Examination of the effects of abrasive powder amount added to the minimum quantity-lubrication system on the cutting process

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Abstract

In machining operations, the cutting process is negatively affected due to the high temperature occurring between the cutting tool and the workpiece. The heat generated in the environment should be removed from the cutting point with a chip. In this study, the surface roughness of the processed surfaces and the changes in cutting forces depending on the abrasive powder added to the minimum-quantity-lubrication (MQL) system and cutting speed were examined. In the experiments, 1.2379 cold-work tool steel hardened to 59 HRC hardness was used; a cubic boron nitride (BN) cutting insert, which is resistant to turning operations at high hardness, was chosen as the cutting insert; and aluminum oxide (Al_2O_3) nanoparticles were used as abrasive powder. When the experiment results were examined, the best average surface roughness obtained was 0.888 μm in the experiment where the cutting speed applied was 160 m/min and volumetric nanofluid concentration applied was 4%. When the resultant cutting forces were examined, it was observed that the change in the abrasive powder amount did not have as much effect on the resultant cutting forces as surface roughness did. Therefore, it was revealed that the nanofluid-doped MQL system applications are needed to increase surface quality with a lubrication effect rather than a cooling effect.

Keywords: abrasive manufacturing nanoparticles

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