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Modernization of Continuous Technology Emulsion Cotton seed Oil Refining

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ABSTRACT: Conducted studies allow to draw the following conclusions: technology developed on hydration and alkaline neutralization of cottonseed oil using $C_3N_{12}NO_9P_3$ is more effective than the known technology; by quality indicators and the output of refined cottonseed oil exceeds the oil obtained according to the known technology; introduction of $C_3N_{12}NO_9P_3$ in neutralizing composition of the cottonseed oil significantly reduces the neutral fat content in the soap stock, which saves expenditures of alkalis, acids and other by further processing of the latter.

KEYWORDS: cottonseed oil, refining, acid number, hydration, peroxide value, chromaticity of oil, soap stock.

I. INTRODUCTION

At the present stage of fat-and-oil industry development of Uzbekistan provides periodic transfer of technological schemes to continuous ones while high automation processes, significant reduction of oil losses, auxiliary materials, and others are achieved.

As known techniques of continuous refining vegetable oils, in particular cottonseed is not quite perfect because permit overruns of alkali, significant saponification of triacylglycerids, which greatly understates the output of refined oil. Especially it is obvious when using a highly active alkaline reagent so as caustic soda (NaOH) with a high concentration and excess of [1]. High color of produced refined cottonseed oil requires considerable expense of bleaching clay and activated carbon in its further purification [2].

Analysis of the number of enterprises where is used the continuous technology of emulsion refining cottonseed oil shows that they allowed a high percentage of waste refining rate is 5.6-7.2 with an average acidity initial oil of 2.5 mg KOH / g. Generation of refined oil prime at periodic lines is 8.6%, and continuous is 2.5%, which confirms the low need to use latter [3].

II. OBJECTS AND METHODS

As object of investigation refined cottonseed oil with an acid number of 0.55 mg KOH / g and by chromaticity of 15.2 red and 2.1 blue units with 35 yellow had been used. Oil coloration was determined in according to Lovibond colorimeter [4], and the acid number by titration [5].

III.RESULTS AND DISCUSSION

Therefore, the uprated of continuous technology of emulsion refining cottonseed oil, taking into account the peculiarities of its composition and properties is an important task. The solution of the present problem is based on the analysis of well-known studies in this area, the mechanism of interaction between the components of cottonseed oil with an alkaline reagent, the effect of technological factors on the quantitative and qualitative indicators of obtained refined oil, and others.

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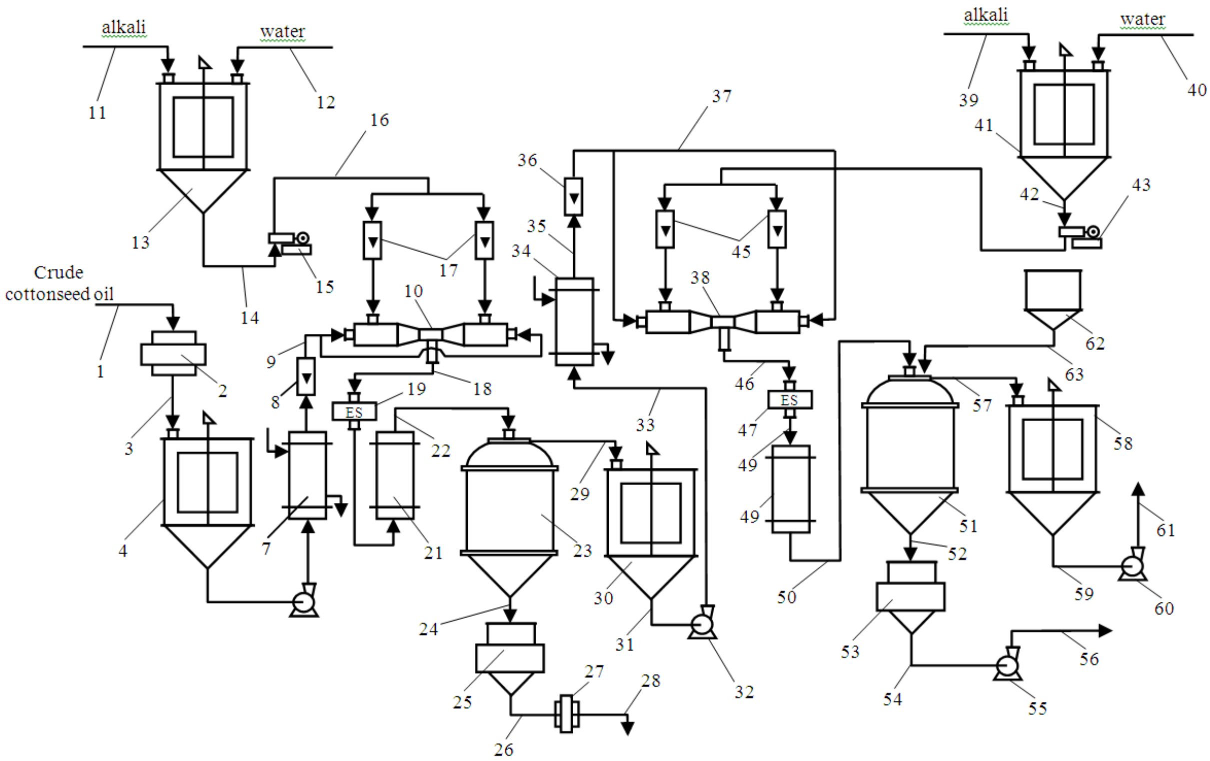

Fig.1. Uprated flowsheet of continuous hydration and emulsion alkaline refining cottonseed oil

At present, in practice, cottonseed oil is not hydrated before its alkaline neutralization. As toxic gossypol contained in the obtained phosphatide sludge. We have explored the possibility of using technical phosphatides in paint and varnish, oil-refining and textile industries to include this unit in uprated flowsheet for continuous emulsion refining cottonseed oil. Figure 1 shows an uprated flowsheet of continuous hydration and alkaline neutralizing emulsion (refining), cottonseed oil, which functions as follows: raw cotton oil via line 1 is fed into the automatic scales 2, where through line 3 flows into the collector 4. From the collector 4 by pumps 5 along the line 6 is fed to heat exchanger 7 where through the flow meter 8 via line 9 enters into the jet reactor with opposite streams 10, where the mixing process intensification provided by colliding head-on collision of oil flow under pressure of 4.0 kgf / cm^2. In the reactor 10 and from the collector line 13 via 14 by pump 15 and line 16 with flow meter 17 aqueous solution of organic acids (citric, apple, or their mixture).

Organic acid via line 11 is fed in the collector 13, while demineralized water fed into line 12. From the reactor 10 the mixture of oil with an aqueous solution of an organic acid through line 18 is fed to the electromagnetic processing of 19, whence on line 20 the treated mixture enters through coagulator 21. From line 21 via 22 the mixture enters the decanter continuous - a separator 23, whence by line 24 the phosphatide sludge enters the collector 25 and further, through line 26 by pump 27 and line 28 is directed to the dehydration and drying. Hydrated oil from decanter 23 via line 29 enters the collector 30 where generated the formation and strengthening of flocks of soap stock; through line 31 by pump 32 and line 33 is flowed to the heat exchanger 34, the oil via line 35 enters the flow meter 36 from the line 37 is fed to inkjet reactor 38 of collector 41 through line 42 via pump 43, line 44 and rotameter 45 enters alkaline solution to neutralize the hydrated cottonseed oil. From the reactor 38 the mixture through line 46 is directed to the electromagnetic processing 47, where the processed mixture through line 48 is fed into coagulator 49. From the last via line 50 the mixture is fed into a settling delimiter tank continuous 51 from the line 52 soap stock enters the collector 53. Of collector 53 via line 54 by pump 55 through line 56, soap stock is directed to further processing. From the settler 51 the separator neutralized cottonseed oil is directed through line 57 into collector 58 where the line 59 via pump 60 and lines 61 neutralized cottonseed oil fed for further processing. From the collector 62 demineralized water through line 63 is sent to the separator 51 for agglomeration flakes of soap stock.

Coagulator with thermo-differentiated heating provides a clear separation soap stock of the neutralized oil. We have been developed efficient operating practices of functioning of the modernized flow sheet of continuous hydration and

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alkaline neutralization of cottonseed oil based on laboratorial experimental and industrial tests. The data are summarized in Table 1.

Table 1.Operating practices of known and proposed flow sheet of continuous hydration and alkaline neutralization of cottonseed oil

Denomination of node and process quality	Value parameter	
	For known flow sheet (control)	For proposed flow sheet
I. Hydration of cottonseed oil:		
Water value, %	2 – 4	2 – 3
-temperature, ^{0}C	50 – 60	40 – 50
-inductance elecromagnetic situation (ES), tesla	-	0.4 – 0.5
- citric acid concentration, %	-	10 – 15
II. Alkaline neutralization		
-oil temperature, ^{0}C	22 – 24	22 – 24
-alkaline solution concentration, g/l	150 – 250	100 – 150
-inductance electromagnetic situation, tesla	-	0.8 – 1.0
- exposition (coagulation) temperature, ^{0}C	55 – 60	60 – 75
-demineralization water, %	0.5 – 1.0	0.2 – 0.5

A distinctive feature of the uprated technological scheme of hydration and alkaline neutralization of cottonseed oil from the well-known one [4] is as follows:

- node of continuous hydration of crude cottonseed oil using jet-stream reactor (mixer) with counter-current flow and electromagnetic apparatus for the destruction of associates (micelles) associated triglycerides substances and increasing hydratable phospholipids;
- node of continuous neutralization hydrated cottonseed oil using a jet-stream reactor (mixer) with counter-currents flow and electromagnetic apparatus for intensification of the process.

According to the proposed technology, unlike known provides continuous hydration cottonseed oil by solution of organic acids (citric, apple or their mixtures) at a concentration of 10-15% of the total weight of water and alkaline hydrated neutralizing cottonseed oil composition consisting of caustic soda (or sodium silicate) and $C_3N_{12}NO_9P_3$ reagent.

Comparative studies of known and the proposed technology on hydration and alkaline refining cottonseed oil allow revealing a number of advantages of the latter, which are presented in Table 2 and 3.

Table 2.Indicators starting and hydrated cottonseed oil based on known and developed approaches

Denomination of indices	Crude cottonseed oil	Hydrated oil	
		For known technology (control)	For developed technology
Acidic number, mg KOH/g	4.55	4.31	4,12
Chroma at 35 yellow.:			
-red unit	65.4	55.2	53,1
-blue unit	4.3	4.0	3,7
Mass fraction, %			
-phospholipid	0.35	0.09	0,02
-unsaponifiables of lipide	0.81	0.72	0,55
peroxidate number, ½ mole 0/kg	2.75	2.64	2,15
Output, %	-	95.4	97,2

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As it is seen from Table 2 that developed technology has more output of phosphatides by 2.2% and a relatively low content of undesirable substances in comparison with known one.

Table 3.Indicators hydrated and neutralized cottonseed oil on known and developed ways

Denomination of indices	Crude cottonseed oil	Hydrated oil	
		For known technology (control)	For developed technology
Acidic number, mg KOH/g	4.12	0.31	0.25
Chroma at 35 yellow.:			
-red unit	53.1	20.5	16.4
-blue unit	3.7	0.6	0.2
Mass fraction, %			
-phospholipid	0.02	0.01	0.01
-unsaponifiables of lipide	0.55	0.44	0.31
peroxidate number, ½ mole 0/kg	2.15	0.17	0.11
Output, %	97.2	89.7	91.3

From Table 3 it is clear that developed technology of neutralizing cottonseed oil in comparison with the known can improve the quality of the resulting oil and its output that increases technical and economic indices of the production. Inclusion of complex cottonseed oil refining process its hydration can reduce emulsifying phospholipids content (0.02% by weight of the oil), which is profitable in increasing the yield of neutralized oil. Using $C_3N_{12}NO_9P_3$ in the composition of neutralizing agent had a positive effect on the quality indicators of oil produced and the output after neutralization process.
The use of a novel kind of neutralized reagent compositions certainly reflected in the performance of soap stock, cotton oil refining waste.
We studied the main indicators of cotton soap stock obtained from the known and the proposed technology with the use of a neutralizing composition $C_3 H_{12}NO_9P_3$. Cotton soap stock analysis results shown in Table 4.

Table 4.The main quality parameters of cotton soap stock obtained on the known and developed technology

Denomination of indices	Soap stock obtained on	
	known technology (control)	developed technology
Mass fraction of total fat, %	55.15	47.95
Including: -neutral fat (NF) -fat acids (FA)	 27.45 27.70	 24.13 24.82
Ratio NF:FA	1.0	1.0

Table 4 shows the total fat content in the soap stock obtained according to the proposed technology is much less than when using known technology. Analogous results are observed for the neutral fat content in the soap stock, which reduces alkali consumption for their before saponification and sulfuric acid for decomposition.

IV.CONCLUSION

As conducted investigations suggest the following conclusions: - developed technology of hydration and alkaline neutralization of cottonseed oil using $C_3 H_{12}NO_9P_3$ismore effective than the known technology; -by quality indicators and the output of refined cottonseed oil exceeds the oil obtained according to the known technology; introduction $C_3 H_{12}NO_9P_3$in theneutralizing composition of the cottonseed oil significantly reduces the neutral fat content in the soap stock, which saves costs alkalis, acids and other by further processing of the latter.

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