Modelling and optimisation of nanocoolant minimum quantity lubrication process parameters for grinding performance

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Abstract

Nanocoolant minimum quantity lubrication is economical, sustainable, and an environment-friendly technique of coolant flow for machining compared to flood lubrication. In the present experimental study, the modelling and optimisation of nanocoolant minimum quantity lubrication process are carried out for improving the grinding performance of EN 31 hardened steel. The optimised value of input process parameters such as table speed, depth of cut, coolant flow rate, dressing depth, and aluminium oxide nanocoolant concentrations obtained from the Jaya algorithm is used for finding the grinding performance in terms of cutting forces, surface roughness, and material removal rate. The experiments were conducted by response surface methodology using Minitab 17 statistical software. The optimisation of process parameters is carried out for single and multi-objective responses. The results show that the nanocoolant minimum quantity lubrication process improves the grinding performance significantly using optimised values at 0.30 volume % nanocoolant concentration.

Keywords

cutting force, design of experiments, EN 31, grinding performance, Jaya algorithm, modelling, material removal rate, MRR, nanocoolant minimum quantity lubrication, optimisation, surface roughness

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