Optimization of Electrode Material for EDM Die-sinking of Titanium Alloy Grade 5 - Ti6Al4V

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Abstract

Titanium alloy grade 5, Ti6Al4V, is extensively gaining importance in the industrial environment, specifically in aerospace, medical and automotive domains, mainly due to its exceptional blend of mechanical properties like high hardness which is further heat treatable, high strength-to-weight ratio which makes it light, high corrosion and temperature resistance etc. However, the same properties undervalue Ti6Al4V as a conventionally difficult-to-machine material. Rapid tool wear, excessive heat generation, dimensional instability and loss of surface integrity are the issues that plague the conventional machining of Ti6Al4V. In view of these facts, non-traditional machining processes like electron discharge machining (EDM) - die sinking and wire cut prove to be a substitute for the conventional machining. In this study, an experimental optimization of EDM die-sinking electrode materials among copper, brass and graphite, is carried out. Experimental design is created using a statistical tool and actual machining is carried out to record the surface roughness, variations on the surface hardness and dimensional stability. Quality evaluation and statistical analysis substantiates graphite electrodes to produce better surface finish-Ra 2.05microns with minimal dimensional variation-less than 10%-when operated at minimum spark gaps. It is inferred that graphite electrodes exhibit higher resistivity towards current than its counterparts thus passing minimum spark energy preventing excessive self-wear and a dimensionally accurate workpiece. The depth of machining highly impacts the variations on the surface hardness post machining.

Keywords:

Ti6Al4V; EDM die-sinking; spark gap; surface roughness; dimensional differential

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