The Austrian Journal of Technical and Natural Sciences, No 11–12
ISSN 2310-5607

PREMIER Publishing
ppublishing.org

Section 2. Food processing industry

DOI:10.29013/AJT-23-11.12-23-28

TECHNOLOGY OF PRELIMINARY CLARIFICATION OF OILS FROM LOW-QUALITY COTTON SEEDS

Akhmedov Azimjon Normuminovich [1], ***Ishankulova Gavxar Norkulovna*** [2]

[1] Department of Food Technology of Products of the Karshi Engineering and Economic Institute, Karshi, Uzbekistan

[2] Department of Agricultural Product Storage and Preprocessing Technology of the Karshi Engineering and Economic Institute, Karshi, Uzbekistan

Cite: *Akhmedov A.N., Ishankulova G.N. (2023). Technology of Preliminary Clarification of Oils From Low-Quality Cotton Seeds. Austrian Journal of Technical and Natural Sciences 2023, No 11-12.* https://doi.org/10.29013/AJT-23-11.12-23-28

Abstract

This scientific article presents the results of pilot-production studies carried out at "Koson oil-extraction" JSC, in which the color of crude oil, its acid number, as a result of preliminary clarification of oils obtained from low-grade and non-standard cotton seeds using urea-modified soil adsorbents (UMSA) led to a decrease. At the same time, using crude oil UMSA-4, oil indicators, including color and soil consumption, decreased by approximately 2.0–2.2 times, and the acid number of oil decreased by 1.8–2 mg KOH. The technology of preliminary refining of crude oils obtained from these low-grade cotton seeds makes it possible to obtain oils that meet standard requirements.

Keywords: *food technology, cotton seeds, clarification of oils, urea-modified soil adsorbents, coloring of raw oils, acid numberoils oils*

Introduction

The difficulties of refining oils obtained from low-grade and non-standard cotton seeds require the development of more effective methods for their clarification. It is known that in cottonseed oil the color is determined by gossypol, chlorophyll and their derivatives, which react difficultly with alkali due to the presence of soap, phospholipids, etc. (Nadirov, N. K., 1973).

Various options have been proposed for reducing the color of "black" oils obtained from low-grade and non-standard cotton seeds (Mazhidov, K. Kh., Abdullaev, N. Sh., Salaev, S. 1986; Tarasov, V. E., 1985; Abullaev, N. Sh., 1989), which have not found their practical application. The reason is that they significantly reduce the oil yield, form new compounds that are difficult to remove, etc.

We consider the preliminary clarification of "black" cottonseed oils obtained from low-grade and non-standard seeds using activated adsorbents to be more economical and accessible for our enterprises.

The transfer of a certain amount of spent clay adsorbent into the cake composition is permissible because this is provided for by feed requirements (Katsitadze, B.V., Merabushvili, M.S., Aizikovich, L.E., Katsitadze, O.V., Bagishvili, M.G., 1979).

Cottonseed oils obtained from seeds III–IV and non-standard varieties of seeds, as well as as a result of deviations in technological conditions at the stage of extraction, extraction and especially distillation of miscella, belong to a number of oils called "hard to refine". These oils are characterized by a significant content of free fatty acids, phospholipids, unsaponifiable lipids and coloring substances: chlorophylls, gossypol and its modified and derivative forms, or a predominant content of coloring substances with moderate acidity of the oils.

In recent years, the number of low-grade seeds supplied to cotton processing enterprises amounted to 25–30% (Akhmedov, A.N., 2019). Therefore, the proportion of hard-to-refined oils, taking into account the quality of seeds and violations of technological conditions, increased to 40–50% of the total volume of processed unrefined cottonseed oils (Akhmedov, A.N., Abdurakhimov, S.A., 2018).

The presence of associated substances limits the use of cottonseed oils for various purposes, especially for food purposes. Therefore, they began to take measures to refine and refine them using the most accessible methods, including alkaline treatment of oils and miscellas (Abdurakhimov, S.A., Ergasheva, D.K., Nazirov, A.N., 1990; Guidance on research methods, 1967).

The intense dark color of cottonseed oil is given by the oxidation products of native gossypol, as well as melanoidin compounds, which are formed during self-heating and heat treatment of seeds. In addition, during the moisture-heat treatment of cotton mint at high temperatures, complex compounds of gossypol and chlorophyll derivatives are formed, which also change the color of the resulting crude oils.

The difficulty of refining cottonseed oils with high color lies in the use of alkaline solutions with high concentrations (more than 250 g/l) in large excess (more than 200%), which entails significant losses of valuable oil, alkali, etc. (Akhmedov, A.N., Abdurakhimov, S.A., 2018).

One of the ways to solve this problem is considered to be preliminary clarification of raw oils obtained from low-grade and non-standard cotton seeds using an effective adsorbent. An analysis of literary sources on the refining of cotton oils showed that it is necessary to improve the existing technology for refining oils obtained from low-grade and non-standard cotton seeds, since there are a number of disadvantages: large losses of raw materials, significant consumption of alkali, etc., low yield of the final product, which negatively affects the technical and economic indicators of oil and fat enterprises (Kopeikovsky, V.M., Danilguk, S.I., Garbuzova, G.I. and others. 1982).

Materials and methods

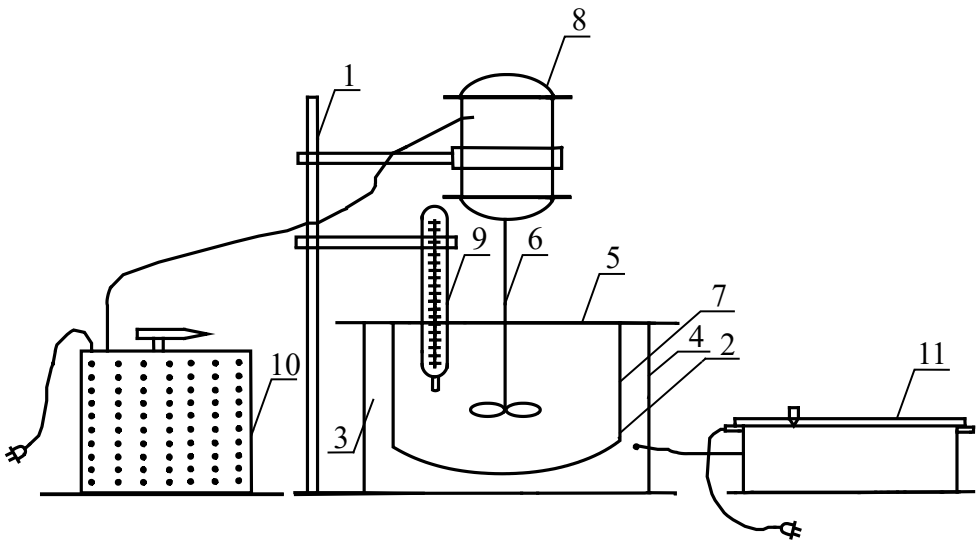
The article uses modern methods of chemical, physico-chemical and other analyzes with the processing of the results by statistical methods (Guidelines for research methods, 1964).

We have studied the content of chlorophyll and its derivatives in oils obtained from ordinary (grades I and II) and low-grade (grades III and IV) cotton seeds. Sampling was carried out during the normal operation of the JSC "Karshi yog-extraction" and JSC "Koson oil-extraction". The analyzes of these samples and the resulting oil were carried out according to the "Guidelines for research methods ..." (Guidelines for research methods, 1964; RST Uz 624–94. 1994).

Urea-modified clay adsorbent (UMCA) was obtained by impregnating the clay adsorbent with a 30% urea solution and drying it at a temperature of 95–100 °C to a residual moisture content of 7–8%. The finished UMCA is stored in a closed desiccator.

Experiments on preliminary clarification of raw dark cottonseed oil using UMCA and refining with a low-concentrated alkaline solution are carried out in a laboratory installation, the diagram of which is presented in Fig.1.

Figure 1. *Laboratory installation for preliminary clarification of raw dark cottonseed oils and their alkaline refining: 1 – stand; 2 – reactor; 3 – electric stove with oil bath; 4 – bath building; 5 – cover; 6 – stirrer; 7 – container with oil; 8 – engine; 9 – thermometer; 10 – LATR; 11 – rheostat*



The acid number of oils was determined by potentiometric and indicator methods using a 1% alcohol solution of thymolphthalein as an indicator (Heftman, E. 1986):

– the color of cottonseed oil was determined using a Lovibond color meter (Akhmedov, A.N., 2012);

– quantitative determination of gossypol was carried out using high-performance liquid chromatography (Akhmedov, A.N., 2012);

Results

Modified adsorbents were used for pre-clarification of crude cottonseed oils obtained from low-grade and non-standard cotton seeds. The choice of the location of the UMCA input in the technological scheme determines the effectiveness of the proposed method for the preliminary clarification of raw oils obtained from low-grade and non-standard cotton seeds.

In agreement with the specialists of OA "Koson oil-extraction", a technological scheme was created for the preliminary clarification of raw cottonseed oil with a clay adsorbent modified with urea. A distinctive feature of this scheme from the known ones is that at the beginning of the line for collecting and supplying raw oils to a collection tank – a fusa-tank (thickness trap), a dosing hopper is installed, from which the UMCA is supplied to the raw oil (depending on the color of the original oil).

Figure 2 shows the proposed technological scheme for clarification of crude oils obtained from low-grade and non-standard cotton seeds using UMCA. This scheme functions as follows: through auger 1, moistened cotton mint enters the fryer 2, which is equipped with a motor and a stirrer 3. From the fryer, the pulp enters the press granulators 4, from where the pulp is sent through the auger 5 to the extraction shop. For preliminary clarification of raw oils obtained from low-grade and non-standard cotton seeds, a urea-modified clay adsorbent from Angre kaolin (UMCA –4) is fed from the collector 10 along line 11 into the raw oil collection screw 6 by a dispenser in an amount of 2–6% by weight of the oil. Next, the raw press oil is fed through line 6 into the fuso tank (thickening trap) 7, where it is cleaned of mechanical impurities and sludge. From the fuso tank 7, the return product (fuse) is sent via elevator 8 and line 9 to fryer 2, and the oil is supplied to the frame filter press 13 using pump 12 for polishing filtration. From filter press 13, the oil is sent to alkaline refining.

In table 1 shows the technological regimes for the preliminary clarification of crude oils obtained from low-grade and non-standard cotton seeds using UMCA.

Figure 2. *Technological scheme for preliminary clarification of raw cottonseed oil with a urea-modified clay adsorbent: 1 – screw; 2 – broiler; 3 – stirrer; 4 – press granulators; 5,6,9 and 14 – screw; 7 – fuso tank; 8 – noria; 10 – collection; 11 – valve; 12 – pump; 13 – filter press*

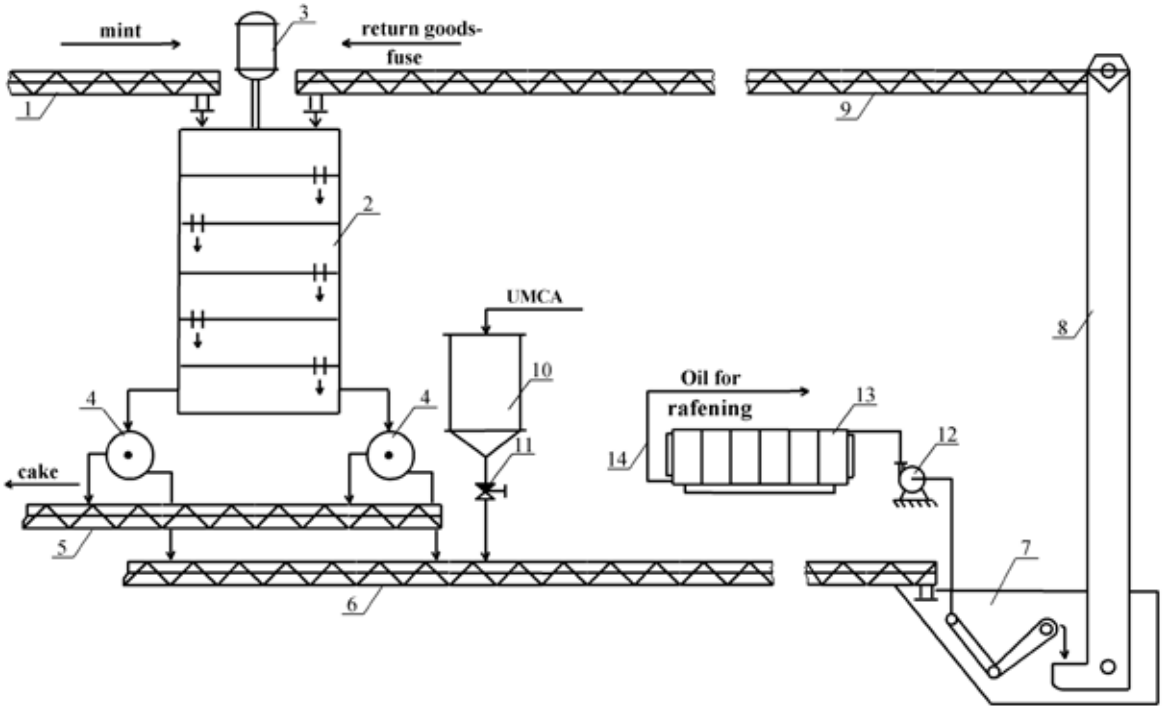


Table 1. *Standards for the technological regime of the process of preliminary clarification of crude oils using UMCA*

Name of processes and operations	Units	Values
I. Moisture and heat treatment of cotton mint:		
– huskiness of mint	%	15–17
– moisture content of mint	%	7–9
– quantity of return goods (fuza)	%	5–7
II. Pressing and granulating:		
– pulp temperature	°C	95–100
– pulp moisture	%	7.5–9.5
– dimensions of grates:		
– first	mm	1.0
– second	mm	0.75
– third	mm	0.45
– fourth	mm	0.35
– matrix size for granulation	mm	10–12
III. Pre-clarification of crude oils:		
– oil temperature	°C	80–90
– number of UMCA	%	2–6
– time	Hour	0.4–0.6
IV. Fusion separation:		
– oil temperature	°C	55–70
– speed of revolutions of the fuso tank	rev/min	50–60
V. Oil filtration:		
– oil temperature	°C	70–75
– press pressure	MPA	0.03–0.05

Table 2 presents the results of preliminary clarification of crude oils obtained from low-grade and non-standard cotton seeds using thermally activated modified adsorbents, for example UMCA-4.

From table 2 it can be seen that the preliminary clarification of crude oils obtained from low-grade and non-standard cotton seeds using 5% by weight of UMCA-4 oil made it possible to significantly reduce the color of the oils, their acid numbers and the sludge content in them. This is explained by the fact that the clay adsorbent modified with urea sorbs substances that color cottonseed oil and removes them when separating and filtering the oil.

It is known that urea is currently used in animal husbandry to enrich feed with non-protein nitrogen. Bentonites and kaolins are also used in the production of mixed feed for various purposes. Therefore, the choice of urea and natural clays when obtaining a modified adsorbent for preliminary clarification of raw oils obtained from low-grade and non-standard cotton seeds becomes justified.

Table 2. *Indicators of cottonseed oils purified in the usual way and pre-clarified using UMCA-4 in an amount of 5% of the total mass of raw materials*

Name of indicators of cottonseed oil	Oil obtained from: low quality seeds	Oil obtained from: mixtures of low-grade and non-standard seeds
Crude oil, conventionally refined (control):		
Color, in 1 cm layer at 70 yellow units:	65.5	74.3
– only one red	3.7	6.5
– blue ones	5.3	6.1
Acid number, mg KOH/g	0.94	1.85
Sludge content,%		
Oil pre-clarified using UMCA:		
Color, in 1 cm layer at 70 yellow units:	36.7	42.4
– only one red	1.5	2.8
– blue ones	3.2	4.0
Acid number, mg KOH/g	0.73	0.98
Sludge content,%		

Discussion and Conclusion

Thus, pilot production studies conducted at Koson Yog-Extraction OJSC showed that the proposed technology for pre-clarification of raw oils obtained from low-grade and non-standard cotton seeds using UMCA gives positive results in reducing the color of raw oils, its acid number, content of unsaponifiable substances, moisture and volatile substances, etc. The use of UMCA-4 in the process of preliminary clarification of raw oils made it possible to reduce their color and sludge content by approximately 2.0–2.2 times. At the same time, their acid numbers also decrease (by 1.8–2 mg KOH). The developed technology for pre-clarification of raw oils obtained from low-grade cotton seeds makes it possible to obtain oils that meet the requirements of the standard. Therefore, this technology can be recommended for use when processing low-grade and non-standard cotton seeds at the plant.

References

Nadirov, N. K. Theoretical basis of activation and mechanism of action of natural sorbents in the process of clarification of vegetable oils.– M.: Food industry. 1973.– 352 p.
Mazhidov, K. Kh., Abdullaev, N. Sh., Salaev, S. Experience in complex processing of highly acidic oilseeds of cotton.– M.: INIITEI food industry, 1986.– Issue 1.– 16 p.
Tarasov, V. E. Improving the preparation of oilseed materials for oil extraction using surfactants. Abstract of Candidate of Technical Sciences. Krasnodar, KPI, 1985.– 26 p.
Abullaev, N. Sh. Development of a combined process of oil extraction and oil refining as applied to the processing of low-grade cotton seeds. Abstract of Candidate of Technical Sciences,– L.: All-Union Scientific Research Institute of Fats, 1989.– 19 p.
Katsitadze, B. V., Merabushvili, M. S., Aizikovich, L. E., Katsitadze, O. V., Bagishvili, M. G. Series: "Economics and organization of production in grain storage and processing enterprises." – M.: INIITEI Minzal, 1979.– 36 p.
Akhmedov, A. N. Investigation of indicators of cottonseed oil obtained by pre-pressing from low-grade cotton seeds // Universum: Technical Science.– Issue: 4(61). April, 2019.– Moscow 2019.– P. 23–26.
Akhmedov, A. N., Abdurakhimov, S. A. The study of the grinding process of rushanka from the nuclei of cotton seeds of different varieties. Journal chemistry and chemical engineering. 2018.– № 3.– P. 11–16.
Abdurakhimov, S. A., Ergasheva, D. K., Nazirov, A. N. Spectral evaluation of the qualitative composition of refined oils. Izvestiya vuzov. Food technology, 1990.– No. 6.– P. 77–78.
Guidance on research methods, techno chemical control and accounting of production in the oil and fat industry. // Under the general editorship of prof. Rzhekhin, V. P. and others – L.: All-Union Scientific Research Institute of Fats –1967.– I-585 p.
Kopeikovsky, V. M., Danilguk, S. I., Garbuzova, G. I. and others. Technology of production of vegetable oils.– M.: Light and food industry, 1982.– 416 p.
Guidelines for research methods, technical and chemical control and production accounting in the oil and fat industry / Ed. V. P. Rzhekhin, A. G. Sergeev-L.: VNIIZH, 1964.– T. 3.– 493 p.
RST Uz 624–94. Cottonseed oil. Color measurement method. – Tashkent. Gosstandart, 1994.– 7 p.
Heftman, E. Chromatography. Practical application of the method. In 2 parts. World.– M.: 1986.– 336 p.
Akhmedov, A. N. Improving the technology of complex refining of oils obtained from low-grade cotton seeds: Abstract of thesis. diss. ...cand. tech. Sci.– Tashkent, 2012.– 25 p.

submitted 28.11.2023;
accepted for publication 11.12.2023;
published 24.01.2024

Contact: a.ahmedov80@mail.ru