

For several years, accelerated development of stone industry can be observed clearly. Diamond tools are a group of products used for cutting and grinding of natural stone, the use of which is growing dynamically. Literature emphasizes the importance of proper selection of the matrix material and manufacturing technology. The matrix material is a key element of the structure metallic-diamond tools. Metallic-diamond segments are associated mainly with adequate property retention and tribological properties, when the matrix material has: high hardness, high yield strength and fatigue strength, which prevents cracking around the diamond particles, high impact strength and low notch sensitivity, which hinders the nucleation of cracks in the vicinity of sharp edges of the diamond particles forming notches and thus stress concentrations, low coefficient of thermal expansion and high thermal conductivity to prevent excessive temperature rise of segments in the saw blade, resulting in reduction of yield strength and the deformation around the diamond particles, and the lack of solubility or the minimum solubility of carbon in order to minimize the graphitization of diamond particles.

The main mechanism of wear when operating the tools is metallic-diamond abrasive wear. It can occur under the influence of loose abrasive particles, forming a suspension of processing products in the cooling medium, or through the direct contact with protrusions of the workpiece, which serve as restrained microblades. The first case is 3-body abrasion, the second -two-body abrasion. Wear of the matrix material may also be by fatigue, which involves the formation of cracks due to impact, or cyclic deformation of the surface layers and chipping of the metal. In addition, the matrix may also be exposed to high temperatures. The phenomenon of erosion of the matrix material occurs mainly in the vicinity of diamond particles and produces characteristic smoothing of the surface craters that have arisen as a result of abrasion.

The main scientific objective of the project is to expand current knowledge about the phenomena which determine the properties of the matrix retention (capacity of the matrix to retain diamond particles) subjected to cyclic loading. However, information from the achieved results should allow us to draw much further-reaching conclusions. In the long term, understanding these phenomena and establishing relations between the properties and structure of the matrix material and the properties of tools should significantly facilitate the complex process of designing these materials. The selection of constituents and their proportions will depend on service requirements. Designing a matrix material on the basis of reduced iron content without previously used materials (cobalt, nickel), with increased mechanical and tribological properties has a very important economic and social importance. It reduces the cost of manufacturing the same tools and reduces the risk of cancer of staff directly employed in the production of professional metallic-diamond tools.

Research carried out in the framework of the project is to assess in laboratory tests the wear of metallic-diamond segments, where the matrix is a newly developed material from the Fe-Mn-Cu-Sn-C system. These materials are subjected to the action of factors similar to those that result from their potential applications. Laboratory tests of abrasive wear resistance of the matrix material will be conducted using Micro Wear Test (MWT), developed by Struers. The ability of the matrix to retain diamond crystals will be determined by a microscopic technique - by reference of the number of diamond particles to the total number of diamond particles and empty sites remaining on the working surface of the segment. Retention properties will be assessed on the basis of modulus of elasticity and yield strength of the matrix. Impact strength will be determined, which has a significant impact on retention properties of the matrix. This review will examine matrix internal stresses in the vicinity of the diamond particles. X-ray analysis (XRD), electron microscopy (SEM + EDS, TEM) will be used to define the structure of the sintered Fe-Mn-Cu-Sn-C and mechanisms of wear of metallic-diamond segments subjected to laboratory tests.

The reason for taking on the described the research subject is the lack of literature data on retention capabilities of a Fe-Mn-Cu-Sn-C acting as the matrix in sintered metallic-diamond tools. Apart from the essential scientific features, the results will be of great practical importance in particular as regards the durability of the metallic-diamond tools in which the matrix material is without cobalt and nickel. In the case of a positive result in the proposed project, the development of new matrix materials for sintered metallic-diamond tools will be continued within the framework of application projects which is consistent with the policy project of the National Center for Science and the National Centre for Research and Development.