CROSS-LINKING OF CHITOSAN AND CARBOXYMETHYLCELLULOSE IN A SHEAR STREAM

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Biopolymeric nano- and micro-dimensional materials on the basis of chitosan (ChS) and carboxymethylcellulose (CMC) are widely demand in various branches of industry. The efficiency of application of such materials in many respects depends on their stability which can be reached by means of cross-linking of polysaccharides by various reagents, in particular, glutared aldehyde (GA). Meanwhile the receipt of compatible mix of ChS and CMC, and their ordered cross-linking are important. It is possible in shear stream, rendering a constant deformation influence on macromolecules. In the present work the cross-linking of ChS and CMC in the compatible condition by GA in the shear stream have been investigated. Such deformationed stream is generated in the system of coaxial glass cylinders, which specially-collected to carry out such experiments.

The hydrodynamic experiments have shown that the compatible mix of ChS and CMC is possibly to receive by mixing of strongly diluted solutions of the polysaccharides in which mass fraction of CMC shouldn't exceed 0.3. The rheological experiments revealed that the transfer of polysaccharides molecules in deformational-ordered state required the constant pressure of shear stream ($\sigma \approx 100$ Pa). For realization of cross-linking of ChS and CMC the GA mass fraction should be above 0.125.

In general ChS intensively interacts with CMC without any reagents when the mix of the given polysaccharides is incompatible, i.e. at concentration of initial solutions (C) of the polymers corresponding to the criterion of Debay $C[\eta] \geq 0.1$ (where $[\eta]$ – is the characteristic viscosity). This interaction is realized comparatively sharply, and it is accompanied with lowering the frequency of (the internal cylinder) rotor ($\omega \rightarrow 0$) during 3 - 5 min. Experiments have shown that for incompatible mix of ChS and CMC in 2 % CH_3COOH at ratio of (0.05:0.05:0.9) the interaction of the polysaccharides is accompanied by sedimentation in the shear stream.

The analysis of sewing of ChS in 2 % CH_3COOH by GA (0.05:0.95):0.2 has shown that the limiting decrease in rotation of the rotor ($\omega \neq 0$) is reached in 16 - 18 min from the experiment beginning. Thus the received continuum gelation structure has a favor to deformation and therefore the rotation of rotor doesn't stop completely as it occurs at interaction of ChS with CMC in an incompatible mix.

Cross-linking of compatible mix of ChS with CMC in 2 % CH_3COOH by GA [(0.05:0.02:0.91):0.2] is accompanied by formation of not monolithic gel, and formation of lamellar nano- and micro-dimensional gel-like particles which exuded as a new phase in the mix. The frequency of rotation (ω) of a rotor intensively decreases by time (t) of cross-linking, because the formation of the given particles lead to interaction the viscosity of system.

Thus the dependence of $\omega(t)$ is characterized by the expression of S-shaped form which leaves on a plate at $\omega \approx 0.6$ c^{-1} in 60 min from the experience beginning. Formed nano- and micro-dimensional particles after liophylic drying take a steady powder form and are characterized by porosity (the sizes of the pores 2 - 5 nm). These particles keep the integrity without destruction at swelling and sorption of liquids.

As a whole, the results of research of samples have shown that at cross-linking of ChS in the solution or a mix ChS with CMC nano- and the micro-dimensional, lamellar, porous, in regular intervals cross-linking mesh systems are formed which are stabilized and characterized by a high degree of stability in comparison with the samples received at interaction of ChS with CMC without GA.