

A Method of Separating Oil from Crude Palm Oil and Water.

This invention relates to a method of separating oil from crude palm oil and water. In a palm oil mill, the fresh
5 fruit bunches, after sterilizing to deactivate the enzymes, are stripped, and the fruit is pressed by hydraulic or screw presses to extract the crude palm oil from the pericarp of the fruit. This crude palm oil is screened to remove large fibrous matter. The resulting screened
10 crude palm oil contains about 50% palm oil, dispersed in water containing cell walls, organelles and short fibres, carbohydrates in the range from hemicelluloses to simple sugars, all other major and minor components constituting normal plant cells and matter adhered to
15 the surface of the palm fruit. In appearance it is a viscous brownish-grey sludge.

To separate the palm oil the crude palm oil sludge, the viscosity is lowered by adding hot water and by
20 heating the mixture. The mixture is passed into a separator, in which a palm oil phase separates and floats on the remaining aqueous slurry.

The oil is continuously removed over an overflow weir,
25 and also the slurry is continuously removed, and is, then, centrifuged in order to remove the oil present therein as much as possible.

The separation in such a separator is a consequence of the differences in specific mass, and depends on the viscosity, the drop size, the residence time etc.. Moreover the size of the horizontal surface of the vessel is
5 a determining factor for the upward velocity of the oil drops which, at a given quantity of crude oil to be handled per unit of time, can just reach the free surface. As the surface is made smaller, this boundary velocity will be higher, and the proportion of non-separated oil
10 will be higher accordingly. The oil remaining in the slurry is to be removed by centrifuging, which requires additional energy.

The separation can be improved by raising the temperature
15 so as to reduce the viscosity, which also requires additional energy, and, on the other hand, the oxidation risk at the free surface will also increase with the rising temperature. This is also the case when increasing the cross-section of the separation vessel and thus, the
20 free surface, and, of course, the installation cost and the required space will increase too. Moreover, the heat losses at the free surface will be larger accordingly, and the cost for insulating the vessel will be higher. A draw-back of heating is, furthermore, that it
25 will lead to convective flows which counteract the separation and which will be the more important as the

temperature differences increase. The separation efficiency is, furthermore, impaired by the liquid current within the vessel.

- 5 On the other hand, as the separation in this vessel becomes worse, more centrifuging is required for removing the oil residues from the slurry, which also requires energy and delays the treatment, and furthermore the centrifuges will be more heavily loaded thereby.

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In spite of these objections no improvements of existing separators have been proposed up till now, probably on the assumption that with such viscous heterogeneous masses other separation methods could not be used.

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- According to the present invention therein provided a method of purifying crude palm oil mixed with water, comprising feeding the crude oil and water mixture into a separation vessel so that the mixture separates into a layer of oil floating on a layer of slurry, and, below the slurry, layer, a layer containing water and any impurities, and guiding oil as it is separating within the vessel along an inclined path which extends at least through the slurry layer.
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Further according to the present invention there is provided a vessel when used for carrying out the method according to the immediately preceding paragraph, said vessel having a crude oil supply, an overflow for separated oil, a
5 discharge for water and oil-containing slurry, and a discharge for separated water and impurities present therein, and at least one inclined member defining the said inclined path.

10 By means of such inclined members the mean path length of a separating particle will be shortened, and the separated particles are gathered against the lower surface of the inclined member in the case of oil drops, and on the upper surface of the inclined member in the case
15 of water. The separation efficiency will be improved accordingly.

Preferably the supply means open into this vessel symmetrically with respect of said inclined members

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The inclined members may be corrugated in the direction of the flow of separated components along said inclined members.

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The invention will now be described by way of example, with reference to the accompanying diagrammatic drawing in which:

Figure 1 is a cross-section of a conventional crude
5 palm oil separating vessel;

Figure 2 is a corresponding cross-section of a vessel such as shown in Figure 1, modified according to the invention;

Figure 3 is another embodiment of vessel in accordance
10 with the invention,

Figure 4 is a cross-section of a further embodiment of separating vessel according to the invention; and

Figure 5 is a partial section on line V-V of Figure 4.

15 In Figure 1 a cross-section of an oil separator of current design is shown, comprising a substantially cylindrical vessel 1 with a substantially conical bottom part 2, communicating with a valve 3 and a discharge duct 4.

20 A supply duct 5 for the crude oil to be treated mixed with hot water discharges in the vessel 1. During the residence time in the vessel 1, an oil phase separates from the crude oil, which will float as a layer 6 on a residual slurry 7, below which a layer 8 of separated water contain-
25 ing heavy components such as sand etc., is present.

5 The layer 6 consists mainly of oil in which some water and fruit pulp is present, the oil content depending i.a. on the separation efficiency.

10 In the upper part of the vessel 1 an overflow 9 communicating with a discharge duct 10 is provided. Moreover a rising tube 11 extends downwards into the layer 7, its upper end opening into an overflow chamber 12 communicating with a discharge duct 13, the bottom of the chamber 12 being situated lower than the oil overflow 9. The duct 13 leads towards a schematically indicated centrifuge 14, in which the oil remaining in the slurry will be removed to a considerable degree from the slurry.

15 As the oil layer 6 grows thicker, oil will flow over the overflow 9. The rising tube 11 forms, together with the overflow chamber 12, a manometric discharge regulator. The height differences are chosen so that at an increasing thickness of the layer 7 slurry will rise in the tube 11 and will flow off through the duct 13. If the overflow 9 is adjustable, an upward displacement will lead to an increase of the thickness of the oil layer 6. The thickness of the water layer 8 is restricted by opening the valve 3 at intervals. In this manner oil and slurry are removed in the same proportion in which they are supplied in the crude oil.

25 The separation efficiency of such a separator is mainly determined by the ratio between the supply rate of the crude oil and the ^{bottom} surface of the separation vessel. Moreover the separation will be improved as the viscosity is reduced so that the separated oil drops can rise more quickly.

30 Therefore the crude oil should be mixed beforehand with hot water so as to reduce the viscosity by the temperature rise and by diluting the slurry. Also directly heating the slurry by injecting steam, or indirectly by means of a heat exchanger is used. A disadvantage thereof is, however, not only the required energy, but also the increased risk that oil will be oxidised at the free surface, and that, as a consequence of cooling near the walls and

the free surface, convection currents will be generated which counteract the separation. Moreover the ratio between supply rate and bottom surface area of the vessel will determine the separation efficiency, said ratio being equal to the upward velocity required for an oil drop rising from the lower boundary surface of the layer 7 to reach the upper boundary thereof. A maximum separation efficiency is important as, then, less centrifuging is required, which leads to a lower energy consumption, and, moreover, the centrifuges will be not so heavily loaded. However there is a limit to the possible separation degree, i.e. since increasing the surface area inevitably leads to more heat losses oxydation etc.

Fig. 2 shows a separation vessel similar to that of fig. 1, in which corresponding parts have been indicated by the same reference numerals. The former differs from the latter in that, in the layer 7, an inclined plate 15 is arranged, separating this layer into two parts. In the right-hand part oil drops will rise until the lower surface of the plate 15 is reached, and then these drops will slide upwards along the plate. The average flotation path length is halved thereby. In the left-hand part the average flotation path length is halved too, since, there, the plate 15 forms the lower boundary of the layer 7.

Apart from the fact that, in this manner, the flotation path length is halved, such a plate will also suppress convection flows, and, thus, also the cooling of the liquid. Such a plate can be arranged in an existing separator of the shape of fig. 1, and will substantially improve the separation efficiency.

If the crude oil supply 5 is arranged as shown, provisions should be made for ensuring that the oil can reach also the other side of the plate 15, for instance by leaving some space between the edges of said plate and the wall of the vessel 1. It is also possible to shift the supply towards such a point that the oil can flow in at both sides of plate 15, e.g. as shown at 5', or to arrange a second supply diametrically opposite the first supply duct 5. It is also possible to use a ring duct with a plurality of apertures or nozzles. The plate 15 preferably extends into both adjacent layers 6 and 8, so as to prevent short-circuit flows.

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Because of the considerable improvement of the separation effect it is even possible to reduce the dimensions of the vessel, which leads to a reduction of the manufacturing cost, i.e. since insulating the vessel becomes simpler. In particular, however, the upper surface of the liquid will be reduced thereby, and thus also the heat loss and oxydation risk at that surface.

Fig. 3 shows a simplified representation of the separation vessel of Fig. 2, in which, now, a plurality of plates 15 is arranged. Between each of the plates the separation path length for oil drops, on the one hand, and water, on the other hand, is shortened accordingly. In each passage 16 between the plates 15 oil will gather below the upper plate 15, and will slide upwards along that surface, and water will be collected on the lower plate of this passage 16, and will flow off downwards. Between both a slurry layer is present, which will also move downwards. The crude oil supply can, for instance, take place in the passages 16 by means of supply tubes 17 opening therein.

There is a certain limitation on the number of plates, since, if the passages 16 therebetween become too narrow, the viscosity of the liquid may be too high for obtaining a sufficient liquid flow. Moreover the risk of obstruction of the passages 16 by separated components collected on the plates will increase as the plate distance is made smaller.

If there is no existing separator present, it may be more favourable to design a new separator which is completely adapted to the above-mentioned manner of separation. Fig. 4 shows a schematic representation of an example of such a separator. The same reference numerals are used as in the preceding Figs., and parts having a corresponding function but a modified shape have been indicated by a primed reference numeral. The operation of the separator of fig. 4 is, in principle, the same as in the case of Fig. 2 and 3.

The device according to Fig. 4 is specially designed for the present purpose, and comprises a vessel 1' which is provided with a partition 18 dividing the vessel in two parts. The right-hand part 19 has the same function as the upper part of vessel 1 in

Fig. 3, and the left-hand part 12' has the same function as the overflow chamber 12. The funnel-shaped lower part extending below both upper parts has the same function as the lower part of vessel 1 in fig. 3, viz. collecting the water layer 8.

5 In the right-hand part 19 of vessel 1' which is defined by an inclined wall 20, a plate assembly 15' is arranged which bears on the latter wall and joins the partition 18, which plate assembly 15' consists in particular of corrugated plates. The crude oil mixture is introduced at 5 in the triangular space between the
10 upper wall of plate assembly 15' and partition 18. The liquid flows upwards and enters the upper end of plate assembly 15'. In the passages between these plates the separation takes place, and the separated oil drops flow upwards along the crests of the corrugated plates, and leave the assembly at its upper end, which drops are,
15 again, collected as a floating layer 6. In order to avoid that the oil drops are dragged along by the liquid flow entering the plate assembly, the upper extremities of the crests of the corrugated plates communicate with U-shaped gutters or ducts 21, as shown in Fig. 5, which guide the oil drops upwards, and the incoming liquid
20 flows between these ducts. The slurry and water flows leave the assembly 15' at its lower end, and the water sinks towards the bottom layer 8, whereas the slurry fills the upward chamber 12' in which the level is determined by the level in the chamber 19 and by the relative specific masses of the various liquid layers. The
25 slurry can be removed through duct 13'.

It is also possible to introduce the crude oil mixture in other points of the chamber 19, or even between the plates of the assembly 15'. Furthermore the assembly 15' may be replaced by
30 an assembly or bundle of pipes which operates in substantially the same way as a corrugated plate assembly. Instead of a plate assembly in which all the flows are in the longitudinal direction of the corrugations, it is also possible to introduce the crude oil mixture transversely (i.e. substantially horizontally) to the corrugations,
and to remove the slurry at a point opposite to the supply point.
35 The water and the oil drops will then be removed in opposite senses through the corrugations and transversely to the liquid flow.

as schematically indicated in Figs. 4 and 5 in dotted lines, in which 17' is a supply for the liquid to be treated, and 13' a discharge for the treated liquid.

Also in the case of Figs. 2 and 3 corrugated plates may be used which may provide a better guiding effect on the separated parts.

Within the scope of the invention many other modifications are possible.

CLAIMS

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1. A method of purifying crude palm oil mixed with water, comprising feeding the crude oil and water mixture into a separation vessel so that the mixture separates into a layer of oil floating on a layer of slurry, and, below the slurry layer, a layer containing water and any impurities, and guiding oil as it is separating within the vessel along an inclined path which extends at least through the slurry layer.
2. A vessel for purifying crude palm oil mixed with water when used in a method according to claim 1, said vessel having a crude oil supply, an overflow for separated oil, a discharge for water and oil-containing slurry, and a discharge for separated water and impurities present therein, and at least one inclined member defining the said inclined path.
3. A vessel according to claim 2, wherein the or each inclined member is in the form of a plate.
4. A vessel according to claim 3, wherein the supply for the crude oil mixture opens into the vessel on opposite sides of the plate or plates.



5. A vessel according to claim 3 or claim 4 comprising a plurality of said plates, the plates being corrugated with the corrugation axes extending substantially in the direction of movement of the separated components of the mixture.

6. A vessel according to any one of claims 2 to 5 comprising a plurality of said inclined members, the inclined members being combined into a separation assembly communicating with two mutually separate parts of the vessel in such a manner that the mixture to be treated flows through the passages of the assembly, the oil separated therein being removed from this assembly in the upward sense, and the slurry and the water in the downward sense, the oil and slurry then being collected in said separate parts of the vessel.

7. A vessel according to claim 6, wherein the separation assembly consists of a bundle of tubes.

8. A vessel according to claim 5 and claim 6, wherein the supply for the mixture to be treated is directed transversely to the corrugation axes of the plates of the assembly, the discharge for the slurry being substantially aligned with said supply.

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9. A vessel substantially as hereinbefore described with reference to any one of Figs 2 to 5 of the accompanying drawings.

10. A method substantially as hereinbefore described with reference to any one of Figs 2 to 5 of the accompanying drawings.

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