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Investigation of Dry Ice Mixed Novel Hybrid Lubri-Coolant in Sustainable Machining of Ti-6AL-4V Alloy: A Comparison of Experimental and Modelling

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Abstract : Ti-6Al-4V has numerous applications in the medical, automobile, and aerospace industries due to corrosion resistivity, structural stability, and chemical inertness to most fluids at room temperature. These peculiar characteristics are beneficial for their application and present formidable challenges during machining. Machining of Ti-6Al-4V produces an elevated cutting temperature above 1000oC at dry conditions. This accelerates tool wear and reduces product quality. Therefore, there is always a need to employ sustainable/effective coolant/lubricant when machining such alloy. In this study, Finite Element Modeling (FEM) and experimental analysis when cutting Ti-6Al-4V under a distinctly developed dry ice mixed hybrid lubri-coolant are presented. This study aims to model the milling process of Ti-6Al-4V under a proposed novel hybrid lubri-coolant using different cutting speeds and feed per tooth DEFORM® software package was used to conduct the FEM and the numerical model was experimentally validated. A comparison of experimental and simulation results showed a maximum error of no more than 6% for all experimental conditions. In a nutshell, it can be said that the proposed model is effective in predicting the machining temperature precisely.

Keywords : friction coefficient, heat transfer, finite element modeling (FEM), milling Ti-6Al-4V
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