Experimental Investigation of Minimum Quantity Lubrication (MQL) of Coconut Oil Based Metal Working Fluid

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Abstract

Metal Working Fluid (MWF) is a liquid, which uses during machining for the purpose of heat removal, lubrication at tool chip interface, corrosion protection and wash away chips from the cutting zone. Due to unique properties like biodegradability, renewability and its adequate performance in wide range applications, vegetable oil based MWFs provide significant environmental benefits than the mineral oil based MWFs. Minimum Quantity Lubrication (MQL) is a technique of applying fine mist of MWF, instead a flood of it. This paper describes performance evaluation of novel coconut oil based MWF, during turning experiments executed with AISI 304 Austenitic Stainless Steel and Mild Steel as workpiece materials. The experimental set up was designed after evaluating several conceptual designs established through morphological analysis and finally the best design for the MQL system was fabricated. To corroborate the importance of novel vegetable oil based MWF, the machining performances in terms of surface roughness, tool tip temperature were evaluated and novel coconut oil based MWF could obtain better performances. Further flank wear and nose wear were investigated by observing SEM images. Turning of AISI 304, with presence of new MWF, has shown an improvement in tool flank wear compared with a standard mineral oil based MWF. Optimum decrease in tool tip temperature of 7.833 ^{o}C and best environmental conditions (negligible amount of mist) were identified, while machining of AISI 304, at 45 rpm of spindle speed, 5.231 m/min of linear cutting speed, 0.05 mm/rev of feed rate, 1mm of depth of cut, 2 bar pressure of compressed air and 0.186 ml/s flow rate of novel coconut oil based MWF.

Keywords: Minimum Quantity Lubrication, surface roughness, flank wear