Synopsis

Title of Document: **Mechanical behaviour and microstructural evolution during friction stir welding of similar and dissimilar Al5083-H111 and Al6063-T4 alloys**

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Abstract

The present need of automobile sector is to reduce the weight of vehicles and improve fuel economy in order to control global warming. Aluminum is a light weight metal and it offers various advantages such as excellent formability, high strength to weight ratio, superior corrosion resistance property and infinite recyclability. Accordingly, it makes the most suitable candidate material to replace other heavy materials such as steel, copper and cast iron. Dissimilar welds are being used in automobile, bullet trains, aerospace and ship building sectors to get the advantage of unique properties of different alloys at different locations in the same weldment.

Friction Stir Welding (FSW) is a solid state welding technique developed in 1991. Since inception, the technique has given much required impetus to join large number of alloys. Being a solid state welding process, it presents various advantages over conventional welding processes such as, hot cracking, porosity, embrittlement, thermal distortion, material loss, etc. The dissimilar welds of 5XXX and 6XXX series of aluminum based alloys are used extensively in automobile sector due to its excellent mechanical properties and significant weight reduction capacity.

FSW needs a proper tool geometry and process parameters to join two similar or dissimilar alloys. Therefore, the study is based on determining optimum parameters for joining of 6 mm thick sheets of Al5083-H111 and Al6063-T4 alloys. The heterogeneity in the properties across the weld and its mixing behavior was studied by determining the thermal cycle and performing micro structural analysis and hardness test. The tensile properties of similar and dissimilar weld zone were determined by making transverse samples. It was observed that for Al5083-H111 alloy, the hardness profile and tensile behavior mainly depend on the grain size in TMAZ region. For Al6063-T4 alloy, precipitate distribution and thermal cycle determine the weld zone properties. HAZ region does not show any significant change in properties and retains similar microstructure as observed in base materials. For dissimilar weld, strength efficiency of 103% was achieved. However, the decrease in ductility relative to base materials is observed which is attributed to sharp change in thermo-mechanical properties and microstructure across the weld zone which promotes premature failure.

Keywords: Conventional fusion welding, Aluminum alloys, Dissimilar weld, FSW.