ability to produce high-quality welds with minimal thermal distortion.

What is the Alloying Element Used and why ?

The alloying element used here is Aluminium 6082.
This alloying element is used due to its favourable characteristics, including high strength, good corrosion resistivity and good weldability.

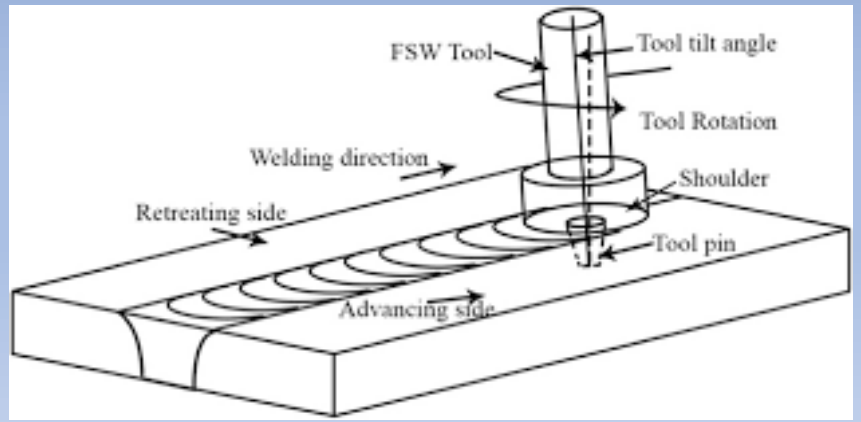
What is the Objective of This Project ?

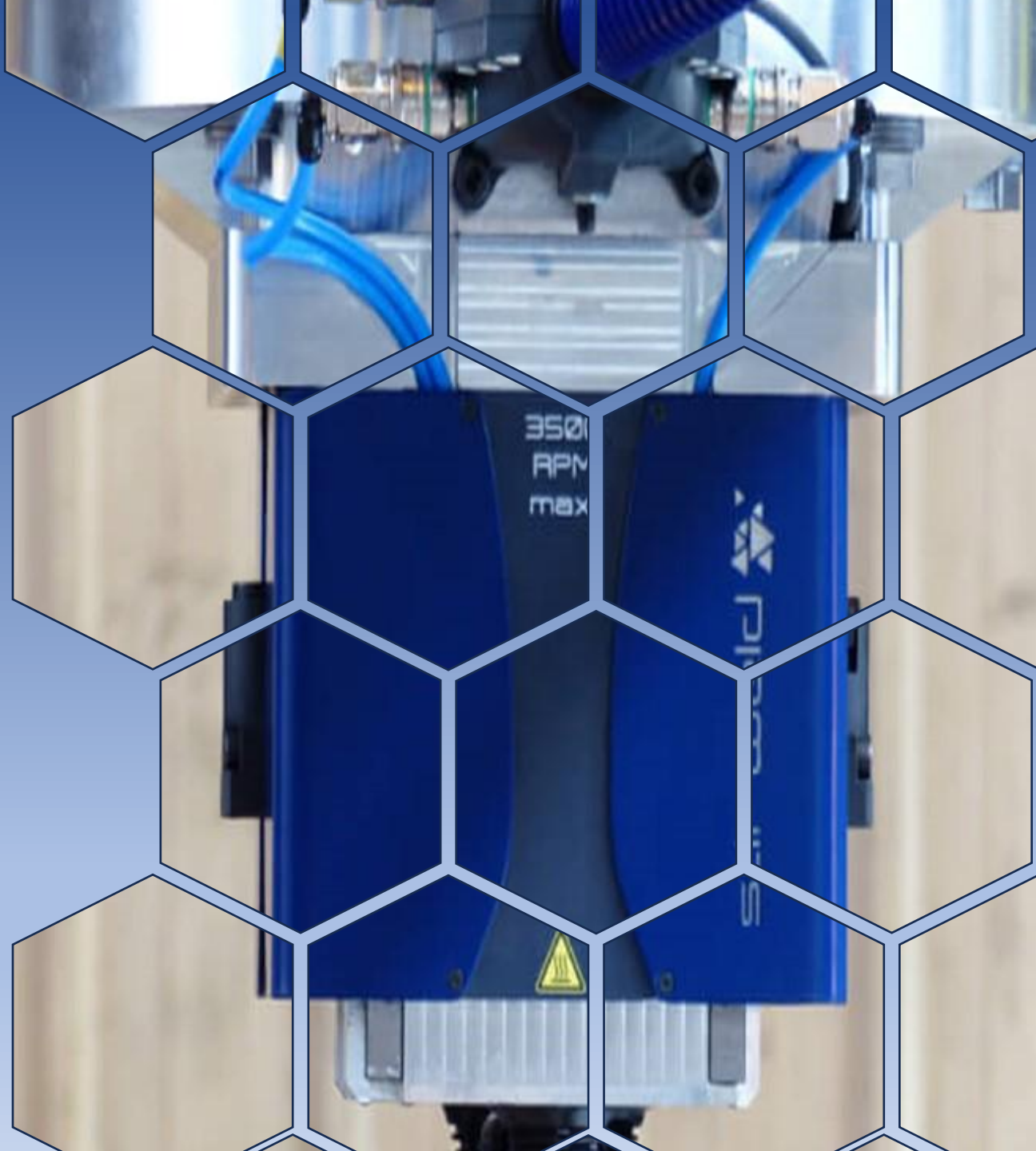
This project is conducted to investigate the influence of rotational speeds (RPM) during Friction Stir Welding on the microstructure of Aluminium 6082.

WORKING PRINCIPLE OF FRICTION STIR WELDING

- Friction stir welding (FSW) is a solid-state joining process developed at TWI Ltd in 1991.

- Friction stir welding uses a special kind of tool that rotates at high speed over the seams that needs to be weld together. As the tool rotates over the metal, heat generates that causes the metals to become plastic and hence fuse into one another.





- The tool used for friction stir welding has two parts. A cylindrical part called shoulder that rotates on the seam, and a profiled pin that extends from the shoulder.

- The pin is first drilled into the seam. Then, the shoulder rotates on top of the workpiece for a certain amount of time until an optimum temperature is reached and absorbed into the materials.

- As the contact surfaces heat up, four types of regains form within the materials – A weld nugget, TMAZ or Thermo-Mechanically Affected Zone, and HAZ or Heat Affected Zone and Base Material.

DIFFERENT ZONES FORMED DURING FRICTION STIR WELDING (FSW)

Base Material

- This region is the unaffected parent material which exists outside the zones influenced by the welding process.
- The base material retains its original properties.

HAZ Or Heat-Affected zone

- This is the zone where the material experiences thermal changes but does not undergo plastic deformation.
- In FSW, HAZ region is narrower as compared to that of traditional welding because the process is conducted at a relatively lower temperature.

TMAZ or Thermo-mechanically affected zone

- This is the zone around the weld where both thermal and mechanical effects are observed , causing some plastic deformation.
- It Lies between Haz and Stir Zone.

STIR ZONE or Nugget Zone

- This is the central region of the weld where the material undergoes plastic deformation due to stirring action of the rotating tool.
- It is characterised by a refined and homogenous microstructure.

What are the Advantages of Friction Stir Welding ?

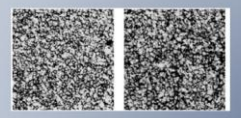
1. No Melting or Solidification Defects, such as porosity, cracking or distortion.
2. No filler material or shielding gas required, reducing the cost and environmental impact.
3. Ability to Join dissimilar materials , such as metals and polymers, or different grades of metals and non-metals.
4. High join strength and ductility.

What are the Disadvantages of Friction Stir Welding ?

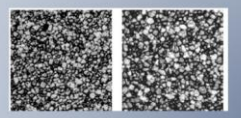
1. High tool wear and tear, due to the high temperature and pressure exert on the tool.
2. Difficulty in welding thin sheets, complex geometries or closed sections, due to requirement of a backing palate and clamping system.
3. Need for precise control of the process parameters, such as rotational speed, transverse speed and tool tilt angle.

RESULT AND CONCLUSION

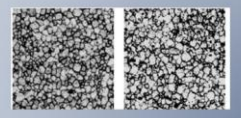
Microstructre obtained after keeping the rotational speed at 300 rpm



Microstructre obtained after keeping the rotational speed at 600 rpm



Microstructre obtained after keeping the rotational speed at 900 rpm



CONCLUSION

1. As we increase the rotational speed of the friction stir welding, we are obtaining a different kind of microstructure as observed.
2. Decreasing the rotational speed results in reduction in final grain size.
3. The reduction in grain size is due to the decrease in the heat generated.
4. As we can observe we are obtaining a more bigger grain size in case of the 900rpm microstructure as compared to that of 600rpm and further smaller grain size in 300rpm microstructure.

APPLICATIONS

1. Helps in fabricating surface composites.
2. Helps in automotive industry for welding aluminium components, such as body panels or chassis parts.
3. Contribution in weight reduction, enchanching less fule consumption and increasing vehicle performance

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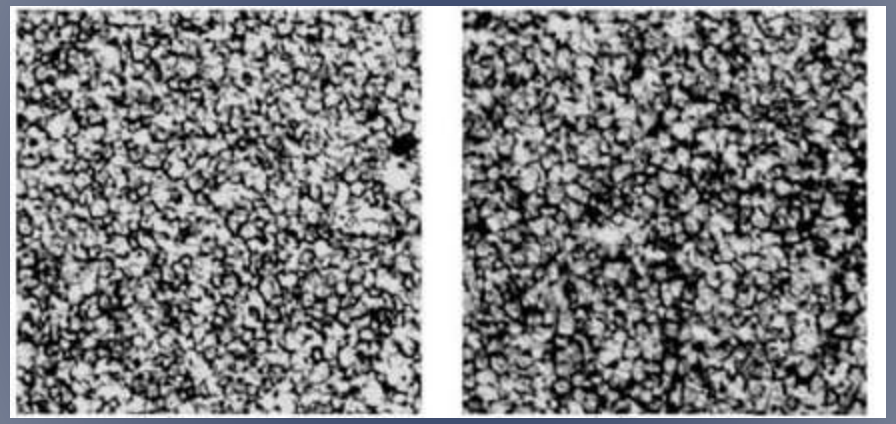
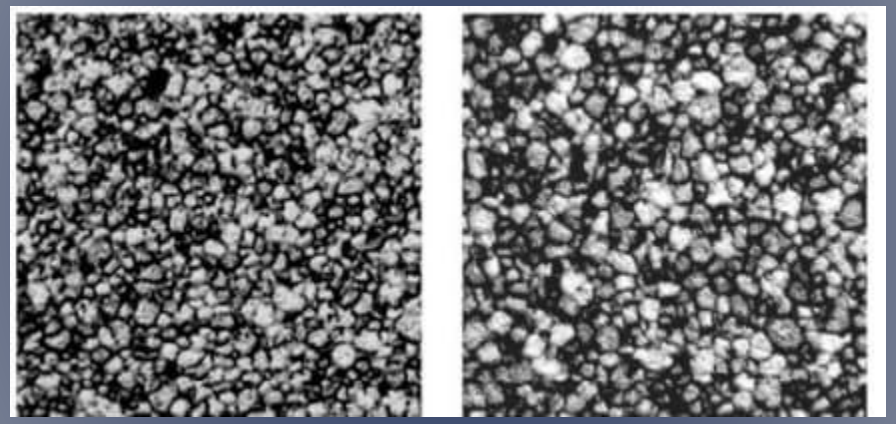
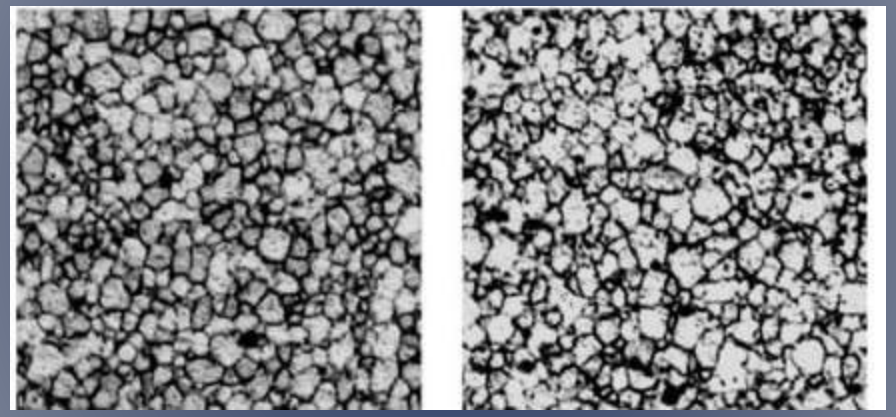


Microstructre obtained after keeping the rotational speed at 600 rpm



Microstructre obtained after keeping the rotational speed at 900 rpm



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THANK YOU !!!