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A Novel Hybrid Lubri-Coolant for Machining Difficult-to-Cut Ti-6Al-4V Alloy

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Abstract : It is a rough estimation that the aerospace companies received orders of 37000 new aircraft, including the air ambulances, until 2037. And titanium alloys have a 15% contribution in modern aircraft's manufacturing owing to the high strength/weight ratio. Despite their application in the aerospace and medical equipment manufacturing industry, still, their high-speed machining puts a challenge in terms of tool wear, heat generation, and poor surface quality. Among titanium alloys, Ti-6Al-4V is the major contributor to aerospace application. However, its poor thermal conductivity (6.7W/mK) accumulates shear and friction heat at the tool-chip interface zone. To dissipate the heat generation and friction effect, cryogenic cooling, Minimum quantity lubrication (MQL), nanofluids, hybrid cryogenic-MQL, solid lubricants, etc., are applied frequently to underscore their significant effect on improving the machinability of Ti-6Al-4V. Nowadays, hybrid lubri-cooling is getting attention from researchers to explore their effect regarding the hard-to-cut Ti-6Al-4V. Therefore, this study is devoted to exploring the effect of hybrid ethanol-ester oil MQL regarding the cutting temperature, surface integrity, and tool life. As the ethanol provides -OH group and ester oil of long-chain molecules provide a tribo-film on the tool-workpiece interface. This could be a green manufacturing alternative for the manufacturing industry.

Keywords : hybrid lubri-cooling, surface roughness, tool wear, MQL
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