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Title:

Optimization of Sustainable Cutting Conditions in Turning Carbon Steel by CNC Machine

Abstract:

The current study aims to find the optimum cutting parameters in turning process without using cutting fluids (dry cutting condition) towards sustainable manufacturing. Where the power consumption and environmental pollution increase due to increase of the machining operations in manufacturing field, so it is important to adopt sustainability in machining processes to save energy and environment and reduce cost.

The experimental work in this study involved the preparation to a number of experiments on AISI 1045 carbon steel to collect the necessary data for implementing optimization process. The experiments were conducted by changing levels of cutting parameters (spindle speed, feed rate and depth of cut) in CNC turning machine. Surface roughness of the workpiece has been depended as a quality indicator. In addition, the temperature of cutting tool has been recorded during machining the workpieces in order to control the temperature of cutting process.

Theoretically, empirical equations for temperature of cutting tool and surface roughness of the workpiece have been discovered. By using Genetic Algorithm technique these equations have been used to find the optimum of cutting parameters spindle speed, feed rate and depth of cut. The optimum values that obtained by using Genetic Algorithm which achieve sustainable cutting were spindle speed 588.96 rpm, depth of cut 0.50 mm and feed rate 64.55 mm/min in order to have the optimum of surface roughness in low cutting temperature.