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TRANSLATION

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The relationship between deformation and shift-stress in starch paste is studied. It is shown that the limit of elasticity depends on concentration of starch in a paste, on thermal processing and mechanical dispersion.

Code 1

The structural-mechanical properties of starch solutions and gelatins were studied (1-13). The majority of work was conducted on viscometer instruments of the Ostwald, Heppler, and other types. As has been shown recently (12, 13), instruments of this type should not be used for measurement of these properties in structural systems. There are data (14), that it is difficult to obtain with them reporducible results in determining viscosity even of dilute pastes. It is expedient to use instruments which determine the shift stress limit and other rheological parameters. Widely distributed and suitable are instruments based on measurement of tangrntial displacement of a membrane immersed in the tested solution or gelatin (15), on rotation of a cylinder placed in the solution and suspended by an elastic cord (16), and others. A number of works (2, 4, 12) are devoted to the study of rheological properties of starch pastes on such instruments.

The purpose of our work is to study in greater detail the rheological properties of pastes of raw and partially broken down starches.

A potato starch was used, purified by the method used in the laboratory of A. V. Dumanskij (17). Paste was prepared in a tub of boiling water 15 min while stirring continually with a reversible cooler and quickly cooled to 20°C. Such a paste possesses high strength which falls in time. Same showed (18) that a rapidly cooled paste has less stable structure than by slow cooling. Apparently, right after preparation and quick cooling, two processes take place simultaneously - structural formation and aging, with the second predominant.

Using a Vejler-Rebinder instrument (15) with a constant deformation rate of 200 mk/min we studied the effect of concentration on change of strength of starch paste. In figure 1 is shown the dependence of deformation on shift stress P for the starch paste 0.5 hours after preparation. As seen, its strength sharply increases with increase of starch concentration. This regularity is always observed in similar means of preparation of pastes of all concentrations.

It is established (2, 3) that the limit of elasticity sharply changes with the action of mechanical working of the paste. The effect of mechanical action on the rheological properties of raw starch is shown in figure 2, where the dependence is shown between pressure R and shift deformation for a 2% paste 0.5 hours after preparation. When it was passed through a No. 2 glass filter at a pressure of 1 atm., the strength of the paste sharply decreased, and with triple filtration became insignificant. With the passage of time the shift stress limit does not increase, but on the contrary, after disruption of the structure, continuously decreased. Consequently, starch paste does not posses tycsotropic properties. In works (3,4) it is also shown that with the passage of time, due to syneresis, shift stress limit decreases. Apparently, after mechanical action, processes take place in paste, leading to spontaneous collapse of the structure.

We also studied the effect of temperature. A 2% paste was held for 3.5 hours at 20-90°C and afterwards its shift stress limit was measured. In figure 3, curve 1 shows an increase in strength of the structural body of the paste with increase in temperature, at 60°C it reaches maximum and then sharply falls almost to zero. Curve 2 gives the dependence of change in shift stress on deformation for partially broken down starch paste, which was thrice filtered after preparation through a No. 2 filter and subjected to heat processing. It is seen that with increase in temperature strength of the paste falls, at 60°C it rises slightly. Reduction in strength of the system apparently is caused by disruption of the structural body.

CONCLUSIONS

1. Strength of paste obtained from potato starch depends on concentration and temperature maintained.

2. With repeated passing of paste through No. 2 glass filter its strength falls. With time, disrupted structures do not set up, on the contrary, the shift stress limit continues to decrease, which indicates the absence of tycsotropic set up of the structure.

3. Paste strength with undisrupted structure increases with increased maintained temperature, reaches maximum at 60°C and further decreases.

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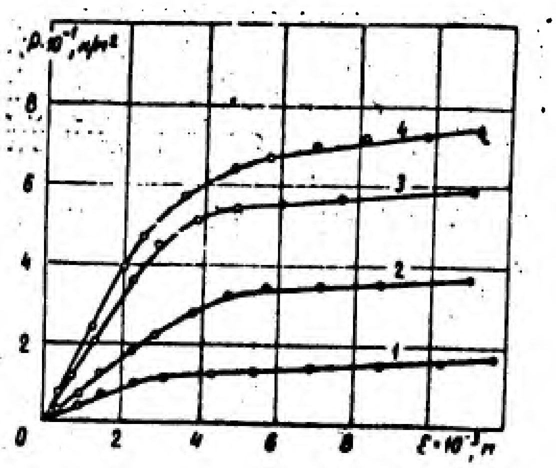

Fig. 1. For solutions: 1 - 0.5%; 2 - 0.75%; 3 - 1.0%; 4 - 2.0%.

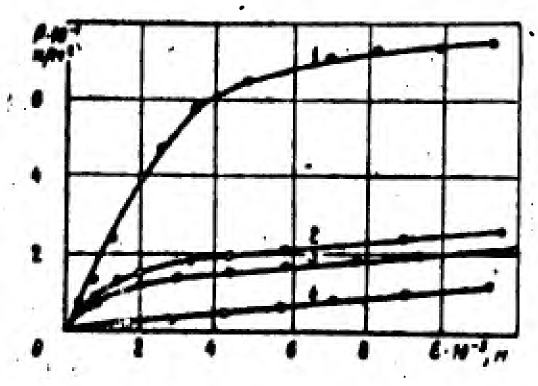

Fig. 2. Paste: 1 - unprocessed; 2 - filtered; 3 - then set aside for 0.5 hour; 4 - set aside for 3 hours.

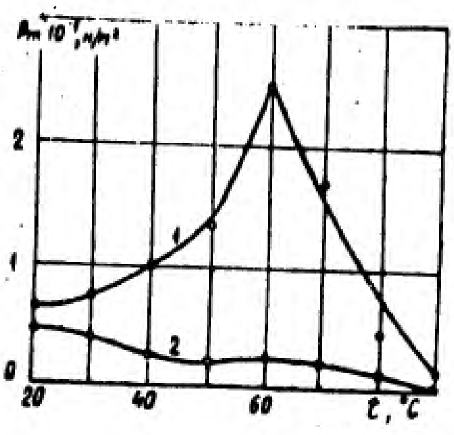

Fig. 3. 1 - for raw starch; 2 - for deteriorated paste.

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