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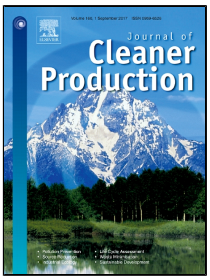

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Sustainable machining: Process energy optimisation of wire electrodischarge machining of Inconel and Titanium superalloys

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Abstract

Process energy optimisation is vital in view of the environmental performance of electrodischarge machining (EDM). This research is focused on identifying the significant parameters that optimise the process energy consumption of wire EDM (WEDM) of superalloys: Inconel-718 and Ti64Al4V. Four general parameters: workpiece material, workpiece thickness, wire material, and wire diameter; and four discharge parameters: gap voltage, peak current, pulse-ON time, and pulse-OFF time were tested against specific energy consumption (SEC) and surface quality of the cut. Taguchi design of experiments and analysis of variance (ANOVA) methods were used for experimentation and analysis. The Green House Gas Protocol is used to analyse potential reductions in carbon emissions. The results indicate that preferred parameters to minimise the specific energy consumption are workpiece thickness, wire material, wire diameter, and pulse-OFF time in the order of significance. It is found that 2/3rd of the total energy was consumed during non-working hours which can potentially be saved. Further, the reduction of carbon emissions corresponds to non-working energy consumption of the machines is also presented.

Keywords: Sustainable machining; WEDM; Process energy, Superalloys

1 Introduction

Glossary of terms

HB	Higher-the-Better
LB	Lower-the-Better
MRR	Material Removal Rate (mm^3/min)
P-OFF	Pulse Off time (µs)
P-ON	Pulse On time (µs)
R_a	Average Surface Roughness (µm)
SEC	Specific Energy Consumption(kJ/mm^3)