

ENHANCING THE TRIBOLOGICAL PROPERTIES OF POLYMER
COMPOSITES WITH DISPERSIVE FILLERS

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The idea of using thermoplastic polymers as matrix materials to create composites is one of the most promising ways to obtain a new generation of composite materials that operate under harsh conditions. Among the prospective materials in the role of thermoplastic matrices, Ultra-High-Molecular-Weight Polyethylene (UHMWPE) holds a prominent position. Due to its specific properties, UHMWPE stands out from many thermoplastics in this series, which are used in industries that require resistance to severe conditions.

However, with societal development and technological advancement, the demands for polymer materials are increasing. There is a growing number of applications where pure UHMWPE can no longer be used in its original state [1,2].

To meet the growing needs of the industry, it has become widespread to create composites with UHMWPE as the matrix material, incorporating fillers of various types and amounts to achieve specific operational properties. For example, by introducing a relatively small amount of dispersive fillers, it is possible to enhance the strength properties of the composite, and in some cases, allow the appearance of unique characteristics [3].

The goal of this work is to study the change in wear resistance of UHMWPE-based polymer composites depending on their composition under conditions of dry abrasive friction.

For this research work, the initial materials used were UHMWPE powder as the matrix material and zirconium dioxide (ZrO₂) powder as the dispersive filler. Composites with the following zirconium dioxide content in UHMWPE were prepared: 0.5%, 1%, 3%, and 5% (by mass fraction). The composites were fabricated using a method based on hot pressing under temperature and pressure in a P-20 press machine [4].

Wear resistance tests were carried out under dry friction conditions on a steel surface using the "IIP-1" wear resistance testing device, by the method of wear in an abrasive environment of unbound particles (aluminum oxide (Al₂O₃) powder with fine dispersion (40-125 μm) was used as the abrasive). The primary method for calculating the wear

quantity was by weight loss measurement, $\Delta m = m_2 - m_1$. The total testing time was 90 minutes [5].

The results obtained show that the introduction of zirconium dioxide in a 5% concentration as a filler reduces the wear of the composite compared to the results of the matrix material. Further increasing the content of zirconium dioxide in the composite leads to an increase in the overall wear resistance, and the wear resistance of pure UHMWPE improves, but the elasticity of the composite sharply decreases.

To determine the characteristics of surface wear changes, optical examinations were carried out on the sample surfaces after testing. After studying the topography of the wear surface of the composites, it is possible to assume a uniform, layered wear nature, excluding the formation of flows and grooves on the surface.

By introducing up to 3% zirconium dioxide, it is possible to reduce the wear resistance of the composites by approximately 1.5 times compared to the wear values for pure UHMWPE. As the filler content increases in the studied samples, the wear rate increases to a similar value.

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