Modification of Polymeric Optical Hydrogel by Ion-Exchange Resins

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Abstract – New drugs form for medical treatment of chemical burn of yeas have been studied. Hydrophilic polymeric materials for soft contact lenses based on N-vinylpirrolidon and estragol of methacrylic acid synthesized in the presence of bivinyl sawed reagent by radiation bulk polymerization have been prepared. Physical-chemistry properties of new materials have been studied. Activity of new materials concluded with bases and acids have been investigated.

The research deals with radiating modification of polymeric optical hydrogel for soft contact lenses with-exchange resins, to create polymeric hydrophilic sorption materials for treatment of chemical burns of eyes. Search we new effective back burn materials is rather actual because of constantly increasing influence of chemical factors on the sight of the person. Not to allow same burning substances to get in to an eye frequently means to rescue to the sight. Synthetic sorption materials allows us to decide the problem successfully, they delete destroying substances from the defeat centre, and prevent to develop accompanying inflammatory process.

The object to be research is polymeric hydrophilic material for soft contact lenses “Kemeron-1” – a copolymer on the basis of N-vinilpirrolidon and a methyl aether methacrylic acid, synthesized in presence bivinyl sewing agent by a method of radiation block polymerization under the influence of radiation Co60 on installation MRKh-γ-20. [1].

The material has high maintenance of water (to 70%), high oxygen permeability, plasticity and stability when treated according set geometrical parameters.

It turned out that to investigate the possibility to give the material same sorption properties, is rather interesting in condition preservation of its basic physical and chemical characteristics. Modification of polymeric hydrogel “Kemeron-1” ion-exchange resins has been made. In our research, we used weak acid carboxyl cation exchange KB-4 (modification material Kemeron-IS) and strongly acid sulphatecation KU-2-8 (modified material Kemeron-IS) in the H-form. Chosen exchangers are nontoxical, are characterized by firmness to biological environment, ability to maintain sterilization. Active groups of exchangers can tie not only aggressive chemical substances, but also various pathogenic connections – toxins, viruses, bacterial cages [2]. Cation exchange we applied in the crushed kind (fraction of 20–40 micron), in number of 2 and 5% from weight of monomeasured mix.

Introduction of cations in to polymeric matrix was carried out at a stage of gelatinization. Such method provides uniform distribution of cation exchange resin in matrix volume and excludes its subsidence. The absorbed doses of formation of gel of necessary viscosity and the general absorbed dose of polymerization which make 10 kGr and 35 kGr ware defined.

The materials received are firm polymers, they are well sharpened and polished. When hydrating polymers bulk up, become soft and plastic. The materials modified exchanger, are characterized by smaller transparency, however it is not a lack for therapeutic soft contact lenses, used for a short time interval.

At studying sorption properties of material in model experiments samples in the form of disks with the initial sizes were used (diameter of ~12 mm and a thickness of ~1.0 mm.) The definition of absorption of alkali a method of the acid-core of titration. Samples ware placed in consistently replaced volumes of a solution of 0.02 M NaOH for certain time at constant stirring. After the extraction of the sample, the remained alkali was titrated in 0.1 M solution HCl in the presence of the indicator phenolphthalein.

The quantity of sorption alkalis was defined on the basis of difference between the maintenance of alkali in initial solution and the solution after extraction the sample. The absorbing ability was estimated dynamically in 15, 30, 90, and 120 min under the contact of the sample with a reagent. The results are presented in Fig. 1.

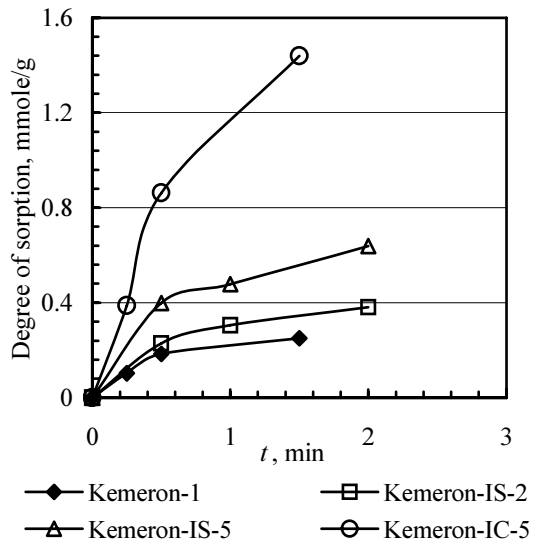

Fig. 1. Alkali sorption curves for the samples of materials “Kemeron-1”, “Kemeron-IS”, and “Kemeron-IC"

The received results have shown that modification of polymeric hydrogel "Kemeron-1" with exchange capacity pitches in the N-form effectively raises (in 2–5 times) it sorption properties in relation to alkali.

At the saturation of exchanger material ionogenic functional group of the acid form in salt (sodium) in to alkali happen. Such material is capable to exchange sodium ions in to hydrogen ions when it is put in to sow environment.

Restoration of the acid form of the samples of material sated with alkali was help the according to the scheme similar to a technique of absorption of alkali while maintaining the samples to 0.02 M HCl for a certain time. the exchanger acids quantity was counted by titration of solutions after exemplary 0.1 M alkali solution.

The results are presented in Fig. 2.

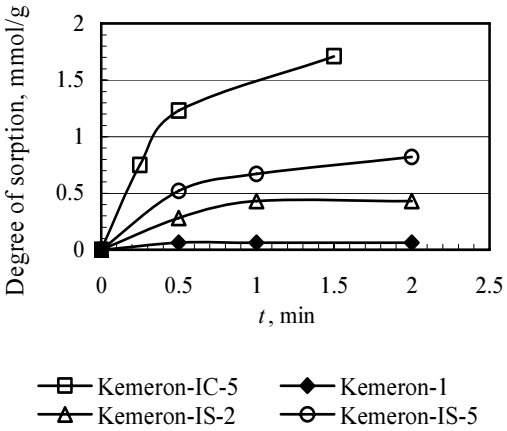

Fig. 2. Acid sorption curves for the samples of materials "Kemeron-1", "Kemeron-IS", and "Kemeron-IC"

The absorption of acid by samples of a material "Kemeron-1" happens more slowly than alkali absorption. It can be connected with reduction of swelling of hydrogel in the sour environment and, as a result, with the delay of diffusion of electrolyte. When modifiers of ion-exchange type the static exchange capacity (SOYA) of materials on acid raises at 8–30 time, compared with "Kemeron-1". The sorption and regenerations process is reversible at practically for the modified material at the time of investigating alkali saturation (for a period of 2 h). It testifies the stability of materials in investigated environment.

Modification of hydrogel by a mix exchanger in the H-form and in the Na-form gives the chance to receive universal sorption a material capable to absorption and neutralize acids, as well as alkalis. Such materials are necessary under the condition when the nature of burning substance is unknown.

Thus, the carried out research specify in the possibility of creating exchanger capacity soft contact lenses with enough high sorption capacity to use them as the eye medicinal form at treatment of chemical burns of eyes.

The radiation technology of synthesis of polymeric hydrogels gives wide opportunities for other modification and the possibility to get materials with new practical properties.

References

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