# [1]Influence of nano-minimum quantity lubrication with $MoS_2$ and CuO nanoparticles on cutting forces and surface roughness during grinding of AISI D2 steel

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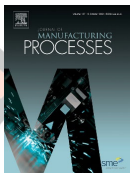


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**Abstract**

Environmental side effects of machining lubricants are the main reasons for the progressive development of ~~the application of~~utilizing the minimum quantity lubrication (MQL) method instead of conventional methods. Owing to the high specific energy of cutting and ~~the~~ generation of more heat in grinding, the MQL technique has a lower efficiency than conventional methods. However, by adding nanoparticles to the base oil, ~~it is possible to enhance~~the lubrication efficiency in grinding can be enhanced. In this research, grinding of cold work tool steel AISI D2 was studied using a MQL technique by adding MoS2 and CuO nanoparticles to two types of vegetable-based oils~~,~~ : colza and soybean with different concentration percentages, and their effects were examined on the cutting forces (normal and tangential forces) and surface roughness ~~were examined~~. The ~~outcomes~~ results indicated that the values of normal force and tangential forces diminished by 19 and 35% when using CuO nanopowder in soybean base oil with a concentration of 4% and MoS2 nanopowder in soybean base oil with a concentration of 2%, ~~diminished by 19 and 35%,~~ respectively. Furthermore, when using CuO nanopowder in colza base oil and with a concentration of 2%, the surface roughness had a significant ~~decrease~~ reduction of 77% in comparison with pure oil as a grinding fluid.

**Keywords**

Grinding, MQL, $MoS_2$, CuO, AISI D2 steel, Surface Roughness

**Abbreviations**

| | |
|---|---|
| MQL | Minimum quantity lubrication |
| NFs | Nanofluids |
| CNT | Carbon Nanotubes |
| HRC | Hardness |

**Commented [Ed1]:** Ref?!

**Commented [Ed2]:** Or nano-fluid minimum...?!