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Investigation of ball burnishing processing on mechanical characteristics of wooden elements

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Abstract

Numerous research results indicate that the finishing processing of metal materials using ball burnishing has positive effects from the aspect of surface roughness decrease to the hardness increase in the surface layers of the processed materials. Little research has been devoted to this type of processing for nonmetal materials. This paper presents research results related to the influence of ball burnishing processing on the hardness increase of a wooden element. It was determined that the hardness can be increased up to three times for processing of wood using this technology, which is not the case for processing of metal materials.

Keywords

Ball burnishing, hardness, micro-hardness, nano-indenter, wood

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Introduction

Wood is the most widely used industrial raw material in the world. In industry, wood is used as an engineering material either in a natural or in a processed state. Despite the fact that today metals, plastics and composites are used more, wood is still much used for making different products. When choosing wood as an engineering material, one should take into account its physical characteristics such as: density, distribution layer and fibre, strength and elasticity, hardness, flexibility, tendency to shrinkage and swelling, humidity, heat and thermal conductivity, toughness, and colour and lustre after processing. Wood is composed of cellulose, lignin and inorganic materials. In terms of chemical composition, about half of the wood is carbon, approximately 40% oxygen, the remainder consisting of hydrogen, nitrogen and ash (K_2O, P_2O_5, CaO). From species to species wood does not change significantly in chemical composition, but the physical properties can be very different. One major influence on the mechanical properties of wood is humidity, whereby an increase of humidity to the point of fibre saturation leads to a loss of strength. Besides oxygen, the presence of moisture is one of the important factors that influences the development of putrefaction. In order to protect wood from putrefaction, basic processes such as different drying procedures and different protections of wood from moisture (i.e. polishing, painting, etc.) can be applied. Putrefaction of wood is due to the presence of moisture and oxygen in the tree.

Burnishing is a cold finishing process and no-chip process that applies a sufficient force over the yield strength of materials to produce plastic deformation of a surface layer, in which a roller or a ball pushes surface materials from the peaks into the valleys; thus the asperities are flattened.[1–6] Many previous investigations of burnishing processes have been focused on the ball burnishing process, due to its advantages.[3,7] Randjelovic et al.[3] used FEA and an experiment to demonstrate that the initial surface roughness has no significant effect on the surface quality achieved by ball burnishing. Tadic et al.[4] analysed the influence of ball burnishing tool stiffness on surface roughness. These workers compared the elastic burnishing tool with the high-stiffness burnishing tool. Lin et al.[8] analysed surface roughness from the perspective of tribological theory. The study proposed a useful parameter for assessing the optimum combination of burnishing

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