Orthogonal Cutting Performance of Vegetable-Based Lubricants via Minimum Quantity Lubrication Technique on AISI 316L

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Abstract In this research, the workpiece material used is AISI316L stainless steel, which has higher corrosion resistance and is also difficult to machine at high speeds. The objective of this study is to determine the machining performance of 316L stainless steel using minimum quantity lubrication (MQL) and dry machining. The effects of MQL lubricants and dry machining are then studied and compared in terms of cutting performance, such as tool chip contact length, chip thickness, and cutting force (N). The MQL lubricants used are a bio-lubricant: Crude Tamanu Oil (CTO), Crude Jatropha Oil (CJO), Synthetic Ester (SE) and Refined Bleached and Deodorized Palm Olein (RBDPO). The cutting insert used in this study is an uncoated tungsten-carbide insert (WC) SPGN120308 to ensure that the surface of the carbide insert is in direct contact with the stainless-steel disc. The cutting and MQL parameters are set to be the same for both MQL and dry machining. After machining, the micrographic representations of the chip and inserts are magnified by examination with a scanning electron microscope using energy dispersive X-ray spectroscopy (SEM–EDX) to identify any material adhering to the rake face of the tool. It is found that SE gives the best machining performance compared to the CTO, CJO, RBDPO and dry machining. Nevertheless, CTO and other crude vegetable oils are exhibiting high potential to be used as bio-based metalworking fluids following chemical modifications to improve their anti-wear and anti-friction capabilities.

Keywords Cutting performance · Orthogonal cutting · MQL · Lubrication · Plant-based oil

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