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Synthesis and Research of Kinetic Laws of Esterification Process of ESTER

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ABSTRACT*:* The synthesis was carried out and the kinetic laws of etherification of the ester based on oleic acid and isoamyl alcohol were studied at various initial ratios of the components. The main characteristics of the ester are established. It was revealed that the synthesized ester is an individual new substance and belongs to the class of esters.

KEY WORDS*:* ester, synthesis, kinetics, etherification, oleic acid, isoamyl alcohol, fatliquoring materials.

I.INTRODUCTION

In order to expand the range of preparations for light industry, a new technique for the synthesis of fatliquoring materials, which can be used in the technology of producing natural leather and fur, is proposed.

This study proposes a method for the synthesis of a new ester, which is part of the fatliquoring compositions for plasticizing leather. The production of ester based on the etherification reaction, based on by-products of oil and fat and hydrolysis industries.

In the present experiment, oleic acid was used as a model compound of distilled fatty acids, and isoamyl alcohol was used as a model compound of fusel oil.

The selection of chemicals in accordance with their chemical nature, as well as with their surface-active properties, is the basis for regulating the degree of absorption of fatliquoring preparations in the process of fatliquoring of the leather, the strength of binding to the dermis of the skin, and the uniformity of their distribution across the layers. A synthesis is proposed by the method of the etherification of oleic acid with isoamyl alcohol to increase the penetrating ability of fatliquoring compounds [1].

In the production of cottonseed oil and fatty acids, many secondary products and wastes are formed depending on the technological scheme and methods for the isolation of the main products. One of them is distilled fatty acids.

Distilled fatty acids are the waste products of alkaline refining of vegetable oils, the so-called soap stocks, which are concentrated aqueous solutions of soaps and organic impurities.

Esters containing unsaturated acid or alcohol are capable of addition reactions. Since, the etherification was carried out with free fatty acids.

Oleic acid is generally considered the predominant fatty acid in nature. It accounts for 50% or more of the total acids of many fats. Fats are known to contain less than 10% of this acid [2-3].

The etherification reaction of the resulting ester was synthesized by reacting isoamyl alcohol with oleic acid with an excess of alcohol in the presence of a catalyst. Concentrated sulfuric acid was used as a catalyst.

The reaction in general can be represented as follows:

$$\underset{\text{oleic acid}}{CH_3(CH_2)_7-CH=CH(CH_2)_7COOH} + \underset{\text{isoamyl alcohol}}{C_5H_{11}OH} \xleftrightarrow{H_2SO_4}$$

$$\underset{\text{isoamyl oleate}}{CH_3(CH_2)_7-CH=CH(CH_2)_7COOC_5H_{11}} + \underset{\text{water}}{H_2O}$$

In this regard, the synthesis of ether was carried out at a temperature of 140 ° C, the duration was 0.5 hours, the catalyst was 0.5% (by weight of the mixture) and in various initial ratios of acid and alcohol.

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The results are shown in table 1.

Table 1
The effect of the initial ratio of acids and alcohols on the conversion of ether

№	The initial ratio		Conversion, %
	oleic acid	isoamyl alcohol	
1	5	1	31,6
2	4	1	35,1
3	3	1	38,4
4	2	1	42,8
5	1	1	44,5
6	1	2	45,9
7	1	3	46,3
8	1	4	44,7
9	1	5	38,2

From the obtained results it is seen that the greatest yield of the ester formed is observed at the initial ratio of oleic acid and isoamyl alcohol 1:3 at a constant temperature of 140 °C, with a reaction time of 30 minutes and 0.5% of the catalyst by weight of the mixture.

Other things being equal, an increase and vice versa a decrease in the initial ratio of isoamyl alcohol yields a lower product. Apparently, this is due to the equilibrium of the reaction of the starting compounds of the corresponding molar masses.

And also, to obtain an ester, the next major contributing factor is the amount of catalyst. At this stage of the study, based on the literature [4-6], the effect of the amount of the catalyst — sulfuric acid in the range of 0.5-1.5% by weight of the reacted components, at a temperature of 140 ° C, and the duration of 0.5 hours was studied.

In the course of the research, it was determined that the use of sulfuric acid as a catalyst, as expected, affects the increase in the yield of ester, which is maintained by constantly removing one of the formed substances from the reaction sphere from the reaction. In addition, sulfuric acid binds free water, helping to shift the equilibrium reaction to the right.

The results of the effect of the amount of catalyst on the reaction rate of obtaining the ester are given in table. 2.

Table 2
The effect of the amount of catalyst on the process of obtaining an ester based on oleic acid and isoamyl alcohol

№	The initial ratio, in a mole		The catalyst, in % (by weight of the mixture)	Conversion, %
	oleic acid	isoamyl alcohol		
1	1	3	0,1	39,7
2	1	3	0,2	46,3
3	1	3	0,4	52,6
4	1	3	0,5	73,2
5	1	3	0,75	69,3
6	1	3	1,0	67,2
7	1	3	1,5	63,5

The products of this reaction containing several functional groups in the molecule (ether, amine and hydroxyl) have a fairly wide range of properties and, therefore, ample opportunities for their practical application.

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The resulting fatliquoring preparations can bind to the functional groups of skin collagen by forming ionic bonds or enter the intramuscular sphere of chromium complexes associated with collagen.

In order to compare the starting substances, during the study the basic physicochemical properties of the studied substances were determined.

In the table 3 shows the main characteristics of oleic acid, isoamyl alcohol and the product of the etherification reaction.

Table 3

The main characteristics of oleic acid, isoamyl alcohol and the etherification product

№	Indicators	oleic acid	isoamyl alcohol	oleic acid and isoamyl alcohol ester
1	Appearance, consistency	Liquid	Liquid	Liquid
2	Molecular mass	282,47	88,15	358
3	Density, at 20 ^{o}C , g / cm^{3}	0,87	0,81	0,865
4	Temperature, ^{o}C boiling point	228,15	131,4	215
5	Unsaponifiable matter, %	2,5	-	2,0
6	Iodine number,	85-105	-	34,7
7	Acid number	185-105	-	7,76
8	Saponification number	185-105	-	171-182
9	Essential number	-	-	285

To determine the kinetics of the etherification process during the reaction, samples of the reaction mixture were taken and their acid number was determined every 20 min.

The resulting ester is a uniform, liquid-like form, with a slightly specific odor, dark brown in color, volatile, insoluble in water and liquid, but easily soluble in most organic solvents. Most of these compounds are in a saturated state of 66.25 %, as well as an unsaturated state of 33.75 %.

From the results presented in table 3 it is easy to notice and argue that the synthesized ester obtained by the etherification reaction based on oleic acid and isoamyl alcohol differs significantly in physical and chemical properties from the starting components. Accordingly, this serves as an assumption and reason that the product synthesized by the etherification reaction based on oleic acid and isoamyl alcohol is an individual new one and belongs to the class of esters.

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