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High-speed machining parametric optimization of 15CDV6 HSLA steel under minimum quantity and flood lubrication

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ABSTRACT

High-speed machining (HSM) maintains a high interest in the preparation of metal parts for optimum results, but with the application of HSM, the sustainability issue becomes important. To overcome the problem, minimum quantity lubrication (MQL) during HSM is one of the innovative and challenging tasks during conventional cutting (milling) to improve quality, productivity, and strength under the umbrella of sustainability. The objective of this research is to achieve sustainable machining by simultaneously optimizing sustainable machining drivers during the HSM of 15CDV6 HSLA steel under MQL and flood lubrication. The response surface methodology has been applied for the development of mathematical models and selecting the best combination of process parameters to optimized responses, i.e. surface roughness, material removal rate, and strength. Optimization associated with sustainability produced compromising optimal results (Min. *Ra* 0.131 μm, Max. *MRR* 0.64 cm^3/min, and Max. *ST* 1132 MPa) at the highest cutting speed 270 m/min and the lowest feed rate 0.09 mm/rev and depth of cut 0.15 mm under MQL. The comparative investigation exposed that significant improvement in *Ra* (1.1-16.6 %) and *ST* (1.3-2.3 %) of the material using MQL has been witnessed and gives a strong indication that MQL is the best substitute than the flood lubrication. The scientific contribution of the approach is to develop mathematical models under MQL and flood lubrication that will aid practitioners to choose input parameters for desired responses without experimentations. The work would be beneficial in the field of aviation, defense, and aeronautical applications due to the excellent mechanical properties of 15CDV6 HSLA steel.

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