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Commentary

Effects of Cutting Fluid and Thermal Aspects in Turning of Hardened Alloy Steel

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DESCRIPTION

Technological innovations such as new tool materials, new tool coating materials and optimized tool geometries have developed the possibility of dry hard turning. However, in dry hard turning, the excessive heat generation and subsequent increase in cutting temperature at cutting zone reduces the tool life and impairs the surface integrity. Despite of several benefits, white layer formation, micro hardness variation and residual tensile stresses have been found to exist and are expected to reduce fatigue life of the machined component during dry hard turning of alloy steel. So, it may not be feasible to completely switch over to dry hard turning on the shop floor with existing facilities and all the machine tools may not be rigid enough to support dry hard turning.

Cutting fluid is known to improve machinability through reduction of cutting forces and cutting temperature. However, the cutting fluid related costs and health concerns associated with exposure to cutting fluid mists and the growing desire to achieve environmental sustainability in manufacturing lead to re-examine the role of these fluids and quantify their benefits. Also, the conventional cooling method is not effective in terms of lowering cutting temperature, as the cutting fluid does not readily access the tool-chip and tool-workpiece interfaces. A good understanding of the cutting fluid type and the methods of applying cutting fluid at the cutting zone significantly reduces the heat generation and temperature in machining process, improves tool life, surface finish and integrity of the machined parts.

According to the literature, most hard turning studies were conducted under dry cutting conditions and few studies have been performed in a wet environment. There is consensus and disagreement on the use of coolant in hard turning, which requires further research in this field and is open to researchers. Therefore, several new technologies need to be explored to identify green alternatives to traditional cutting fluid applications in hard machining. In recent years, Minimal Quantity Lubrication (MQL) and Minimal Cutting Fluid Application (MCFA) techniques have been developed for minimization of cutting fluid and cutting temperature at the cutting zone to enhance the machinability characteristics. Minimal Quantity Lubrication (MQL) has been tried by several researchers. In minimum quantity lubricant technology, the problems associated with the low capacity of heat removal by oil, the difficulty of its tiny, light drops reaching the hottest surface of the cutting zone and the impossibility of taking out chips from the cutting zone makes this method practicable only in specific machining operations.

CONCLUSION

Minimal Cutting Fluid Application (MCFA) technique, in which extremely small quantity of cutting fluid in the form of high velocity pulse jet is applied at the cutting zone. This can also meet the requirements of environmental awareness and is suitable for eco-friendly, near-dry green cutting technology. To develop a minimal cutting fluid application system in the case of an existing machine tool for enhancing the machining performance and to overcome the issues related to cutting fluids and dry turning of hardened alloy steel at elevated hardness. This research mainly focused to investigate the influence of cutting parameters such as cutting speed, feed and depth of cut, and cutting fluid application parameters such as, cutting fluid pressure, pulsing frequency, flow rate and nozzle stand-off distance on major machinability characteristics.

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