ABSTRACT

Metal matrix composites, a new class of advanced and innovative materials, which are capable of providing superior and reliable performance, are posing a challenge to monolithic material. Metal matrix composites are being used for structural and non-structural applications in aerospace, transport industries due to their enhanced physical and thermo physical properties. However, production, processing and fabrication of metal matrix composites pose a challenge to researchers and practising technologists. Published literature in stir casting, machining and welding of Al/SiCp metal matrix composite, Al/Al₂O₃p MMC and Al/Grp metal matrix show stir casting, machining and welding metallurgical problems due to which desired mechanical properties are not attained. This present experimental research investigates on the production, processing and fabrication of different aluminium base metal matrix composites. Low stir casting technique was used to produce Al/5,10,15 vol% SiCp MMC, Al/5,10,15 vol% Al₂O₃p-MMC, Al/5,10,15 vol% Grp-MMC. In the present experimental work, determination of the stir casting process parameters for obtaining an optimal combination of mechanical properties in stir casting is presented. The Taguchi method is used to formulate experimental layout, to analyse the effect of stir casting parameters namely pouring temperature, stirring time, and stirring speed on the mechanical properties and to predict the optimal setting for stir casting process parameter. Experimental results and microstructural investigations are presented to explain the efficacy of proposed approach. Mechanical properties obtained by the optimised stir casting technique were better then that available in literature.

The prepared optimised Al/5, 10, 15 vol% SiCp-MMC, Al/5, 10, 15 vol% Al₂O₃p-MMC, Al/5, 10, 15 vol% Grp-MMC are then processed by machining using uncoated and coated carbide inserts. Machinability of the composites was investigated and the results were reported. Machining results of the investigation indicate that the prepared composites are machinable by carbide inserts at low cutting speed and coated carbide inserts are more effective in machining when compared to uncoated insert. Optimised prepared stir cast metal matrix composites were joined using manual AC gas tungsten arc welding so as to study the weldability of the prepared composites. The visual tests, microhardness and tensile strength tests of welded and
unwelded metal matrix composite were compared. It was found that the fractures of the welded specimens were either in the base matrix or in the weld indicating stronger interface between the weld and base MMC. Weld strength and microhardness were approximately 80% of the parent material but better than the commercially available monolithic alloy. Optimal and microstructural investigations revealed the presence of less amount of reinforcement particulate in weld zone in all the prepared composites.