Grinding Temperature and Cooling Fluids

The first study I reviewed is "*A novel cryogenic machining concept based on a lubricated liquid carbon dioxide*". It is aimed to introduce a new cooling system for machining processes such as grinding and milling. For this purpose, first the physical and chemical properties of Liquid Carbon Dioxide (LCO2) and some other test oils (base or MQL) are highlighted. LCO2 and these oils are mixed to form a solution to be used in cooling.

In the process of forming the solution, LCO2 is flowed to a mixing chamber with the oil. The tests show that the flow-rate of LCO2 into the mixing chamber affects the solubility of the two substances Nonpolar oils are found to be more soluble in LCO2 compared to polar oils which is important for tool life in machine processes. These substances were then used in the cooling phase of the machining process. According to the results of the experiment, it is favorable to have smaller oil droplets since they are better at penetrating into the cutting zone of the machine process compared to larger droplets. This difference between the substances has an impact on machine performance.

Although the cooling solutions suggested by this study were experimented on milling machines, it can provide insight to how effective they can perform when employed in grinding machines.

The second study I reviewed is "*Machining evaluation of a hybrid MQL-CO2 grinding technology".* The aim of the study is to come up with sustainable cooling solutions to the grinding process. Grinding fluid minimization is essential to reduce waste and environmental impact.

According to the tests, higher temperatures were observed when no cutting fluids were used. To test alternatives to oil-based lubricants, cryogenic grinding using liquid nitrogen and MQL-low temperature CO2 solution are proposed as cooling fluids. Between these two, MQL-CO2 gave better results in terms of process performance and grinding wheel wear as well as protecting the integrity of the grits. Surface finish quality increases with MQL-CO2 because the friction conditions between the grit and workpiece are improved significantly. Also thanks to the reduced wear and increased grinding ratio, it provides longer wheel life for the tool.

MQL-CO2 achieved these advantageous conditions while maintaining a similar power consumption and minimum oil consumption. Workpiece temperature was slightly higher than the conventional method but still kept below the thermal damage threshold of 833K.

The third study I reviewed is "*MINIMUM QUANTITY LUBRICATION (MQL) GRINDING USING VITRIFIED CBN WHEELS".* This study investigates the forces, roughness, workpiece temperature and energy partition conditions of grinding of cast iron using vitrified CBN wheels.

According to the test results, CBN wheels provide a more desirable energy partition compared to conventional Al2O3 wheels, hence improving the cooling problem that occurs with MQL. MQL cooling came in between the flood cooling and dry condition in terms of grinding temperature and energy partition. This study demonstrates the material characteristics of the wheel is just as much important in terms of cooling and other properties that are important for the performance of the grinding machine.

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