Thermal analysis of cellulose nanocrystal-ethylene glycol nanofluid coolant

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ABSTRACT

In this paper, cellulose nanocrystal (CNC) – ethylene glycol (EG) + Water (W) based nanofluid was developed and assessed for their thermophysical properties and the usefulness towards machining performances. The nanofluid was prepared by adopting two-step preparation method and at volume concentration of 0.1%, 0.3%, 0.5%, 0.7%, 0.9%, 1.1%, 1.3% and 1.5%. The nanofluid with 1.3% and 1.5% concentration showed to have superior the conductivity properties, around 0.559 W/m·K at 70 °C. However, the 0.5% concentration has the highest stability with 0.52 W/m·K at 70 °C. The 0.5% nanofluid concentration was then selected for the machining performance evaluation. The machining performance was evaluated by using a lathe machining operation to determine the heat transfer and tool life properties. The cutting variables such as cutting speed, depth of cut and feed rate are varied to understand the effect of developed nanofluid on the machining bahaviour. Findings revealed that the tool failure on machining using MWF is flank wear, chipping and abrasion and fractured at the maximum cutting distance of 500 mm. However, machining using CNC-EG+W nanofluid revealed the tool failure to be flank wear, adhesion and build- up-edge (BUE) and fractured at the maximum cutting distance of 772 mm.

Keywords

Nanofluid; Ethylene glycol; Cellulose; Nano crystals; Thermal analysis.