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A study on material removal mechanism and recast layer formation in the electric discharge machining of AA6061-B_4C metal matrix composite

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ABSTRACT

The AA6061-4wt.% B_4C metal matrix composite was fabricated by an ultrasonic-assisted stir-casting method. The distribution of B_4C particulates in the AA6061 matrix was ensured from an optical and the scanning electron micrographs. The aim of the present work is to study the effect of various input parameters on the material removal mechanism and the formation of recast layer while electric discharge machining of the fabricated composite. Hence, the EDM was performed at varied input experimental conditions based on Taguchi's experimental design. The three-levels of discharge current, *I* (3A, 6A, and 9A), discharge time, *t-on* (25µs, 45µs, and 65µs), and discharge idle time, *t-off* (24µs, 36µs, and 48µs) were considered as input variables (3^3=9 total runs). The average recast layer thickness, *ARLT* was considered as a response variable. The linear regression model was developed and the *ANOVA* was performed. The results showed that *'t-on'* is the significant parameter followed by *'I'* which effecting the recast layer formation and the reasons were discussed. The material removal mechanism was explained with the help of SEM micrographs of surface topography of machined zones. It was observed that the material removal mechanism involves not only the phenomenon like the melting and evaporation of AA6061 matrix material but also the de-bonding and thermal spaling of B_4C.

Keywords: Metal Matrix Composite (MMC); Boron-carbide (B_4C); Stir-cast; Electric Discharge Machining (EDM); Crater; Recast-layer; topography; Spalling, Design Of Experiments (DOE); ANOVA.