



## Original Article

# Optimization of pre-turning parameters for diamond burnishing of AISI 4340 steel

Mevlüt AYDIN<sup>\*</sup>, Ömer Faruk GÖKCEPINAR, Mete KALYONCU

Department of Mechanical Engineering, Konya Technical University, Konya, Türkiye

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## ABSTRACT

The presented study investigated for the first time the pre-turning performance before the diamond burnishing of AISI 4340 hardened steel under various cutting speeds, feed values, and cutting depths at flood cooling cutting conditions. Multi-objective optimization was conducted to obtain an effective pre-turning process regarding total cost and surface characteristics. The results showed that the pre-turning parameters must be optimized to benefit from diamond burnishing effectively. It was also observed that the diamond burnishing could have been more influential on pre-turned specimens with high surface roughness. Under the bohr-oil-added flood-cutting conditions, the average surface roughness and maximum roughness depth improved by 63.4% and 48.5%, respectively. The most influential parameters for average surface roughness and maximum roughness depth were the feed values with 98.2% and 99.3% contribution ratios, respectively. The Bees algorithm optimized the pre-turning parameters in terms of output parameters. The optimum cutting speed, feed values, and cutting depth levels are 264 m/min, 0.1325 mm/rev, and 0.55 mm, respectively.

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## INTRODUCTION

The interest in finishing processes is increasing to improve surface integrity and precisely manufacture parts. Conventional finishing processes such as grinding, honing, and lapping are widely used in applications that require superior surface quality and dimensional accuracy. Roller burnishing (EP) has recently been considered the efficient solution in cases where surface integrity criteria such as surface roughness, compressive residual stresses, and surface microhardness are essential [1]. Also, roller burnishing is a remarkable process for increasing fatigue strength as it generates compressive residual stresses on the surface [2]. This process is performed by a burnishing tool with one or

more balls contacting the surface of the workpiece. The burnishing tool or workpiece rotates at a certain speed in the burnishing process. As the tool moves forward, the balls try to burnish the surface by pressing the rough peaks into the micro-gaps. Besides the outer diameters or outer surfaces, the inner diameters of materials with holes inside can also be burnished [3, 4]. Burnishing has significant potential to improve the surface integrity, cost efficiency, and overall quality of products. Burnishing is commonly applied to rotating components that require high-quality standards, such as automotive crankshafts, bearing parts, and axles [5]. In the literature, the roller burnishing method appears in different forms. Some are roller burnishing [6], ball burnishing [7], deep rolling [8], and diamond burnishing [5].

\*Corresponding author.

\*E-mail address: maydin@ktun.edu.tr

