Multi-responses optimization in dry turning of a stainless steel as a key factor in minimum energy

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Abstract

The machining of stainless steel is of interest because of its corrosion resistance and high strength. Usually, this process involves the application of cutting fluids, which negatively affect the environment, ecologic, and health impacts. Therefore, dry machining is the optimum solution, when applicable. Moreover, due to the high cost of cubic boron nitride (CBN) cutting edge, the improved performance is important for hard finish turning. Reducing energy consumption under dry condition should consider for sustainable machining. This study aims to optimize machining parameters (i.e. power consumption and surface roughness) of stainless steel 316 with CBN tool under dry conditions. A multi-responses based on response surface methodology with Box-Behnken design (BBD) was employed to optimize machining parameters. A compound desirability function was applied to determine optimum levels and contribution of parameters. A validation test was conducted to confirm results. This combination of parameters resulted in the minimum power consumption of 6.78% and decreased surface roughness by 13.89%. This method also effectively reduces the environmental effects in terms of noncutting fluid use and less energy required which is affected in sustainable of machining.

Keywords Turning machine · CBN · Multi-responses · Power consumption · Surface roughness