

Experimental Investigation on Sustainable Machining of Hastelloy C-276 Utilizing Different Cooling Strategies

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Abstract : The present research focused to improve the machinability of Hastelloy C-276 at different machining speeds such as 31, 55, and 79 m/min. The use of CO₂ gas and Minimum quantity lubrication (MQL) was applied as coolant and lubrication purposes to enhance the machinability of the superalloy. The output in the form of surface roughness (S.R) and heat generation was monitored under dry, MQL, and MQL-CO₂-cooled conditions. The Design of the Experiment was prepared using MINITAB software utilizing Taguchi L-27 orthogonal arrays followed by ANOVA analysis for finding the impact of input variables on output responses. At different speeds and lubrication conditions, different behavioral patterns for Surface Roughness and the temperature was observed. ANOVA analysis depicted that the cooling environment impacted the S.R. majorly (50%) followed by cutting speed (29.84%), feed rate (5.09%), and least through depth of cut (4.95%). On the other side, the temperature was greatly influenced by cutting speed (69.12%), Cryo-MQL (8.09%), feed rate (7.59%), and depth of cut (6.20%). Experimental results revealed that Cryo-MQL cooling enhanced the Surface roughness by 12% compared to MQL condition.

Keywords : Hastelloy C-276, minimum quantity lubrication, olive oil, cryogenic Cooling (CO₂)

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