Friction Spot Processes
- FSSW and FSpW -

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Motivation

Scientific, technologic, economic and environmental gains:

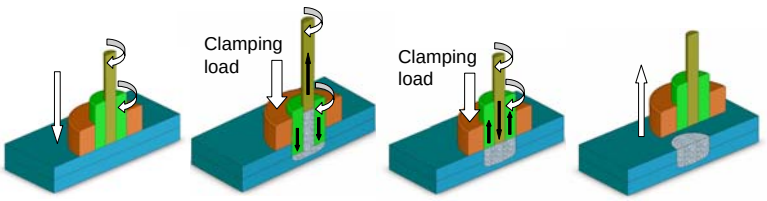
- Replacements of conventional spot conections (RSW, clinching, riveting, etc.);
- Enviromental friendly technique;
- Promising cost / conection strength relation;
- Lower cost when compared to conventional techniques;
- No fusion based welding;
- Ease of automation.

Objectives

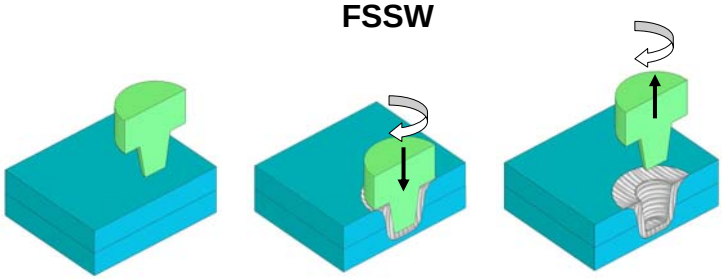
- Verify the aplicability in the spot conection of mechanical components;
- Establish set of parameters so that welds can fulfill the mechanical operation requirements;
- Investigate material flow and bonding mechanism;
- Evaluate potential service performance of specific components;
- Develop numerical modeling approaches.

Friction Based Spot Processes

FSpW



FSSW



Preliminary Results

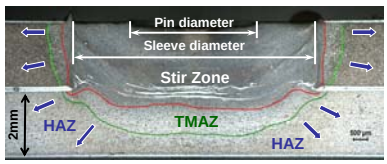
Microstructure

The microstructure of Friction Based Spot Process comprises three weld zones: Stir Zone (SZ), Thermo-mechanically Affected Zone (TMAZ) and Heat Affected Zone (HAZ).

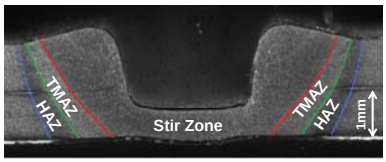
SZ: characterized by very fine dynamic recrystallized grains.

TMAZ: in this zone grains are severely plastically deformed and due to the temperature reached recovery is predominant. Depending on alloy treatment over age may also take place.

HAZ: grain coarsening of the originally rolled microstructure of the base material is possible to occur. Moreover, even lower temperature in comparison to TMAZ can lead to over aging.

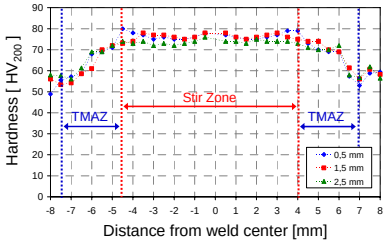


AA 2024-T3 (FSpW)



AHSS TRIP 800 (FSSW)

The hardess profile on the right is for a 5042 strain hardening aluminum alloy. In the stir zone the hardess is high, droping down in the TMAZ and then rising up to the hardness level of the base material.



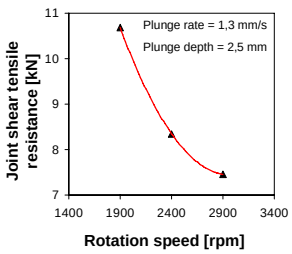
Material flow in FSSW of a AA6181-T4 as function of pin geometry. Rotational speed 3000rpm and plunge depth 3mm were used.

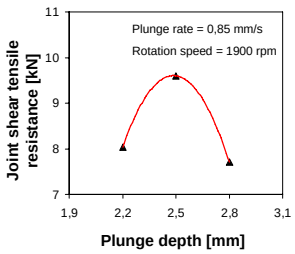
Cylindric (no features)

Three flat surfaces

Three flat surfaces with three prongs

Mechanical Performance

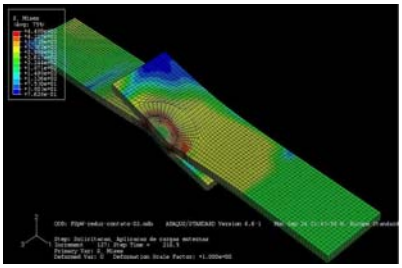




FSpW joint modeling

Simulation of the mechanical behaviour of a FSpW joint under shear tensile test loading. The simulation results are being compared to experimetal observations aiming the model validation.

The final goal is to predict the joint mechanical response in engineering components under general types of loading.



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