

Grey Relational Analysis Coupled with Taguchi Method for Process Parameter Optimization of Friction Stir Welding on 6061 AA

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Abstract : The highest strength-to-weight ratio criterion has fascinated increasing curiosity in virtually all areas where weight reduction is indispensable. One of the recent advances in manufacturing to achieve this intention endears friction stir welding (FSW). The process is widely used for joining similar and dissimilar non-ferrous materials. In FSW, the mechanical properties of the weld joints are impelled by property-selected process parameters. This paper presents verdicts of optimum process parameters in attempting to attain enhanced mechanical properties of the weld joint. The experiment was conducted on a 5 mm 6061 aluminum alloy sheet. A butt joint configuration was employed. Process parameters, rotational speed, traverse speed or feed rate, axial force, dwell time, tool material and tool profiles were utilized. Process parameters were also optimized, making use of a mixed L18 orthogonal array and the Grey relation analysis method with larger is better quality characteristics. The mechanical properties of the weld joint are examined through the tensile test, hardness test and liquid penetrant test at ambient temperature. ANOVA was conducted in order to investigate the significant process parameters. This research shows that dwell time, rotational speed, tool shape, and traverse speed have become significant, with a joint efficiency of about 82.58%. Nine confirmatory tests are conducted, and the results indicate that the average values of the grey relational grade fall within the 99% confidence interval. Hence the experiment is proven reliable.

Keywords : friction stir welding, optimization, 6061 AA, Taguchi

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