Parametric study of die sinking EDM process on AISI H13 tool steel using statistical techniques

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ABSTRACT

The correct optimization of process parameters is one of the more important aspects when taking into consideration the majority of manufacturing processes and particularly for processes relating to electrical discharge machining (EDM). It is capable of machining geometrically complex or hard material components that are precise and difficult-to-machine, such as heat-treated tool steels, composites, super alloys, ceramics, carbides, heat resistant steels etc. The presented study focused on the electric discharge machining (EDM) of AISI H 13, W.-Nr. 1.2344 Grade: Orvar Supreme for finding out the effect of machining parameters such as discharge gap current (GI), pulse on time (POT), pulse off time (POF) and spark gap (SG) on performance responses such as material removal rate (MRR), surface roughness (R_a) and overcut (OC) using a square-shaped Cu tool with lateral flushing. A well-designed experimental scheme was used to reduce the total number of experiments. Parts of the experiment were conducted within the L27 orthogonal array based on the Taguchi method and significant process parameters were identified using analysis of variance (ANOVA). It was found that MRR is affected by gap current and R_a is affected by pulse on time. Moreover, the signal-to-noise ratios associated with the observed values in the experiments were determined by which factor was most affected by the responses of MRR, R_a and OC. These experimental data are investigated using response surface methodology (RSM) for the effects of four EDM parameters GI, POT, POF and SG on MRR, R_a and OC. Response surfaces and contour plots were considered for exploring the importance of the variables and their levels, so as to optimize the responses. Finally multi-response optimization was carried out by means of overlaid contour plots and desirability functions.

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Parametrična analiza potopne elektroerozije pri obdelavi orodnega jekla AISI H13 z uporabo statističnih tehnik

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POVZETEK

Pri večini obdelovalnih postopkov je vitalnega pomena pravilna nastavitve procesnih parametrov, še posebej pa pri obdelavah s postopkom elektroerozije (angl. Electrical Discharge Machining – EDM). Z njim je mogoče natančno obdelati geometrijsko zahtevne oblike iz materialov z visoko trdoto, ki jih je sicer težko obdelovati. Taki materiali so npr. toplotno obdelana orodna jekla, kompoziti, super zlitine, keramike, karbidi, toplotno obstojna jekla itd. Pričujoča raziskava je bila namenjena študiju obdelave orodnega jekla AISI H 13, W.-Nr. 1.2344 s postopkom elektroerozije. Želeli smo ugotoviti vpliv obdelovalnih parametrov, kot so tok v reži (GI), čas impulza (POT), čas pavze (POF) in velikost reže (SG), na učinkovitost postopka, kot so stopnja odvzema materiala (MRR), površinska hrapavost (R_a) in obdelava nad predvideno nominalno mero (angl. Overcut – OC). Uporabili smo pravokotno bakreno orodje s stranskim dovajanjem dielektrika. Z dobro načrtovanim eksperimentalnim delom smo zmanjšali potrebno število eksperimentov. Ti so bili izvedeni v skladu z L27 ortogonalno matriko, temelječo na Taguchi metodi. Signifikantni procesni parametri so bili ugotovljeni z metodo analize variance (ANOVA). Ugotovili smo, da tok v reži vpliva na MRR, čas impulza pa na R_a . Poleg tega smo z razmerji signal/šum in ustreznimi eksperimentalnimi podatki ugotovili tiste vplivne parametre, ki najbolj vplivajo na MRR, R_a in OC. Eksperimentalne podatke smo raziskali z metodologijo odzivnih površin (angl. Response Surface Methodology – RSM) in ugotavljali vpliv štirih procesnih parametrov elektroerozijskega postopka (tj. GI, POT, POF in SG) na MRR, R_a in OC. Za ugotavljanje pomembnosti procesnih parametrov in s tem optimiranje odziva, smo uporabili odzivne površine in konturne diagrame. Na koncu smo izvedli še optimizacijo z ozirom na več odzivov s pomočjo konturnih diagramov in t. i. funkcij želja (angl. Desirability Functions).

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PODATKI O ČLANKU

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