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THE INFLUENCE OF PH ON STRUCTURE AND PROPERTIES OF POLYMER HYDROGEL MATERIALS BASED ON GELLAN AND SYNTHETIC POLYMERS

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In the last decades composite materials become widely spread which are mixtures of different polymers, and various combinations thereof with low-molecular substances, in particular interpenetrating and semi-interpenetrating networks (IPN). Use of various polymers for the IPN synthesis is promising because by combining different grids it is possible not only to obtain new materials with a wide range of properties, but also to deal with many new technical challenges.

In this study hydrogel polymer composite materials were obtained, which are semi-IPN based on gellan and synthetic nonionic polymers – polyvinylpyrrolidone (PVP) and polyvinyl alcohol (PVA). Method of obtaining gellan-PVP and gellan-PVA hydrogels was based on the unique property of gellan – structuring in a three-dimensional spatial grid while the temperature rises to the sol-gel transition point. This property of gellan allows to simplify and cheapen hydrogels synthesis process due to the lack of additional components in the system (e.g., crosslinking agent), and reduce the number of synthesis steps.

The process of gellan gelation is a polymer conversion from random coil to double helix and their aggregation. Decrease in pH leads to conversion of glucuronic carboxyl groups from a negatively-charged COO^- to an uncharged COOH and reduce the electrostatic repulsion between the gellan coils, which contributes to their further aggregation. Thus, for preparation of hydrogels, pH of distilled water was adjusted to pH = 2 by adding 0.1 N HCl. Gellan concentration was 1 and 2 wt. %; PVP and PVA – 3, 5 and 7 wt. %. Synthesis of hydrogel is a gradual disolving of a nonionic polymer and gellan, followed by gradual heating and stirring the mixture at a temperature of 80°C – the temperature of the sol-gel transition. Upon reaching this temperature, the mixture was kept under stirring for 10 minutes and allowed to cool to room temperature. Effect of pH was studied by examining the physicochemical properties of the hydrogels.

The sorbing properties of hydrogel material obtained at pH = 2 relatively decrease in comparison with swelling properties of the same hydrogel obtained in a neutral environment. The study of the mechanical properties on compression of the materials showed that hydrogels prepared in an acidic medium are not sufficiently strong and lose their elasticity. The strength of the hydrogels increases with the increase of total components concentration in the composite material, due to the dense structure of the hydrogel network. Also hydrogels gellan-PVA have lower values of the compressive strength than hydrogels gellan-PVP.

The tensile strength of the hydrogels obtained at pH = 2 is 2.5 times higher than tensile strength for compression of hydrogels obtained in neutral medium. Texture of the hydrogels' pores was studied using optical microscope with a magnification of 20 times and it was heterogeneous. The pore size of gellan-PVA hydrogels is greater than the pore size of PVP-gellan hydrogels. A decrease in the pore size of the hydrogel samples is observed with increasing concentration of gellan and synthetic polymer contained in the composite material. Thus, the decrease in pH of obtaining environment leads to increasing of network density in gellan-PVP and gellan-PVA hydrogels.