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The Effect of Solvent on the Process of Hydrogenation of Cotton Missella

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ABSTRACT

The results of the analysis of the content of organosulfur compounds in a low-boiling hydrocarbon solvent obtained from a mixture of oil and gas condensate at a ratio of 1: 1 and the results of studying the kinetics of the hydrogenation process of cotton miscella obtained using traditional extraction gasoline and a new hydrocarbon solvent are presented.

Studies have shown that with a change in the nature of the solvent, in general, the same patterns remain that are observed when using a traditional solvent, changes occur in quantitative terms.

Key words: hydrogenation, solvent, cotton miscella, catalyst.

The most promising direction of the technology of processing fats and oils for obtaining fat masses for various purposes is its hydrogenation in the solvent. The use of organic solvents makes it possible to reduce the temperature of the hydrogenation process, reduce the loss of raw materials and finished products. This is due to the fact that the usage of the solvent reduces the bonding energy of the hydrogen compound on the surface of the catalyst and increases the rate of its hydrogen supply.

The study of triglyceride hydrogenation in gasoline, benzene and ethers showed that the catalysts contained in these solvents quickly lost their activity. The author explains the reason for this by the degree of purity of the hydrogenated oil, but there are other factors that depend on the composition of the solvent. [1, p.3].

D.V Sokolsky and his colleagues [2, p.48] having studied the process of ethanol and ketone oxidation of cottonseed oil, they found that the effect of erythrocyte on the rate of gidroxidation decreases sharply when its content in micelle is less than 30%.

To find the most effective solvent for hydrogenating cottonseed oil, we planted absolut ethanol, acetone, diethyl ketone, methyl ethyl ketone and others.c.

At the same time, in the composition of solvents used in the oil production industry, there are substances that are catalytic toxic. [3, p.41, 4, p.49, 5, p.111].

In some organic solvents (ethyl, n-methyl, isopropyl alcohols, acetone), it was found that the speed of the process in the hydrolysis of cotton oil depends on the solubility of triglycerides and hydrogenation products. When studying the effect of solvent mixtures [6, p.67], it was found that one of its components (ethanol) is poorly soluble in fats, especially solid oils, and the other components (n-heptane, dibutyl ether) have good solubility . Studies have shown that the addition of ethanol to the n-heptan and dibutyl ether increases both the rate of its degeneration and its selectivity. The practical use of mixed, binary solvents in the hydrogenation process poses additional technological challenges associated with their

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removal and separation after having completed the process.

The problem of choosing a solvent for the processing of vegetable oils should be solved taking into account the previous and subsequent stages and the processes of processing the extracted oil and taking into account the interdependence of all processes of processing of the extracted raw materials. In this regard, the most promising is the hydrogenation of vegetable oils in solvents used in the production of oil extraction.

In the oil extraction plants of Uzbekistan, a hydrocarbon solvent obtained by direct distillation of a mixture of oil and gas condensate with a low boiling point is used. The use of this solvent in the process of hydrogenation of cotton missellin has a positive effect on the quality and cost of the product.

However, the composition of hydrocarbon solvents contains substances that deactivate the catalyst used and adversely affect the stability of the hydrogenation process.

Research methods.

Purified cotton oil and misello obtained at the joint venture of JSC "Tashkent oil-fat combination" were used as a raw material for hydrogenation.

The total amount of sulfur in solvents and oily Solutions was determined using Raney catalyst with micromethod [7, 252-p]. Determination of iodine number in fat, micelles and salutes was carried out according to aosc Cd 1-25 method (Wijs method) [8, 250-p]. Analysis of the low boiling hydrocarbon solvent obtained by direct distillation of a mixture of local oil and gas condensate in the ratio 1:1 showed that it contains sulfur-containing organic compounds in the following quantities: hydrogen sulfide, elemental and mercaptan sulfur- $1{,}74.10^{-4}$%; carbon disulfide compounds- 0,41.10-4 %; disulfide compounds- $1{,}18.10^{-4}$ % ; thiophenic compounds- $1{,}12.10^{-4}$ %; sulfide compounds- $0{,}17.10^{-4}$ %. In short, the total content of organosulphuric compounds in a low-boiling hydrocarbon solvent obtained from a mixture of oil and gas condensate is $4{,}98{\cdot}10^{-4}$ %.

Organosulphuric compounds present in the hydrogenated cotton miscella lead to the deactivation of the catalyst used and a decrease in the quality of the resulting salomas. To reduce the negative effect of such compounds, the effect of local adsorbents on the efficiency of the process of hydrogenation of cotton miscella was studied.

Table 1 shows the hydrocarbon composition of the known and new solvents used in the production of cotton miscella.

Table 1

The hydrocarbon content of the known and recommended oil extraction solution

Hydrocarbons	Hydrocarbons content, % mass					
	In traditional extraction gasoline*			In a new solvent**		
	in the volatile fractions	in the non-volatile reminder	in total	in the volatile fractions	in the non-volatile reminder	in total
2,3-dimethylbutane -2-methylpentane	16,8	4,0	20,8	18,6	3,1	21,7
3-methylpentane	23,1	7,8	30,9	25,5	6,2	31,7

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n-hexane	37,7	33,3	71,0	42,1	30,4	72,5
2,2-dimethylpentane 2,4-dimethylpentane	5,6	9,6	15,2	14,2	10,4	24,6
Methylcyclopentane -2-methylhexane	13,6	21,4	35	8,1	29,9	38
3,3- dimethylpentane- 2,3 dimethylpentane	1,6	7,3	8,9	0,9	6,3	7,2
Cyclohexane	1,0	9,4	10,4	0,5	8,2	8,7
3- methylhexane	0,6	1,6	2,2	0,1	1,1	1,2
n-heptane	traces	5,6	5,6	traces	1,4	1,4

Note: * these indicators of traditional gasoline were obtained at the Ferghana Oil Refinery.

**)A sample of the solvent was obtained and analyzed in the central factory laboratory at the Ferghana Oil Refinery.

As can be seen from Table 1, the main part of hydrocarbons in the new solvent are low-boiling fractions, which can be completely removed at low temperatures. In the new solvent, the content of heavier fractions of hydrocarbons is much lower than in the known extraction gasoline.

The main physico-chemical parameters of the gasoline and the new solvent used in the extraction are listed in Table 2.

Table 2

Physico-chemical composition of known and recommended hydrocarbon solvents

Indicator name	Sing. un.	Value	
		known	new
Density at 200C	g/sm3	0,715	0,675
Fractional structure: -distillation start temperature -distillation temperature of 98% of the sample - remainder in the flask	 ^{0}C ^{0}C %	 70 95 0,1	 61 75 0,75
Mass fraction of aromatic hydrocarbons	%	4,0	2,0
Content of water-soluble acids and alkalis	%	off.	off.
Content of mechanical impurities and water	%	off.	off.

As can be seen from Table 2, the new oil extraction solvent in terms of its physico-chemical properties is significantly superior to the conventional gasoline extracted from oil according to TU 38.101703-90 (nefras S3-70 / 95).

The change in the composition of the solvent leads to a change in the speed of the process of hydrogenation of cotton missell.

The study of the kinetics of the process of hydrogenation of cotton missell, produced using conventional extraction gasoline and a new hydrocarbon solution is to determine the rate of the reaction of hydrogen triacylglycerols to the saturation of fatty acids. The experiments on nickel-copper-molybdenum-rhodium-aluminum in column reactor by “reactive” method (22.0: 20.0: 7.5: 0.5: 50) held with the participation of the catalyst.

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The process temperature was maintained at 80 ° C, the e vacuum speed of micella is 2,0 h^{-1}, the pressure of hydrogen is 300 kPa, and the vacuum speed of hydrogen is 30 h^{-1}. The results of the experiment are presented in Figure 1.

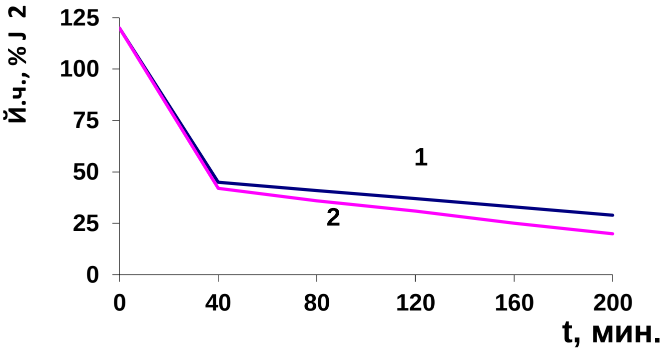

Fig.1. Dependence of the iodine number of the hydrogenated product on the hydrogenation time of cotton miscella in extraction gasoline (curve 1) and a new hydrocarbon solvent (curve 2)

As can be seen from this picture, the saturation reaction of cotton missell in both conventional and new solvents is characterized by a zero order equation for unsaturated compounds. It follows that the surface of the contacts under study is mainly occupied by unsaturated compounds. The change in the nature of the solvent does not affect the "visible" order of the reaction, although the consistency of the reaction rate varies significantly.

An analysis of the dependence of ‘salomas fat content - hydrogenation time’ shows that these are represented by straight lines and that the fracture sites are the main saturation of linoleic acid in the early stages of the process.

It is known that the process of hydrogenation of cotton missello depends on the temperature factor. Figure 2 shows the results of the effect of this parameter on the iodine content of hydrogenate and the selectivity index of the process under consideration.

The figure 2 shows that the hydrogenation of cotton micelles in conventional and proposed solvents in the range of temperature from 40 to 100^{0} C occurs in the outer kinetic region, the limiting stage of the process This phenomenon can be explained as follows: with an increase in the heat of the process, the solubility of hydrogen in the micelle and the rate of diffusion in its gas-liquid interface increase, the viscosity of the micelle decreases, which is convenient for hydrogen diffusion.

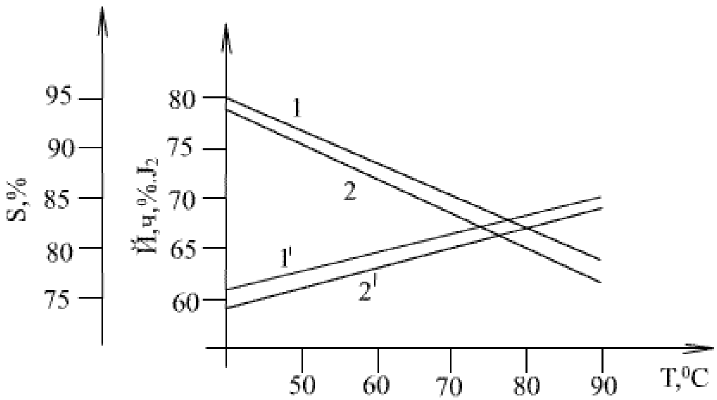

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Fig.2. Dependence of the iodine number of salomas (1, 2) and selectivity (11, 21) of the process of hydrogenation of cotton miscella in traditional (1, 11) and proposed (2, 21) solvents on temperature

The positive effect of temperature on the selectivity of the cotton missello hydrogenation process can be explained on the basis of Balandin's multiplet theory, which states that the adsorption capacity of linoleic acid radicals is much higher than that of oleic acid and shifts the equilibrium with increasing temperature as the contact surface decreases. These reactions proceed mainly with an increase in the proportion of bound hydrogen that saturates the linoleic radicals of fatty acids.

The use of high-pressure cotton misselle hydrogenation prevents the hydrogen starvation of the active centers of the catalyst used and helps to increase the concentration of hydrogen on its surface.

The results of the study of the effect of hydrogen pressure on the kinetic regularities of the saturation process with cotton micelles in conventional and new solvents are presented in Figure 3.

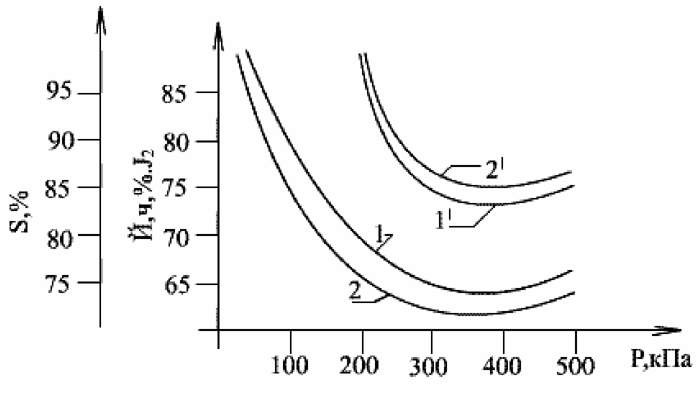

Fig.3. Dependence of iodine number ofsalomas (1, 2) and selectivity (11, 21) on hydrogen pressure during hydrogenation of cotton micelles in conventional (1, 11) and new (2, 21) solvents.

As can be seen from Figure 3, as the hydrogen pressure rises to 300 kPa, the degree of hydrogenation of the cotton micelle in both solvents grows sharply, the increase in which has almost no effect on the change in iodine number, and the pressure is more than 400 kPa, a slight decrease in the rate of hydrogenation is observed.

Similar results are observed with increased hydrogen pressure and saturation of fatty acids contained in cotton micelles in both conventional and new solvents (Figure 3). This can be explained by the fact that any increase in hydrogen concentration shifts the balance to the opposite direction, resulting in the decrease selectivity of the hydrogenation.

Thus, the effect of various technological factors: time, temperature and pressure of hydrogen on iodine saliva and the selectivity of the hydrogenation process of cotton micelles in traditional extraction gasoline and the recommended low-boiling hydrocarbon solvent that with a change in the character of the solvent, basically, the same regulatories,that are observed when using a traditional solvent, are preserved.

Change occurs in quantitative terms that is when using a new solvent, the process of miscella hydrogenation of cotton is enhanced. Besides that, the use of this solvent increases the selectivity of the fatty acid saturation process in triacylglycerols.

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