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Spreadability studies of metal working fluids on tool surface and its impact on minimum amount cooling and lubrication turning

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Abstract:

In machining process, friction between the chip-tool interface and the heat generation due to shearing action are important issues that govern the machining forces, tool life and surface quality of the product. Efficient cooling and lubrication can reduce the high amount of heat generated during machining. The cooling and lubrication depend on the wetting behavior of metal working fluid (MWF) on the tool surface. However, the relation between the key parameters which affect the MWF's wettability behavior on the cutting tool surface are not studied much, especially for the machining process. In this paper, an attempt has been made to understand the correlation between the spreading behavior, surface tension and surface energy of nano-Al_2O_3 based fluid added with different surfactants, on tungsten carbide (WC) cutting inserts (Ti-Al-N coated and uncoated) and Inconel 718. Further, machining experiments have been conducted using the nanofluid (NF) under minimum quantity cooling and lubrication (MQCL) mode. The results showed that the spreading parameter of NF varies linearly with the surface tension on cutting tool surfaces. The spreading parameter has been found to be more reliable, and a relevant parameter for describing the wetting behavior of NF on the tool surfaces. The machining results obtained in this study are explained in terms of the spreading coefficient,