

Effect of Process Parameters on Performance Measures in Wire-cut EDM of Nimonic-90 using Two Different Wires

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Mode of Study : P. Time

ABSTRACT

Nickel based alloys have significance in the present industrial scenario due to their capability of retention of strength alongwith other as mechanical properties; and resistance to corrosion in extreme temperatures. NIMONIC® is a super alloy of nickel having low machinability due to the higher toughness, strength and hardness; and lower thermal diffusivity. This super alloy is widely applied in making components of aero engine and gas turbine like discs, rings, combustion chamber, and gas turbine blades etc. Nowadays non-conventional machining processes are used for hard to machine materials. Instead of using traditional cutting tools for metal removal, they directly apply various kinds of energy. Wire electric discharge machining (WEDM) is an unconventional thermo electrical method with which a metal is eroded from its conductive work piece using electrical erosion. A metallic wire is used to form a programmed contour in a conductive work piece. WEDM also specialize in machining of intricate contours or delicate geometries which are difficult to cut using traditional machining methods. In the present work effect of various parameters in wire cut EDM of Nimonic-90 by two different wires is studied. The machining characteristics that are being investigated are cutting rate (C_R) and surface roughness (R_a). Taguchi's robust design methodology has been applied to plan as well as execute this experimental work. The Investigation indicated that cutting rate and surface roughness increases at higher values of pulse-on time and decreases at higher values of pulse-off time. The mean value of cutting rate at maximum T_{on} level i.e. $124\mu s$ is 4.39 mm/min which is 42 % more than mean cutting rate (3.09 mm/min) at $110\mu s$ pulse on time. Significant effect of spark gap voltage has been found on cutting rate and surface finish. The mean cutting rate falls by 20 % whereas surface finish improves by 22 % from level 1 to level 3 of T_{off} respectively. The wire material exhibits remarkable influence on machining characteristics. The brass wire delivers mean cutting speed of 3.67 mm/min whereas zinc coated cuts at mean speed of 3.95 mm/min ; 7.62 % faster than brass electrode. Brass wire gives 6.9 % better finished surface than zinc plated wire. Finally optimum levels of input process factors for highest cutting rate and lowest surface roughness are suggested in WEDM machining of Nimonic-90 super alloy.