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Effect of process parameters on machining behaviour using S/N ratio and ANOVA analysis

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ABSTRACT

Inconel 725 super alloy is a significant and often used material for many technical applications such as oil and gas industries, aerospace, nuclear and marine areas owing to its exceptional physical and mechanical properties. The major drawback of utilizing this alloy is challenging it is to machine using traditional machining techniques. Production sectors often aim to produce goods with excellent surface finishes and high production rates at reasonable prices. Hence, in the current study deals with the effect of electric discharge machining (EDM) parameters viz. pulse-on time (T_{on}), pulse-off time (T_{off}) and discharge current (I_p) on metal removal rate (MRR) and surface roughness (Ra) of Inconel 725 alloy. According to the Taguchi's L9 orthogonal design the EDM studies were performed. The optimal condition of EDM parameters was obtained by signal to noise (S/N) ratio analysis with an aim was to minimize the Ra and maximize the MRR. S/N ratio results obtained that the higher MRR produced at T_{on} of 45 μs, T_{off} of 60 μs and I_p of 10 A. Similarly, the lower Ra produced at T_{on} of 15 μs, T_{off} of 40 μs and I_p of 5 A. ANOVA results reveals that discharge current (I_p) has the most noteworthy factor for MRR and Ra followed by pulse-on time (T_{on}).

Selection and peer-review under responsibility of the scientific committee of the First Virtual International Conference on Latest Trends in Materials and Mechanical Engineering.

1. Introduction

Inconel 725 super alloys have exceptional strength, good ductility and resistance to corrosion even at very high temperatures. These super alloys are frequently utilized in the aerospace, automotive, nuclear power plant, marine, and other sectors due to their enhanced mechanical characteristics [1–4]. Because of its quick work hardening propensity, high hardness and toughness, poor thermal conductivity and propensity to produce built-up edges (BUE), Inconel is challenging to machine by conventional methods. The BUE formation in the tool is the cause of their poor machinability. There is a significant tooling expenditure since the cutting tool wears out fast during machining [5–7]. For the machining of Inconel alloys, EDM technique becomes the obvious choice. Due to its low setup costs and great precision final product quality, EDM is the widely employed method for Inconel alloys [8–10]. Dhanabalan et al. presented the influence of input factors namely, I_p, T_{on} and T_{off} on the tolerances in EDM process of Inconel 625 and 718 alloys. They observed that T_{on} and I_p have more dominant factors for MRR. It has also reported that the MRR slightly improved with an increase in T_{on} [11]. Basha Shaik Khadar et al. have examined the performance features like MRR, Ra and recast layer thickness for Inconel X-750 alloy while EDM process. They concluded that I_p and T_{on} have most noteworthy factor for MRR, while T_{on} and I_p were more important for Ra [12]. Dileep Kumar Mishra et al. performed the EDM process of Inconel 625 using Cu electrode. They have analyzed the effect of parameters on responses like MRR, Ra, circularity and overcut and hole taper. The results shows that increase in T_{on} increasing the Ra [13]. Muthukumar et al. have developed the empirical model for radial overcut on EDM process of Inconel 800 alloy using response surface method and they stated that voltage and current have highly notable factor for the response [14]. Chinmaya P Mohanty et al.

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