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Numerical study of the influence of the oil mist particle sizes used in MQL by internal canalizations on a surfacing operation

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Minimum Quantity Lubrication started to be largely used in industry, because of its very small oil consumption and because of the positive generated effects (surface state, tool lifetime …) [1]. The oil mist was made up of fine droplets sprayed by and with pressurized air. The oil mist was then carried, via inner canalizations through the spindle and the tool, and was directly sprayed on the cutting edge of the tool [2].
The main goal of MQL inner canalizations was to ensure a good efficiency oil mist spray on the cutting edge [3]. But parameters such as rotation speed and external tool shape decreased the spray efficiency. Moreover oil mist was subjected to wall effect during the transport in the channel. These collisions involved oil mist recondition and different particle size outside the channels. Because of the various parameters and various effects of the oil mist, numerical simulation was used in this study.
This paper proposed a numerical study of the oil mist particle sizes effect outside a rotating tool. A first experimental study determined the particle sizes for different oil mist device input parameters (inlet pressures) as function of different canalization geometries. The parameters thus identified were integrated as boundary conditions for the numerical simulation of a rotating tool during a surfacing process. The numerical study allowed to study the particle size effect on the behavior of oil mist sprayed on inserts. The identified parameters as the inlet pressure, the inner canalization geometries and the rotation speed depending on the machining configuration were considered. The simulations highlighted the impingement of the different oil particle sizes on the tool carbide inserts. A parametric study was realized in parallel to determine an optimal couple of sets based on machining conditions. Surface droplet impingements relative to a global virtual area from tool/chip interface were considered. The global virtual area was taken as function of the machining configurations.

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