ABSTRACT

AA 5083 is an Al-Mg based alloy, which possesses many interesting characteristics such as structural material, moderately high strength, good corrosion resistance, and low price. These advantages of the alloy are quite attractive in the automobile industries and marine applications. Convectional welding processes are found inadequate in welding aluminium alloys because of their higher conductivity, hot cracking and high incidence of porosity. Another important issue in welding aluminium - magnesium alloys is the pronounced vaporization of alloying elements. The selective vaporization of volatile alloying elements, especially magnesium, causes a metal composition change in the joint, thus affecting the mechanical properties and the corrosion resistance of the weld. Laser welding and Friction Stir Welding (FSW) are the feasible solutions to overcome this problem as lower heat input welding techniques.

FSW is a solid state welding process in which the process parameter plays a vital role in determining the output quality characteristics of the weld. The process parameter optimization of FSW process enhances the quality of the weld further. In this thesis an attempt is made to compare the process parameter optimization between single and multi objective using
Taguchi L9 orthogonal experimental design. Assignment of Weight by Engineering Judgment Method and Grey Relational Analysis are used to solve the multi response problem. The Full Factorial Design of Experiments is performed to study the effects of the interactions of the process parameter. The process parameters considered for optimization are the Rotational speed of the tool in rpm, Transverse speed in mm/min and the axial force in kN. The responses are the tensile strength of the FSW welds, and energy consumption in terms of input power required for the process. The optimum levels of the process parameter obtained by single and multi response optimization are discussed and compared. To validate the optimum predicted levels of the parameter, confirmation run was performed by setting the parameters at predicted optimum levels. The micro and macro structure of the joints are also carried out to characterize the weld.