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INFLUENCE OF OZONE ON STRUCTURE AND PHYSICAL-MECHANICAL PROPERTIES OF THE NONWOVEN MATERIALS BASED ON POLYHYDROXYBUTYRATE

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There has been a great practical interest in the development and study of nonwoven fibrous materials based on biopolymers for medical purposes. Electrospinning is one of the most promising methods for obtaining materials with a highly developed surface. From the practical point of view, there is a sufficient interest in the study of ozone effect on materials and medical devices, because ozonation method is one of the most effective techniques to sterilize and purify different substances.

Non-woven materials based on PHB obtained by electrospinning has a highly developed surface and a complex structure of the fibrous layer. High porosity, large surface area, controlled biodegradation and bioresorption in the living organisms are the advantages of these materials over a number of analogues commonly used in medicine. However, the problem of sterilization of these materials before usage in medical devices and equipment has been a topical issue. The aim of current work was to consider the structural features of ultrathin PHB fibers, and to establish the regularities of the ozone impact on the physical-mechanical properties of the obtained materials.

Nonwoven samples were obtained by using the electrospinning method in a single capillary laboratory setup. The voltage on the electrode was 17 kV. The electrode gap was 18 cm. The diameter of the capillary was 0.1 mm.

Finely dispersed poly-3-hydroxybutyrate (PHB) powder from Biomer (Germany) with $M_w = 2.06 \times 10^5$ was used.

In order to establish the changes occurred in materials properties due to ozonation the physical and chemical properties were determined.

Samples of nonwoven materials with different densities were studied by electron paramagnetic resonance method in order to study amorphous phase of the materials. For this purpose, the EPR-V EPR spectrometer was applied (ICP RAS, Moscow). The crystallinity degree of the materials was determined by differential scanning colorimeter Netzsch DSC 214 Polyma (Germany) with a heating rate of 10 °/min. The fibers packing and relative position of fibers in the structure of the material was examined by using light and electron microscopy methods (optical polarizing microscope Micromed Polar-3, scanning electron microscope Hitachi TM-1000) respectively. Mechanical tests were carried out by using the mechanical analysis machine Devotrans (Turkey). The elasticity modulus, relative deformation and maximum elongation of examined materials were determined.

Based on the series of conducted studies, it was found that under the influence of ozone, mechanical properties of the material rose significantly before the moment of rupture. In the work, the possible causes of such changes in strength properties of materials were studied. It was concluded that at the initial stage of ozonation, macromolecules broke up, and the possibility of more regular packing of molecules in the amorphous phase emerged. It was confirmed by an increase in the melting enthalpy of ozonized PHB samples. The obtained data emphasized the great potential of usage of non-woven materials based on PHB obtained by electrospinning for medical purposes, and confirmed the effectiveness of ozone sterilization of devices based on these materials without mechanical properties' reduction.