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Performance analysis of EN31 alloy machining under sustainable condition using machine learning models.

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The growing demand for sustainable manufacturing has led to exploring advanced cooling and lubrication techniques in machining processes. EN31 alloy steel is machined under liquid CO_2-assisted minimum quantity lubrication (MQL) conditions to assess its impact on machining performance in this study. The investigation analyses the influence of key process parameters—flow rate, cutting speed, feed rate, and depth of cut—on two critical output responses: material removal rate (MRR) and surface roughness (Ra). Various machine learning algorithms are applied to model the complex relationships between input and output variables to enhance predictive capabilities and optimize machining parameters. The dataset consists of experimental results obtained from controlled machining trials, and the performance of machine learning models is evaluated. The models are assessed based on their predictive accuracy and ability to capture nonlinear dependencies between process parameters and machining responses. The study provides valuable insights into the effectiveness of liquid CO_2-assisted MQL in improving material removal rates while maintaining surface quality. The findings contribute to the advancement of sustainable machining strategies while demonstrating the potential of artificial intelligence in enhancing manufacturing efficiency.

Keywords: MQL, MRR, Surface roughness, machine learning