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STUDY OF THE PROPERTIES OF MODIFIED DEXTRIN MIXTURES FOR DRILLING

Abstract. In the article, the structure of modified dextrin obtained in different proportions was studied by means of IR-spectroscopy, SEM analysis, and its physical and chemical properties were analyzed. Modified dextrin, which forms the basis of the new composition of the obtained drilling mixtures, allows to use them in oil and gas wells at different pressures and temperatures.

Keywords: mineral powder (calcium carbonate), modified dextrin, IR-spectroscopy, electron microscope analysis, drilling mixtures.

Introduction. The production of modified dextrin in the world and its use in food, pharmaceuticals, and industry increased to 2,785 million US dollars in 2020, and according to experts, it is predicted to grow to 4,032 million US dollars by 2030 [1].

When ordinary starch containing 10–20% water is exposed to different temperatures, with the help of special catalysts, starch molecules consisting of high-molecular natural polymers are broken down into low-molecular polymers, resulting in dextrin, which is more than 95% soluble in water at 20 °C [2; 3; 4; 5].

Chemical reagents containing modified starch, KMK and dextrin are widely used for drilling mixtures in the oil and gas industry to reduce water loss during drilling. The use of these drilling compounds strengthens the walls of the wells and serves to suppress the solid phase in the solution. This organic product is sensitive to the action of microorganisms, so it requires the addition of bactericidal additives [6; 7].

Discussion of the results. Exploration of hydrocarbon products and drilling in high temperature and pressure conditions are becoming more difficult. This situation was caused by the deterioration of the underground layer due to the inefficiency of the rheological properties of the fluids of the drilling mixtures due to the change in the pressure and temperature during the drilling process due to the decrease in the reserves of oil and gas products, the failure of the pipelines, the change of the shale layers, and the complication of the technological processes due to the high pressure. In order to overcome these problems, today, as a result of the use of modified starch-based drilling fluids, the fact that they have properties such as pressure, normalization of aquifers, and control of the density of the mixture creates an opportunity for scientific research and the development of effective technologies in this field [8; 9; 10].

In order to obtain and widely use the modified dextrin offered by us in drilling, the production enterprises of «Uzkimyosanoat» JSC focus on the

preparation of mixtures consisting of compounds containing metal, phosphorus, and nitrogen, which are necessary for the production of local raw materials – starch contained in rice husks.

Dextrin is mainly mixed with starch treated with hydrochloric acid. Then it is stored for 5–6 hours and modified for 2.5–5 hours in an oven or using an extruder at a temperature of 100–180 °C. The degree of dextrinization is determined by the color of the product: light yellow dextrin is 82–85% soluble in water, and orange color is a completely water-soluble product.

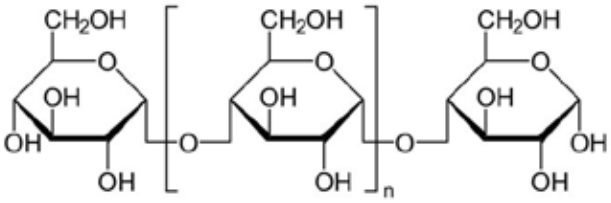

Figure 1. General structural formula of dextrin

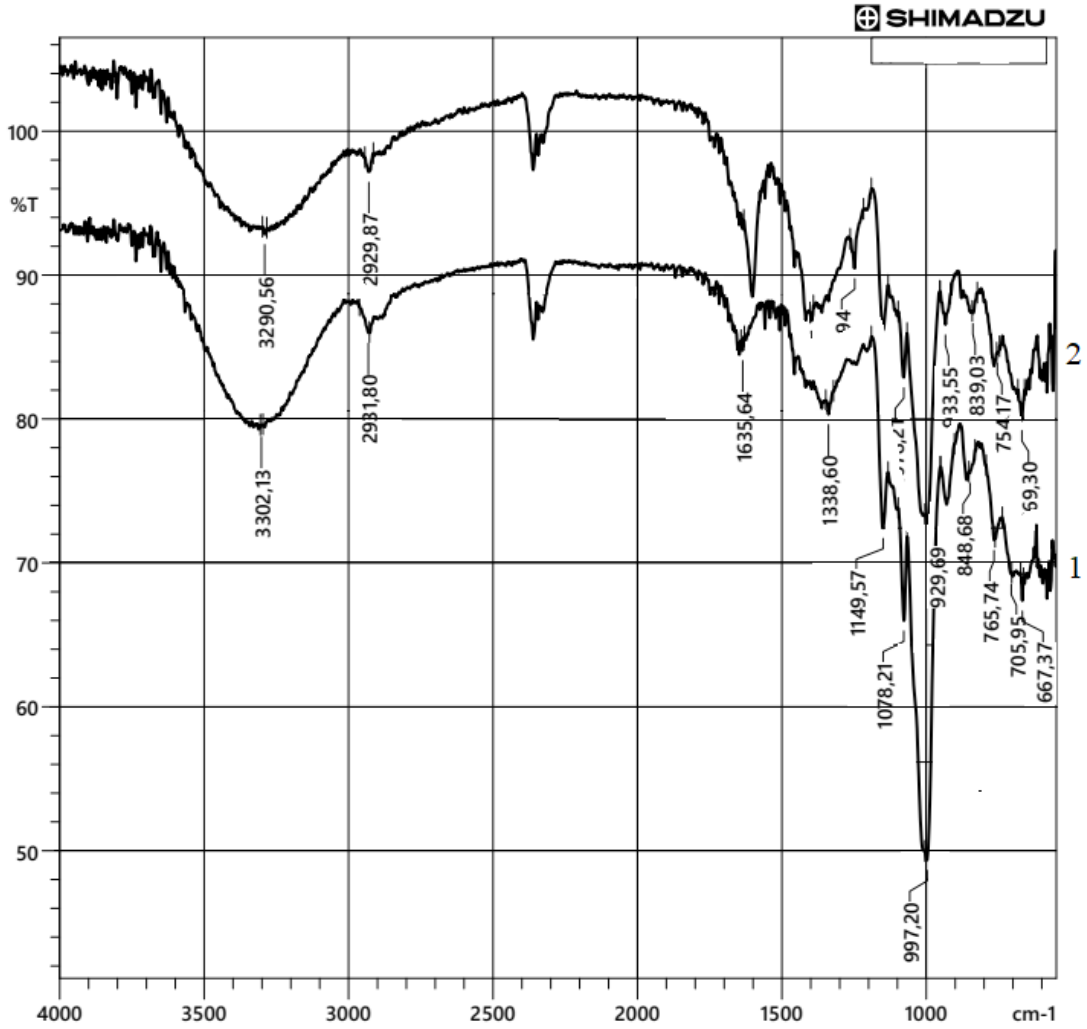

Figure 6. IR spectroscopy: (1) starch, (2) from the right

Figure 1 shows the IR spectroscopy of the obtained dextrin, mainly starch and hydroxyl groups in dextrin showed peaks in the range of 3310–3290 cm $^{-1}$. In addition, frequencies related to the S-N group were observed in the range of 2935–2920 cm^{-1}. It can be seen that the frequency in the region of 1100–1000 cm^{-1} is characteristic of the SN2-O-SN2 group in starch and dextrin, showing valence and valence bands. In IR-spectroscopy of dextrin and starch, frequencies were determined in several different regions. According to it, two new peaks at 1600–1150 cm^{-1} in dextrin were found to belong to the SOO-group.

Table 1. – Properties of the resulting dextrin

Characteristics of Namkna	Properties of dextrin obtained under the influence of temperature up to 100–180 °C		
	1	2	3
Processing temperature, °C	110	150	175
Solubility in water,%	73	76	85
Colour	Pale yellow	Orange	Dark orange
Density, г/см^3	1.03	1.03	1.02

Some physicochemical properties of dextrin obtained by processing starch at different temperatures are presented in (Table 1) below.

On the basis of the dextrin obtained in this way, the following composition was selected for the preparation of a mixture widely used in drilling oil and gas wells: mass%.

Dextrin	2–3
Oxidized starch	2–5
mineral powder (calcium carbonate)	25–30
clay mixture	10–15
sodium chloride	30–40
water	30–50

Conclusions. In the preparation of this composition, water is added until the mixture is formed, and mineral powder (calcium carbonate) and clay mixture are mixed. The mixing process was mixed at 3000 min/speed for 20–30 min. The finished oil and gas well drilling mixture is then allowed to stand for 24 hours and then mixed. To control the fluid viscosity of the resulting mixtures, a saturated solution of sodium chloride salt was added and stirred for 40 minutes, and if the viscosity increased, it was diluted by adding water.

Thus, dextrin, mineral powder (calcium carbonate) and clay mixture were added and mixed, and mineralization of drilling mixtures using mineral powder (calcium carbonate) and clay mixture allows to create new compositions of temperature stable drilling mixtures.

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