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TECHNOLOGICAL SCHEME OF REFINING OF COTTONSEED OIL PURIFIED FROM GOSSYPOL

Abstract. The article deals with the technological scheme of refining cottonseed oil purified from gossypol. In the experiments, oil samples purified from gossypol containing monoethanolamine (MEA) were refined in two stages using sodium hydroxide. According to the research, the optimal temperature for the refining process was increased from 25 ˚C to 50–55 ˚C at the end of the process, the concentration of the alkaline solution was 200 g/l, and the amount of water supplied to moisten the soapstock was formed 0.5–1.0% by weight of oil. To completely purify the oil from gossypol and its derivatives, urea solutions with a concentration of 20–25% in the amount of 0.3–0.7% are given using capacity (5a) instead of water supplied in the process of alkaline refining. The results of the study showed that high gossypol cottonseed oil was treated with monoethanolamine in the amount of 0.2% by weight of oil, as well as when treated with urea solution in the amount of 0.5% by weight of oil for complete refining of gossypol refined oil, it has been found that positive results such as obtaining oils containing gossypol content of up to 0.002% can be achieved.

Keywords: cottonseed oil, refining process, gossypol, purification of cottonseed oil from gossypol, monoethanolamine, forrafination.

Introduction

Several scientists have researched the separation of gossypol from the composition of cottonseed oil with high gossypol. In particular, scientists of the Institute of Bioorganic Chemistry named after O. S Sodikov of the Academy of Sciences of the Republic of Uzbekistan U. A. Saidakhmedov, A. S. Ibragimov and others managed to obtain gossypol acetate with a purity of 85% by processing acetylene acetic acid in different proportions in the separation of gossypol acetic acid [1; 2; 3].

In addition, methods have been developed in which the anthranilate gossypol content is reduced in processes compared to the conventional method,

and the yield of the final finished product gossypol is higher [2; 4; 5].

Research has also been conducted on the conversion of gossypol in cottonseed oil from oil to shrot by combining it with various components in cottonseed. In the research, the technology of low-gossypol cotton shrot and lightly refined oil production by hydrothermal treatment of cottonseed meal using a solution of urea and sodium silicate was introduced. Today it is used in 23 oil companies of the republic.

Processing of urea solution in cottonseed meal is one of the patented scientific inventions of the Intellectual Property Agency for the invention of IAP 03125 "Method for obtaining lightly refined cottonseed oil and low-content gossypol" [4; 7; 9].

Materials and methods

The method proposed by us has been studied to obtain high gossypol cottonseed oil by converting gossypol to maximum oil by processing the seed pulp using ultra-high frequency rays [5–9].

Studies have been carried out on the formation of a monoethanolamine compound of gossypol in isolated high gossypol cottonseed oil and its separation with gossypol as a separate commodity by treatment with sulfuric acid [10–17].

In the study, high-gossypol cotton oil with a high gossypol content of 1.46–1.68%, obtained using ultra-high frequency processing, was forrafinated by adding 0.2% monoethanolamine to its mass, followed by complete refining with urea solution. a decrease in the amount of gossypol was observed until traces were detected [18–21].

The processing of two fractions – ethanolamingossipol and gossypol degreased oils – formed as a result of the treatment of high-gossypol cotton oil with monoethanolamine (MEA) requires the development of two separate technological sequences. The chemical reaction of high-gossypol cottonseed oil treated with MEA and its separation from technical gossypol with sulfuric acid is as follows:

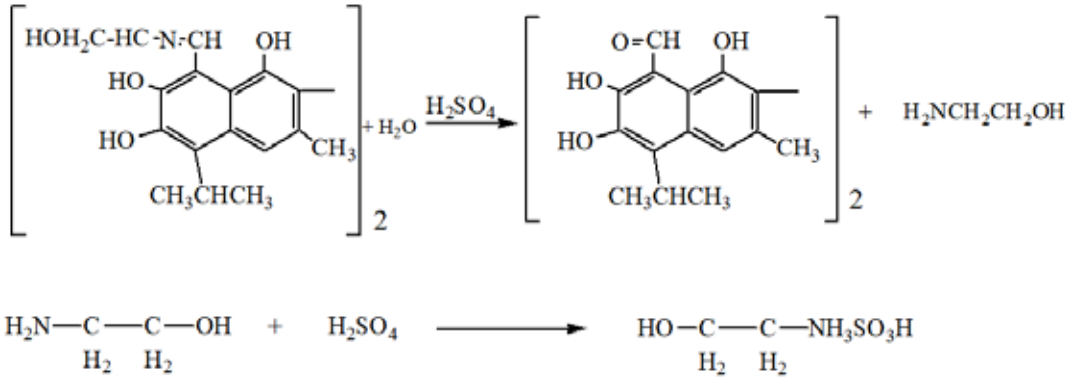

Figure 1. The chemical reaction of separating gossypol from a derivative of gossypol with MEA

As can be seen from Figure 1, when the gossypol product is treated with sulfuric acid, the acid initially acts as a catalyst. Monoethanolamine is released by accelerating the hydrolysis of the product under the influence of water [21–25].

It then interacts with the separated MEA to form the sulfuric acid salt of MEA and precipitates. The following are the technological schemes for the separation of technical gossypol from the combination of gossypol with MEA and complete refining of gossypol degreased oil using urea solution (Figure 2).

The pressed high gossypol cotton oil obtained by ultra-high frequency processing falls into the tank (2). From there, the pump (3) is transferred by its own flow to the reactor (1) using a filter regulator (4). The capacity of the reactor is 1000 kg of oil. The lower part of the reactor is equipped with a stirrer and a coating to heat the mixture and stir it for 50–60 rpm to proceed with the forrafination process. The mixer is equipped with an individual electric motor via a separate reducer.

Once the required amount of high gossypol cotton oil has been loaded into the reactor, the mixer is

switched to operating mode and water or steam is supplied to heat or cool the oil (if necessary). The temperature of the oil is monitored using a thermometer installed in the reactor.

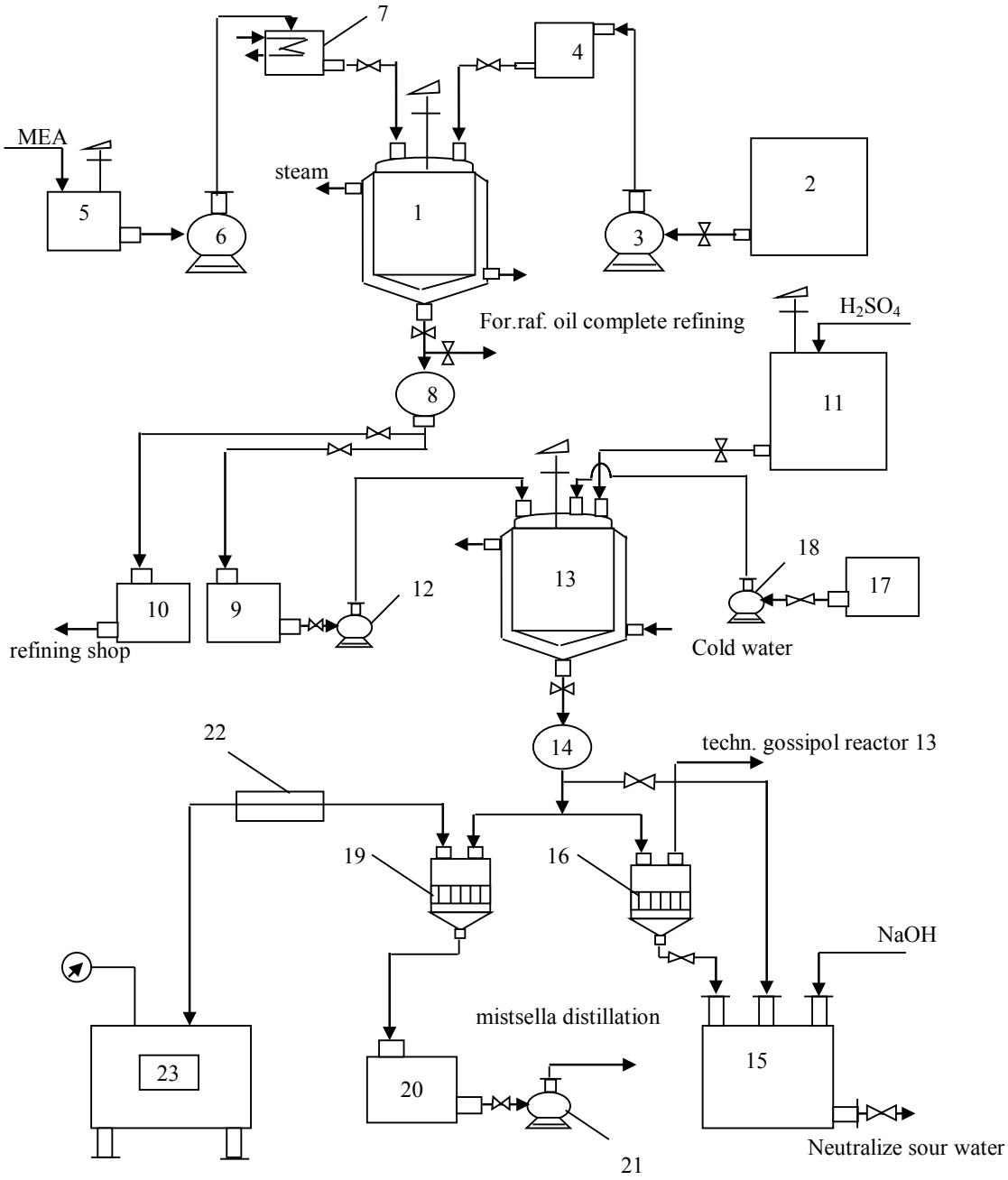

Figure 2. Technological scheme of processing and technical gossypol separation of high gossypol cotton oil with MEA

Results and discussion

We know that in the traditional technology when the periodic forrafination process is carried out periodically, the temperature of the oil starts at 20–25 ˚C and ends at 50–55 ˚C. In traditional technology, the refining process takes 20–25 minutes. In our research, high gossypol cottonseed oil was refined in a stepwise manner. During the study, forrafination of high gossypol cottonseed oil was carried out at different temperatures, and it was found that the optimal temperature for the maximum sedimentation of gossypol is 45–50 ˚C. Studies have shown that

treatment with MEA at a rate of 0.2% relative to the oil mass is mainly effective.

The reactor (1) is treated with MEA through the tank (5), pump (6) and regulator (7), calculated relative to the oil mass as mentioned above. The processing and mixing time is 15–20 minutes. MEA is gradually added to the high gossypol cotton oil with constant stirring. After the addition of the required amount of MEA, the reaction mixture is allowed to stand for 1.5–3.0 hours. The liquid soapstock and oil are separated into two phases at the bottom of the reactor. Because the liquid is heavier than the soapstock mass, it collects at the bottom of the reactor, while the oil collects in the top layer. Extreme care must be taken in separating the phases of degassed oil and liquid soapstock. The liquid collected at the bottom of the reactor is collected in the soapstock tank (9) through a valve and observation window (8) designed to separate the soapstock. The degassed oil is sent through the valves for complete refining. Partial emulsification is observed between the soapstock and the decomposed oil, and the resulting emulsion is collected in a separate tank (10) and returned to the refining process.

The MEA product (soapstock) of the gossypol collected in the tank (9) is transferred to the reactor (13) using a pump (12) in order to separate the gossypol as a separate commodity. To return the compound of gossypol formed from MEA to gossypol to the reactor (13), the working sulfuric acid prepared for treatment with 5% sulfuric acid is prepared in a tank (11) and transferred to the reactor (13) by its own flow.

The soapstock collected in the tank (9) is transferred to the reactor (13) using a pump (12). The disposable liquid soapstock load on the reactor (13) is 245 kg. The reactor (13) is a mixer with a speed of 50–60 rpm and the bottom part is covered with a coating so that the reactor is heated or cooled if necessary. A valve is installed at the bottom of the reactor (13) to separate the reaction mass. In this case, the pH of the interior of the reactor is checked using a universal indicator and the environment is controlled to be around 4.5–5.0. To separate the technical gossypol, the reactor (13) is cooled to 20––25 °C using cold water. As a result of the cooling of the reaction mixture, the technical gossypol rises to the top layer of the mixture. The mixture is allowed to stand for 1 hour to completely separate the technical gossypol in the reaction mixture. To separate the technical gossypol, the sour water is first collected in the tank (15) using a valve, controlled by means of an observation window (14) mounted on the bottom of the reactor (13). To separate the technical gossypol from the intermediate emulsion containing gossypol residues, the nutch is passed through a filter (16) and the gossypol residues are retained. The remaining technical gossypol in the reactor (13) is washed with water until it reaches a neutral point. The leachate from the leaching is cleaned of gossypol residues using a nutch filter (16) and sent to the tank (15) for sour water. The sour water collected in the tank (15) is neutralized with sodium alkali and discharged into the sewer.

The technical gossypol residues trapped by the Nutch filter (16) are returned to the reactor (13). The technical gossypol, washed with water to a neutral medium, is processed with extraction gasoline to remove fatty acids and other water-insoluble raw materials. In the reactor (13), the technical gossypol in a neutral environment is supplied with extraction gasoline using a tank (17) and a pump (18). The reactor (13) performs several functions simultaneously. This serves to avoid the use of redundant equipment in the technological cycle and reduce the cost of the product. The capacity of the reactor (13) was 245 kg for liquid soapstock and 50 kg for technical gossypol. The reactor is treated with 210 kg of extraction gasoline in terms of oil mass and the process is continued for 25–30 minutes. A mixture of technical gossypol and extraction gasoline is trapped in a nutch-filter (19) containing technical gossypol. The mistsella cleaned from the technical gossypol is sent to distillation using a tank (20) and a pump (21). Gasoline collected during distillation is returned to

the process. Using technical gossypol hand cocktail collected in the Nutch filter (19), parchment paper is spread on 3–4 cm thick sheets. Partially dried technical gossypol of the same thickness is taken to the table (22) after one day for complete drying and dried for 10 hours at 50–60 ˚C using dry air in a vacuum dryer (23). The yield of technical gossypol is 16.5–16.8 kg per 1000 kg of high gossypol oil. The technological scheme of complete refining of degassed oil is given below.

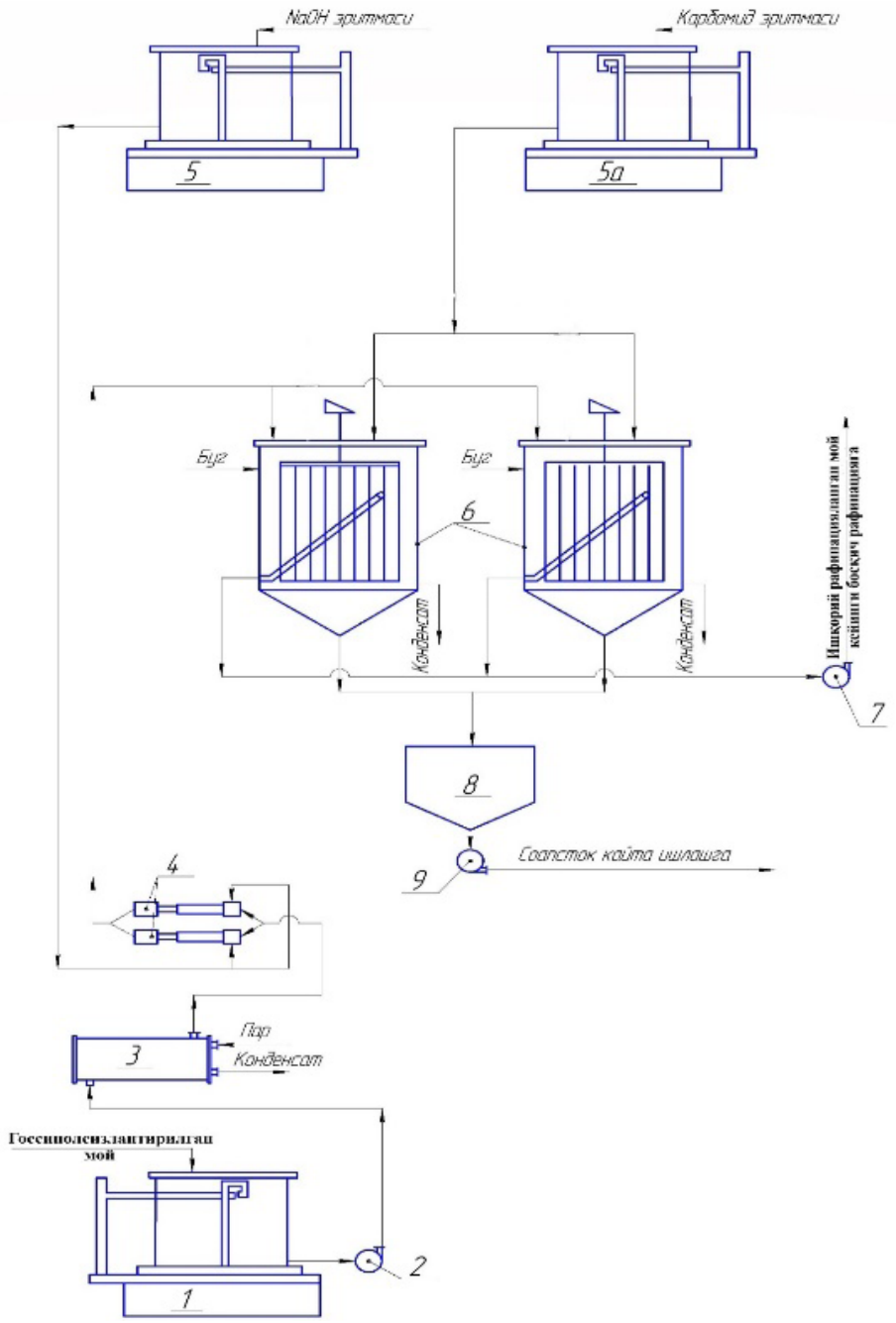

Figure 3. Technological scheme of refining oils purified from gossypol using urea solution

The oil purified from the gossypol (Fig. 4) falls into the weighing tank (1). The temperature is then adjusted to 20–25 ˚C using a pump (2) and a heat exchanger (3). Adjusting the temperature of the oil serves to ensure the optimal course of the refining process and the complete purification of the accompany-

ing substances in the oil. The adjusted oil is transferred to the reactor-turbulizer (4). In the reactor-turbulizer unit, the oil and alkali solution are intensively mixed. The reactor turbulizer unit, on the other hand, is supplied with a calculated amount of working alkali solution based on the acid number of the oil.

In the experiments, oil samples purified from gossypol containing monoethanolamine were refined in two stages using sodium hydroxide. According to the research, the optimum temperature for the refining process was increased from 25 ˚C to 50–55 ˚C at the end of the process. The concentration of the alkaline solution was 200 g/l, and the amount of water supplied to moisten the soapstock was 0.5–1.0% by weight of oil. The refining process took 23–25 minutes. The working alkaline solution is continuously transferred to the recuperator turbulizer using the weighing tank (5). A mixture of oil and alkali is fed to the periodic neutralizer (6). To completely purify the oil from gossypol and its derivatives, urea solutions with a concentration of 20–25% in the amount of 0.3–0.7% are given using capacity (5a) instead of water supplied in the process of alkaline refining. The alkaline refined oil is transferred to the next stage of refining using a pump (7). The soapstock collected at the bottom of the neutralizers (6) is sent to the soapstock for processing using a tank (8) and a pump (9).

Conclusion

The results of the study showed that high gossypol cottonseed oil was treated with 0.2% MEA of oil mass, while gossypol oil was treated with 0.5% urea solution for complete refining of gossypol refined oil. it has been found that positive results can be obtained, such as obtaining oil in the state.

The proposed technological scheme allows for the simultaneous forrafination of high-hemp cotton oil using MEA and the separation of technical hemp as a separate commodity. The advantage of the proposed technology is that the complete refining of oil refined from forrafined gossypol using a urea solution does not significantly change the existing technological process, but the possibility of obtaining high-quality oil.

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