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IR SPECTROSCOPY OF THICKENING POLYMER COMPOSITION PELLICLES

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ABSTRACT:

The IR spectra of carboxymethyl starch (CMC) and its composition have been studied.

Keywords: carboxymethyl starch, IR spectra, composition.

АННОТАЦИЯ:

В работе изучены ИК спектры карбоксиметилкрахмала (КМК) и композиции на его основе.

Ключевые слова: карбоксиметил крахмал, ИК спектры, композиция.

INTRODUCTION:

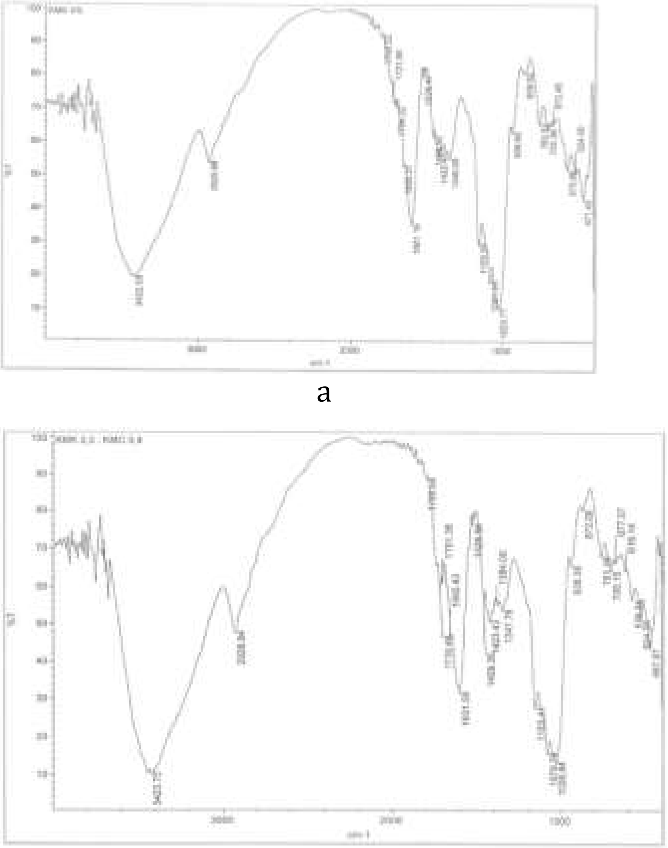
To identify the composition and structure, as well as intermolecular interactions in the compositions, IR spectra of powders obtained from their films in tablets with potassium bromide were taken. It was found that carboxymethyl starch gives similar spectra, similar to carboxymethyl cellulose [1-4]. The spectra of samples of carboxymethyl starch compositions were studied with its added polymers separately and with two components in place.

As it is known, carboxymethyl starch, like starch, contains unsubstituted hydroxyl groups, and in the CMC spectra (Fig. 1 a) have an intense blurred band with a main maximum of about 3422 cm^{-1} and a significant protrusion of 2929

cm^{-1}, belonging to hydroxyl groups. Also in the spectrum there is a strong absorption of about 1000 – 1200 cm^{-1} with clearly pronounced three maxima of 1023, 1081 and 1155 cm-1. There are sharp bands in 763 and 859 cm^{-1}, as well as bands of 936 cm^{-1} related to external deformation vibrations -CH2 and C-H groups and to pulsed oscillations of pyranose rings [5-7].

It is known from the literature that, along with the absorption bands common to all starches, spectral features in the range of 840-860 cm^{-1} were detected in these regions, depending on the origin of this starch. For corn starch modified by us, this area is equal to 856 cm^{-1}, which is 77.2%. But with the addition of NaKMC (Fig. 1, b) and HYPAN (Fig. 2, a), the intensity of these bands decreases. In the composition of CMC, in contrast to CMC, new absorption spectra appear in the region of

1384 cm^{-1}. The triplet spectra are placed in the region of 1000 – 1200 cm^{-1} (Fig. 1 b. and 2 a). The picture changes dramatically when HYPANe is added to the composition with CMC, forming a strong shift in the spectra in the regions of 3448 cm^{-1} with a change in the absorption intensity by 15% (Fig. 4.9 a).



a

Б

Fig. 1. IR spectra of CMC (a) and its compositions with CMC (b)

In the spectra of CMC and HYPAN, the absorption signal disappears in the region of 1798 cm^{-1}. This is due to the formation of intermolecular bonds between carboxyl groups. But in the spectra of the composition, a weak signal appears in the region of 1235 cm^{-1}, unlike the CMC spectrum. This signal refers to the deformation vibrations of -CH3, -CH2 and -CH groups reflecting the angles of C–O–N. The appearance of a signal at 1542 cm^{-1} shows the displacement of the corresponding signals.

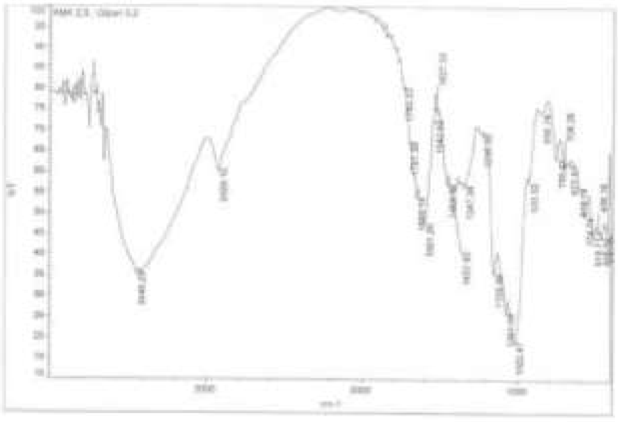
It is known that in the spectra of carbohydrates in the region of 1300-1500 cm^{-1}, the frequencies of deformation vibrations of groups -CH2 are manifested, a manifestation specific to each compound of groups of bands is observed (in descending order of intensity). In the spectrum of starch-derived corn, this absorption region lies at 1423 cm^{-1}, in the spectrum of the composition with HYPANE, this region has a weakening signal at 1422 cm^{-1}. This is probably due, in particular, to interactions between the -CH2 groups and the environment, which leads to a significant change in the frequencies of the -CH2 groups depending on the conformation of the -CH2ON groups. Perhaps this phenomenon is influenced by changes in the environment not only in C6, but also in more distant carbon atoms, which indicates the relationship of structural elements.

A number of bands in the 2600 – 2800 cm^{-1} region are also observed in the spectra of many sugars. But in our case, the blurred nature of these bands does not give grounds for attributing them to overtones or composite frequencies. Transmittance in this region is typical for compounds with OH groups included in a very strong chelate-type hydrogen bond. The bandwidth of stronger hydrogen bonds is largely overlapped by the bandwidth of groups -CH, -CH2 and -CH3, located in the region of 2800 – 3000 cm^{-1}. In addition to increasing the number of components, the spectra of this region decrease in intensity (Fig.1 a, b, and Fig.2 a, b).

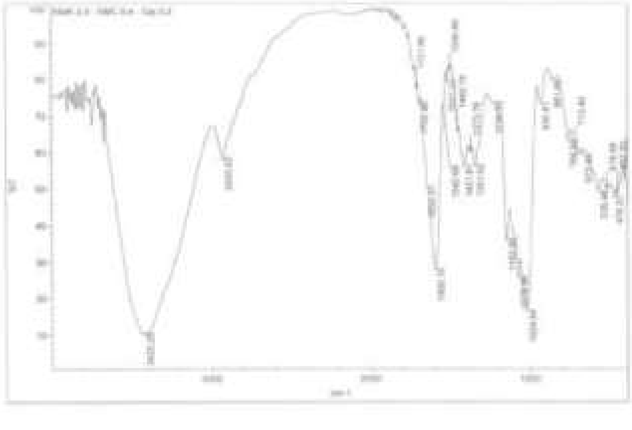
Comparison of the spectra of the latter composition (CMC–CMC–HYPAN) shows that a change in the spatial arrangement of even individual groups or their substitution leads, as a rule, to a noticeable change of the entire system of H-links. But in the spectra of the composition containing all the mentioned polymers, there are differences from other compositions, i.e. the synergy is clearly visible in the region of 3425 cm^{-1}, where the intensity increases.

The composition also has a sharper peak in the area of 1508 cm^{-1}, unlike other compositions and the CMC itself. Probably, during the formation of the composition, weak intermolecular hydrogen bonds are also formed.

Absorption in the region of 400 – 800 cm-1 can be caused by the overtones of the hydrogen bonds themselves and the out-of-plane oscillations of OH groups (Fig. 1 and 2.) But with the formation of compositions (Fig. 1. b and 2. a), the absorption intensities of similar signals gradually decrease.



a



б

Fig.2. IR spectra of KMK-HYPAN and KMK-HYPAN-CMC compositions

On the IR spectra of a system containing all the components of the system (CMC + HYPANE + CMC), a shift of the peak of the carbonyl group from 1690 cm-1 to 1680 cm-1 is observed, this is apparently explained by the rupture of the hydrogen bond in dimeric carboxyl groups under the action of the alkaline agent sodium hydroxide (Fig. 2 b.). It should be noted that when an alkaline agent is added, a characteristic peak in the region of 1710 cm-1 disappears, proving the disappearance of hydrogen bonds in the system between the carboxyl group of starch and the amide group of HYPANE.

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