

IMPROVED CRYSTALLISATION AND FRACTIONATION PROCESS

FIELD OF THE INVENTION

[0001] The present invention relates to an improved process for producing a
5 fractionated oil from a feed oil. More particularly, the present invention relates to improved crystallisation and fractionation process for a fractionating a feed oil.

[0002] The invention is applicable to the fractionation of palm oil to produce palm olein and palm stearine and it will be convenient to hereinafter disclose the invention in relation to that exemplary application. However, it is to be appreciated
10 that the invention is not limited to that application.

BACKGROUND OF THE INVENTION

[0003] Naturally occurring palm oil is characterized as a stabilized oil due to its chemical composition. As such, it can be used in most food applications without
15 hydrogenation, thus reducing production cost. Palm oil is also priced competitively compared to other edible oils.

[0004] Palm oil is available in a variety of forms: crude palm oil, palm olein, palm stearine, refined bleached and deodorized (R.B.D.) palm oil, fractionated palm olein and palm mid-fraction. Many of the various forms of palm oil are produced
20 through fractionation of the naturally occurring oil.

[0005] Palm oil can be fractionated by solvent fractionation, detergent fractionation, dry fractionation and the like. One process which is widely used for the fractionation of palm oil is dry fractionation, so called because fats and oils are fractionated without using any solvent, detergent or the like.

25 [0006] In a typical dry fractionation process, R.B.D. Palm Oil is feed into a crystallisation tank containing cooling tubes. A crystallisation and fractionation stages are then undertaken, using a series of cooling stages utilizing chilled water and normal temperate cooling water the cooling tubes to crystalise and fractionate the R.B.D. Palm Oil into a liquid fraction of R.D.B. Palm Olein and crystal fraction of
30 R.B.D. Palm Stearine. Thereafter, the R.D.B. Palm Olein and R.B.D. Palm Stearine

are separated into separate fractions using various types of drum or membrane filters. Hereinafter, this process is referred to as the conventional process.

5 [0007] The R.B.D. Palm Oil can be further fractionated to obtain various quality and percentage yield of R.B.D. Palm Olein and R.D.B. Palm Stearine, depending on the market demands. It is worth mentioning that in palm oil fractionation, palm olein is the premium product and the palm stearin is the discount product.

10 [0008] However, the use of chilled water for the crystallisation stages in the conventional process can be very costly. In addition, the reliance on chilled water in the conventional process requires a constant supply of such water to be available to successfully fractionate the palm oil. Should the power fail or the chilled water supply be interrupted, the conventional crystallisation process cannot continue and the entire batch of palm oil must be reprocessed.

15 [0009] In view of the foregoing, it would be desirable to provide an improved fractionation process, particularly for the dry fractionation of palm oil, which has a comparatively lower energy cost in comparison to the conventional process.

[00010] This advantage as well as other advantages of the present invention will become apparent from the following description.

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SUMMARY OF THE INVENTION

[00011] According to the present invention, there is provided a process of producing a fractionated oil, comprising the steps of:

- (a) introducing a feed oil into an agitation equipped crystallisation apparatus, said apparatus including a water cooling device;
- 25 (b) subjecting the feed oil to one or more crystallisation and fractionation stages by cooling the feed oil with temperate water circulating through the water cooling device to form a solid crystal fraction and a liquid oil fraction of the feed oil; and
- (c) separating the solid crystal fraction from the liquid oil fraction.

30 [00012] Unlike the conventional process, the temperature of the cooling water used in the water cooling device in the present invention is temperate, being at a

temperature close to room temperature. As can be appreciated, the use of temperate water does not require the water to be significantly heated or cooled. Accordingly, the use of temperate cooling water for each and every one of the crystallisation and fractionation stages results in a significant energy savings in comparison to the conventional process. As previously noted, the use of chilled water can be very costly.

[00013] In this respect, it is preferable that during each crystallisation and fractionation stage cooling water is fed through the water cooling device having a temperature of between 20 to 50°C. More preferably, the cooling water is fed through the water cooling device having a temperature of between 25 to 40°C.

[00014] In order to utilize temperate water during crystallisation, it is preferable that the feed oil is in a suitable temperature range for crystallisation to occur with temperate water. Accordingly, in one embodiment of the invention, the feed oil temperature is between 20 and 50°C during each crystallisation and fractionation stage. More preferably, the feed oil temperature is between 25 and 45 °C.

[00015] The process of the present invention can comprise various number of crystallisation and fractionation stages to obtain the desired crystallisation yield (i.e. the desired amount of crystal fraction formation). It is preferable, that the process of the present invention comprises a plurality of crystallisation and fractionation stages. In one embodiment of the invention, the feed oil is subjected to twenty crystallisation and fractionation stages. In another embodiment of the invention, the feed oil is subjected to five crystallisation and fractionation stages.

[00016] In one exemplary embodiment of the invention the feed oil is subjected to nine crystallisation and fractionation stages. In this embodiment, the process of the present invention preferably comprises one or more of the following crystallisation and fractionation stages:

- a first stage in which the feed oil temperature is about 45°C and water is fed through the water cooling device for approximately 10 minutes at a temperature of about 40°C;

- a second stage in which the feed oil temperature is about 42°C and water is fed through the water cooling device for approximately 30 minutes at a temperature of about 40°;
- 5 • a third stage in which the feed oil temperature is about 40°C and water is fed through the water cooling device for approximately 30 minutes at a temperature of about 35°C;
- a fourth stage in which the feed oil temperature is 35°C to 36°C and water is fed through the water cooling device for approximately 30 minutes at a temperature of about 30°C;
- 10 • a fifth stage in which the feed oil temperature is about 32°C and water is fed through the water cooling device for approximately 30 minutes at a temperature of about 30°C;
- a sixth stage in which the feed oil temperature is about 30°C and water is fed through the water cooling device for approximately 60 minutes at a temperature of about 30°C;
- 15 • a seventh stage in which the feed oil temperature is 29°C-30°C and water is fed through the water cooling device for 60 minutes at a temperature of 28°C-29°C;
- an eighth stage in which the feed oil temperature is 28°C-29°C and water is fed through the water cooling device for approximately 60 minutes at temperature of 27°C-29°C; and/or
- 20 • a ninth stage in which the feed oil temperature is 27-29°C and is fed through the water cooling device for 60 minutes at temperature of 26-29°C.

[00017] Any number of control systems and monitoring devices can be included in the process of the present invention in order to measure the various process parameters of the process. For example, one or more of the oil temperature, cooling water temperature, pressure, agitation speed, fluid flow rate, mass, or weight can be measured. However, it is preferable for the flow rate of the water fed through the water cooling device to be monitored by a computer, manually or a combination thereof.

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[00018] The process of the present invention can be used to fractionate any suitable oil which can undergo crystallisation using a temperate cooling water system as described above. Suitable oils include sunflower oil, soybean oil and palm oil.

5 [00019] In one exemplary embodiment of the present invention, the feed oil is palm oil. In this embodiment, it is preferable that the process is used to produce a fractionated oil comprising a liquid oil fraction including palm olein and a crystal fraction including palm stearine. The process can preferably process a wide variety of palm oils having a wide range of iodine values.

10 [00020] Any number of cooling device(s) could be used in the agitation equipped crystallisation apparatus. Suitable devices include plate heat exchangers, tubular heat exchangers, cooling tubes or a combination thereof. In one preferred embodiment of the invention, the water cooling device comprises water cooling coils.

15 [00021] Any number of separation means can be used to separate the solid crystal fraction from a liquid oil fraction of the fractionated oil. Suitable means include filtration devices, gravity separators, mechanical separators, suitable floatation devices or the like. In a preferred embodiment of the present invention, the separation step comprises a filtration step, the filtration step preferably being carried out using at least one membrane filter.

20 [00022] Further, there is also provided a fractionated oil obtained from the aforementioned process.

BRIEF DESCRIPTION OF THE DRAWINGS

25 [00023] The present invention will be readily understood by the following detailed description in conjunction with the accompanying drawing which illustrates one particular preferred embodiment of the present invention, wherein:

[00024] FIG. 1 is a block diagram illustrating one exemplary fractionation process for obtaining palm olein and palm stearine from palm oil incorporating one preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[00025] In the following description, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will be understood, however, to one skilled in the art, that the present invention may be practiced without some or all of these specific details. In other instances, well known process operations have not been described in detail to not unnecessarily obscure the present invention.

[00026] The process of the present invention is particularly suitable for producing a fractionated oil from palm oil or sunflower oil or soybean oil. The illustrated process 10 comprises an oil crystallisation and fractionation process in which palm oil is processed in a dry system to produce a liquid palm olein fraction 20 and a crystal palm stearin fraction 22.

[00027] As would be understood by a person skilled in the art, palm olein is a liquid, more unsaturated fraction separated from palm oil after crystallization. The olein typically consists of a more homogeneous mixture of triglycerides than the original palm oil. Palm stearin is a more saturated and more solid fraction separated from palm oil after crystallization.

[00028] Referring to the process illustrated in Fig. 1, the feed oil 12, in this case palm oil, is first fed into an agitation equipped crystallisation tank 14 containing water cooling coils 15. The water cooling coils 15 only circulate normal temperate water, the temperature of which is controlled for the crystallisation and fractionation process.

[00029] Once fed into the crystallisation tank 14, the feed oil 12 is subjected to a series of crystallisation and fractionation stages. The stages of crystallisation and fractionation are as follows:

[00030] During stage 1, the temperature of the palm oil 17 is about 45°C. Water is introduced into the water cooling coils 15 at a temperature of about 40°C for a duration of 10 minutes.

[00031] Upon reaching stage 2, the temperature of the palm oil 17 is now slightly lower, i.e. about 42°C. Water is introduced into the water cooling coils 15 at a temperature of 40°C for a duration of 30 minutes.

5 [00032] During stage 3, the temperature of the palm oil 17 has been lowered again to about 40°C. In this stage, water is introduced into the water cooling coils 15 at a temperature of about 35°C for a duration of 30 minutes.

[00033] At stage 4, the temperature of the palm oil 12 is approximately 35°C to 36°C. In this stage, water is introduced into the water cooling coils 15 at a temperature of about 30°C for a duration of 30 minutes.

10 [00034] Proceeding to stage 5, the temperature of the palm oil 17 is about 32°C. In this stage, water is introduced into the water cooling coils 15 at a temperature of about 30°C for a duration of 30 minutes

[00035] During stage 6, the temperature of the palm oil 17 is now about 30°C. Water is introduced into the water cooling coils 15 at a temperature of about 30°C for
15 a duration of 60 minutes.

[00036] Moving forward, at stage 7, the temperature of the palm oil 17 is between 29°C to 30°C. Water is introduced into the water cooling coils 15 at a temperature of between 28°C to 29°C for a duration of 60 minutes.

[00037] During stage 8, the temperature of the palm oil 17 is between 28°C to
20 29°C. Water is introduced into the water cooling coils 15 at a temperature of between 27°C to 29°C for a duration of 60 minutes.

[00038] Finally, upon reaching stage 9, the temperature of the palm oil 17 is between 27 to 29°C. Water is introduced into the water cooling coils 15 at a temperature of between 26 to 29°C for a duration of 60 minutes.

25 [00039] During each of the crystallisation and fractionation stages, solid crystals of palm stearin are crystalised in the liquid 17. Accordingly, upon completion of the 9 stages, the crystallisation and fractionation process is completed and the mixture 16 of obtained crystals of palm stearin and liquid palm olein is then passed through a filtration process, in this case a membrane filter 18, to obtain the
30 respective palm olein 20 and palm stearine 22 fractions.

[00040] In the illustrated process, the temperature of the cooling water fed into the water cooling coils 15, the temperature of the oil in the agitation equipped crystallisation tank 14, the flow rate of the water fed into the water cooling coils 15 are measured and monitored using a computer monitoring and recording apparatus (not illustrated). As would be understood by a person skilled in the art, many process parameters and measures can also be monitored.

[00041] As can be appreciated from the preceding description of the crystallisation and fractionation process, the temperature of the palm oil 17 and the cooling water in the cooling coil 15 are gradually reduced over subsequent stages. Unlike the conventional process, the temperatures of the water in the present invention are close to room temperature. There is no need for use of chilled water for the crystallisation process, which is very costly. As such, there is a reduction in electrical energy cost of the process tremendously (by at least 40%-50%) as compared to the conventional process of using chilled water for the crystallisation process.

[00042] With the process of the present invention, the crystallisation time is typically shorter compared to the conventional process, allowing for more oil to be processed daily, thus, increasing the overall plant capacity.

[00043] Furthermore, many embodiments of the present invention produce more stable and better yields (up to 84%) of palm olein in comparison to the conventional process.

[00044] Moreover, due to the use of temperate water, when there are electrical and mechanical failures in the process, the simplified process of the present invention can still continue without fail.

[00045] Due to the simplicity of this modified process, the process of the present invention can process R.D.B. Palm Oil of varying iodine value without any significant problems.

[00046] Other embodiments of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention. It is understood that the present invention includes all such variations and modifications which fall within the spirit and scope.

[00047] Furthermore, certain terminology has been used for the purposes of descriptive clarity, and not to limit the present invention. The embodiments and preferred features described above should be considered exemplary, with the invention being defined by the appended claims.

- 5 [00048] Throughout the description and claims of the specification the word "comprise" and variation of the word, such as "comprising" and "comprises", is not intended to exclude other additives, components, integers or steps.

CLAIMS

What is claimed is:

1. A process of producing a fractionated oil, comprising the steps of:-
 - 5 (a) introducing a feed oil into an agitation equipped crystallisation apparatus, said apparatus including a water cooling device;
 - (b) subjecting the feed oil to one or more crystallisation and fractionation stages by cooling the feed oil with temperate water circulating through the water cooling device thereby forming a solid crystal fraction and a liquid oil fraction
 - 10 of the feed oil; and
 - (c) separating the solid crystal fraction from the liquid oil fraction.
2. A process as claimed in claim 1, wherein during each crystallisation and fractionation stage water is fed through the water cooling device at a
- 15 temperature of between 20 to 50°C.
3. A process as claimed in claim 1 or 2, wherein during each crystallisation and fractionation stage the feed oil temperature is between 20 to 50 °C.
- 20 4. A process as claimed in any one of claims 1 to 3, comprising a plurality of crystallisation and fractionation stages to obtain a desired crystallisation yield.
5. A process as claimed in any one of claims 1 to 4, wherein the crystallisation and fractionation include a first stage in which the feed oil temperature is
- 25 about 45°C and water is fed through the water cooling device for approximately 10 minutes at a temperature of about 40°C.
6. A process as claimed in claim 5, wherein the crystallisation and fractionation include a second stage in which the feed oil temperature is about 42°C and
- 30 water is fed through the water cooling device for approximately 30 minutes at a temperature of about 40°C.

7. A process as claimed in claim 6, wherein the crystallisation and fractionation include a third stage in which the feed oil temperature is about 40°C and water is fed through the water cooling device for approximately 30 minutes at a temperature of about 35°C.

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8. A process as claimed in claim 7, wherein the crystallisation and fractionation include a fourth stage in which the feed oil temperature is 35°C to 36°C and water is fed through the water cooling device for approximately 30 minutes at a temperature of about 30°C.

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9. A process as claimed in claim 8, wherein the crystallisation and fractionation include a fifth stage in which the feed oil temperature is about 32°C and water is fed through the water cooling device for approximately 30 minutes at a temperature of about 30°C.

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10. A process as claimed in claim 9, wherein the crystallisation and fractionation include a sixth stage in which the feed oil temperature is about 30°C and water is fed through the water cooling device for approximately 60 minutes at a temperature of about 30°C.

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11. A process as claimed in claim 10, wherein the crystallisation and fractionation include a seventh stage in which the feed oil temperature is 29°C-30°C and water is fed through the water cooling device for 60 minutes at a temperature of 28°C-29°C.

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12. A process as claimed in claim 11, wherein the crystallisation and fractionation include a eighth stage in which the feed oil temperature is 28°C-29°C and water is fed through the water cooling device for approximately 60 minutes at temperature of 27°C-29°C.

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13. A process as claimed in claim 12, wherein the crystallisation and fractionation include a ninth stage in which the feed oil temperature is 27-29°C and is fed through the water cooling device for 60 minutes at temperature of 26-29°C.

14. A process as claimed in any one of claims 1 to 13, wherein the water fed through the water cooling device flows at a flow rate which can be monitored by a computer, manually or a combination thereof.

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15. A process as claimed in any one of claims 1 to 14, wherein the feed oil is palm oil.

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16. A process as claimed in any one of claims 1 to 15, wherein the fractionated oil comprises a liquid oil fraction including palm olein and a crystal fraction including palm stearine.

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17. A process as claimed in any one of claims 1 to 16, wherein the water cooling device comprises water cooling coils.

18. A process as claimed in any one of claims 1 to 17, wherein separation step comprises a filtration step.

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19. A process as claimed in claim 18, wherein the filtration step is carried out using at least one membrane filter.

20. A fractionated oil produced by a process as claimed in any one of claims 1 to 19.