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Asit Saha
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Analysis of Surface Texture and Material Removal Rate During AISI 202 Thermal-Assisted Turning Using a Carbide Cutting Tool

Subhas Chandra Moi, Rajeev Ranjan(✉), and Baban Rajak

Department of Mechanical Engineering, Dr. B. C. Roy Engineering College, Durgapur 713206, India
subhas.moi@bcrec.ac.in, rajeevranjan.br@gmail.com

Abstract. To attain a superior surface quality and material removal rate, it is advisable to employ environmentally conscious machining techniques, often referred to as "green machining." Within the domain of conventional machining, the thermal-assisted turning method applied to the workpiece emerges as a commendable option, owing to its operational simplicity and the elimination of coolant requirements, thereby aligning with eco-friendly practices. This research is fundamentally oriented towards the optimization of machining performance for AISI 202 utilizing a carbide tool, with a specific emphasis on two pivotal output factors: material removal rate and surface roughness. The investigation leverages the Response Surface Methodology (RSM) to extrapolate predictions and optimize the machining process. The Box-Behnken design method is employed to systematically analyze variations in independent variables, which encompass workpiece temperature, cutting speed, and cut-depth (depth of cut). The empirical findings underscore that temperature exerts the most pronounced influence on surface roughness, followed by cut-depth and cutting speed. Similarly, concerning material removal rate, temperature emerges as the most influential factor, succeeded by cutting speed and cut-depth. This research helps us understand how different factors affect metal cutting and gives us ideas on how to make the process more sustainable and efficient.

Keywords: Green machining · Thermal-assisted turning · Box-Behnken design · Material removal rate · Surface roughness · AISI 202

1 Introduction

Sustainable manufacturing has seen a departure from traditional machining techniques with the adoption of thermal-assisted machining, a strategy that enhances both machinability and sustainability. This approach reduces machining forces; enhances surface quality, and eliminates the need for cutting fluids, which are often laden with environmentally harmful or potentially hazardous chemicals. To address this issue effectively,

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