

Comparative evaluation of crude Tamanu oil performance as metalworking fluids

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ABSTRACT

In manufacturing industry, metalworking fluids which are mineral based oils are widely applied as feedstock for many sorts of lubrication and cooling applications, posing environmental and health risks. As an alternative replacement, plant-based oils are found to be a viable contender to the mineral-based oil performance. However, crude vegetable oils possess high viscosity values, and low thermal oxidative stability, which prompted the oil modification method to improve the oil's physicochemical properties. The purpose of this study is to investigate the machining performance of a novel Crude Tamanu oil (CTO), a product from Pahang, Malaysia, market ready Crude jatropha oil (CJO), commercially available Refined, bleached & deodorized palm olein (RBDPO) and Synthetic ester (SE) during the turning process of AISI 316L stainless steel disc using minimum quantity lubrication (MQL) technique. The process outcomes are cutting forces, deformed chip thickness, chip curling effect, and elemental compositions on the surface morphology of the cutting inserts. Based on the experimental results, the best plant-based lubricant in its crude form is revealed by the machining lubricated with CJO, which outperforms all the other tested lubricant samples. The CTO possesses a high kinematic viscosity and viscosity index values, which leads to a huge opportunity for further improvement on its lubrication properties that could improvise its antiwear and antifricition behaviors. This work could further support the sustainable manufacturing efforts in enhancing 'greener' metalworking applications as well as the agricultural and the socio economy of the nation.

KEYWORDS

Calophyllum inophyllum; Chip formation; Metal machining; Metalworking fluid; Mql stainless steel

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