Experimental Investigation of Flank Wear in End Milling of Aluminum Alloy with Water-Based TiO_2 Nanofluid Lubricant in Minimum Quantity Lubrication Technique

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ABSTRACT
This paper investigates the minimum quantity lubrication technique in end milling of aluminum alloy AA6061 with minimum quantity lubrication (MQL) conditions using nanofluid. Wear mechanisms for the water-based TiO_2 nanofluid with a nanoparticle volume fraction of 1.5 % are compared with conventional oil-based minimum quantity lubrication (0.48 and 0.83 ml/min) and flooded cooling conditions using an uncoated tungsten carbide insert. Wear mechanisms are characterized. Results show adhesion of the work material as the major tool damage phenomenon. Abrasion wear is also observed along with adhesion. The major benefit from the water-based nanofluid MQL is shown in the intact edge geometry, i.e., edge integrity showing very little chipping as well as edge fracture. This is attributed to the cooling effect produced by the latent heat of vaporization of water, resulting in lowering of temperature in the cutting zone.

KEYWORDS: MQL; Nanofluid; Wear; Abrasion; Attrition; Adhesion

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