Multi-objective optimization on the machining parameters for bio-inspired nanocoolant

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ABSTRACT

The emphasis of this paper is to evaluate the thermophysical properties of crystalline nanocellulose (CNC)-based nanofluid and the optimized machining parameters (cutting speed, feed rate and depth of cut) for machining using CNC-based nanofluid. Cutting tool temperature and formed chip temperature during machining are determined with CNC-based coolant and metal working fluid. Minimum quantity lubrication technique is used to minimize the usage of the coolant. Nanocellulose coolant with a concentration of 0.5% shows better thermal conductivity and viscosity. Total heat produced at the cutting tool and the temperature generated at the chip during machining shows significant improvement using CNC-based nanofluid. Statistical analysis reveals that feed rate and depth of cut contribute around 27.48% and 22.66% toward cutting temperature. Meanwhile, none of the parameters significantly affects the heat transfer. The multi-objective optimization reveals that the optimum parameter for machining using CNC-based nanocoolant is: cutting speed = 120, feed rate = 0.05 and depth of cut = 1.78 which produces heat transfer of 379.44 J and cutting temperature of 104.41 °C.

KEYWORDS: Nanocellulose; Multi-objective; Wear rate; Wear mechanism

DOI: https://doi.org/10.1007/s10973-018-7693-x