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Durability of blades covered by multilayer anti-wear coatings during wood milling

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Abstract: *Durability of blades covered by multilayer anti-wear coatings during wood milling.* The study presents investigations on the durability of cutting edges covered with multilayer antiwear coats obtained using a physical vapour deposition (PVD) method during milling of solid wood. The CrN/CrCN multilayer coatings were obtained employing the method of cathode arc evaporation. Monolayer coats based on chromium nitride (CrN) and chromium carbonitride (CrCN) created a double-layer (called Λ module). Multilayer CrCN/CrN, Cr_2N/CrN coatings consisted of 7 Λ modules of 400 nm thickness each and of different ratio of CrN and CrCN thickness distribution in a module. The authors presented the impact of the hard coatings spread onto the cutter faces on their durability in the process of pine wood milling. The wear was determined by measuring the surface area of the cutting edge using for this purpose a profilograph meter. It was determined that covering tools with hard multilayer coatings increased resistance to abrasive wear. The best results and the smallest wear was observed for cutters modified with CrCN/CrN type multilayer coats of Λ~400 modulation and 1:2 thickness ratio of individual layers.

Key words: PVD, hard multilayer coatings, wood milling, edge wear, profilograph meter

INTRODUCTION

At the present time, tools with cutting edges made of high-speed steel or sintered carbide are used by the SME in the milling of solid wood and wood-derived materials and it is on these materials that tool manufacturers are concentrated. Tools with cutting edges made of synthetic diamond are employed much less frequently due to high technical and technological requirements as well as relatively high costs of production and utilisation.

Looking for solutions in the field of surface refining of tool edges for wood made from above mentioned materials with the aim to improve the milling properties constitutes a very topical subject. Intensively developing material engineering, in particular vacuum – plasmatic methods of surface refining, makes it possible to manufacture nano-structural layers of unique properties (high microhardness μHV, resistance to abrasion, low friction coefficient, low wear index measured in the system sphere-plane) and structure.

The PVD method, which is characterised by low temperature of coat spreading allowing coating of edges made from high-speed steel without risking their tempering, has gained an important position in the field of manufacturing of hard coatings. Low temperature PVD makes it possible to obtain layers of nanometric thickness with the possibility of application onto working surfaces of tool edges as antiwear layers.

Investigations in this area have been carried out for several years now by many scientific centres, primarily with regard to tools for metal machining [2, 7, 8, 9, 10].

In recent years, thanks to new possibilities which have opened up in the field of technology of the application of antiwear coatings, interests of scientists have again turned towards machining tools for wood and wood-derived materials [1, 3, 4, 5, 6].

The aim of the performed investigations was to determine the life of cutting tool blades used in milling heads made from high-speed steel of various architecture of hard, multilayer coatings of differing thickness ratio of CrN:CrCN layers in the Λ module.