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PROCESSING OF CASTOR OIL

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The present invention relates to the refining of water-immiscible, especially of oleaginous materials including oils, fats and waxes of vegetable, animal or synthetic origin and has particular utility in the refinement of those materials of the above type that have a tendency to form relatively stable emulsions with water or to be hydrolyzed by water used in the refining process or to be thus rendered capable by treatment with aqueous neutralizing agent.

While the process serves to impart advantageous properties to a variety of products, such for instance, as to reduce the corrosive action of oils generally, the process is particularly advantageous for the treatment of castor oil, more especially to increase greatly the utility thereof as a dielectric element for electrostatic condensers. The product that results from the process of the present invention, regardless by what procedure that product may be made, is included in the subject-matter claimed in copending application, Serial No. 450,095 filed by us concurrently herewith.

It is among the objects of the invention to provide a process for purifying water-immiscible materials of the character noted, which process shall be easy to execute and control by resort to relatively simple equipment and, therefore, without great increase in the cost of the resultant product as compared with like product of lesser purity.

Another object is to provide a process by which such material may be readily reconditioned or restored to maximum utility following contamination or degeneration by use.

Applicants have found that castor oil of the best quality heretofore on the market may be improved in utility for certain purposes to a surprising extent after certain impurities present therein or certain constituents thereof are removed therefrom. These impurities or constituents consist mainly of two types: (1) Free acids, largely organic, and more especially the fatty acids. (2) Compounds of a class which are detectable by the deleterious effect which they have on such electrical properties of the oil as resistivity and power factor and which are capable of removal by certain adsorbents such as fuller's earth and other activated clays and carbons. The latter class of impurities or constituents will be referred to hereinafter as "adsorbable matter."

Castor oil of the best quality heretofore available commercially (known in the trade under various designations such as "C. P.," "No. 1" and

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"medicinal grade") and referred to herein as C. P. castor oil, ordinarily has had present therein a free acid content ranging from approximately .5% to 1 3% calculated as oleic acid.

One of the objects of the invention is to provide a process whereby the free acid content of castor oil and related substances may be reduced to any desired low value down to .05% or less (calculated as oleic acid). Remarkable advantages have been found by applicants to result from the use of such a low-acid product in the impregnation of electrical condensers, as described in the copending application referred to above.

Applicants have found that if the adsorbable matter referred to be substantially completely removed by the process of the present invention, the resultant castor oil has vastly improved dielectric qualities. In our copending application referred to above, the product is claimed as such, regardless by what process it may be prepared.

One of the objects of the invention is to provide a procedure whereby said adsorbable matter may be substantially completely removed, yielding the remarkably improved dielectric product referred to above, or if desired, may be removed to a lesser degree thereby obtaining a product having substantially improved dielectric properties as compared with chemically pure castor oil of commerce, though not as excellent as the product from which adsorbable matter has been substantially completely removed.

The effective removal of either of these types of impurities (i. e. of free acid and of adsorbable matter) without effective removal of the other is within the scope of the invention, while in its most specific application the invention is concerned with the effective removal of both of these types of impurities or constituents for obtaining the best results.

It is understood that castor oil and similar compounds may also contain traces of substances that have a detectable effect on the electrical characteristics but which are not removable by adsorbents, and also traces of substances that are removable by adsorbents, the presence or absence of which is not reflected by ordinary electrical tests, but with such types of compound the present invention is not concerned.

Various materials to be removed in the refining process according to the present invention are of the character either capable of being taken up more especially by fuller's earth or rendered capable of being so taken up as is for instance, the

free acid content thereof after it has been treated with aqueous neutralizing reagent. The treatment in general consists of the separation of the fuller's earth or the like with its absorbed material, from the mass and the repetition of the treatment until an electrical characteristic of the resultant product has reached an optimum value. Free acid for instance after neutralization thereof is withdrawn by one or more absorbent treatments. and adsorbable matter is removed by repetition of adsorbent treatments until the resultant product presents maximum resistivity.

The process for obtaining the desired results will now be set forth with greater particularity.

Removal of free acid

According to conventional methods of oil refining. the free fatty acid is removed by first neutralizing with an aqueous alkaline solution and then removing the resultant soap stock in some suitable manner, as for instance, by gravity settling, centrifuging, or washing with water. The product obtained after removing the bulk of the soap stock or "foots," as it is termed in the art, still contains substantial quantities of soap, water. and sometimes free alkali which are customarily removed by washing repeatedly with warm water. Owing to the fact that warm water exerts a hydrolytic action on the soap. as well as on certain of the esters present. the final washed product will contain a small residual amount of free fatty acid formed by hydrolysis in accordance with the equations:

$$RCOOM+H_2O\rightleftarrows RCOOH+MOH$$
$$RCOOR'+H_2O\rightleftarrows RCOOH+R'OH$$

where R and R' are alkyl radicals and M represents a basic element or radical, commonly sodium. The reaction as represented is a reversible one, and the greater the dilution. the greater the tendency for the reaction to proceed from left to right, with consequent formation of free fatty acid.

According to the present invention in one of its aspects. all water washes are avoided, the hydrolytic action referred to above is not incurred and a more uniform neutral product is obtained.

By our invention the removal of the bulk of the foots is accomplished by treatment with absorbent immediately following the neutralization of the free fatty acid with alkali, dispensing with gravity settling, with centrifuging, as well as with washing, one or more of which are resorted to in the conventional methods above. The advantages of the present process as compared with such conventional procedures are substantial, for, the gravity settling is time-consuming and relatively inefficient; the centrifugal process involves costly equipment and the disadvantages of the water washing have already been pointed out. None of these conventional procedures is as efficient as that of the present invention for the complete removal of free acids. The present process has the further advantage of particular efficacy in the processing of oils such as castor oil that has a tendency to form stable emulsions, which are difficult of separation by what we designate as "gravity separation methods" and which include conventional centrifugal and gravity settling methods.

Applicants have found that fuller's earth and other clays when introduced into an intimate mixture, such as an emulsion of mutually immiscible aqueous and oily materials, have the peculiar property of more or less selectively absorbing aqueous in preference to oily materials. In the present invention, this phenomenon is utilized for

the removal of the foots, without entailing such rise in the free acid content as results from water washing. The term "absorbent" is intended to embrace within its scope substances exhibiting such preferential action for water, substances that act essentially as adsorbents, as well as substances that perform both the absorbent and the adsorbent action.

For the removal of the bulk of the foots or other aqueous material following neutralization, it is not necessary that the absorbent employed possess the adsorbent powers of the more highly activated clays and carbons. In this instance, it is only necessary that the particular absorbent used possess the ability, when placed in contact with an intimate mixture of mutually insoluble aqueous and oily material to absorb aqueous in preference to oily matter, thereby exerting a separatory action on the mixture. Many substances, as for instance, clays, carbons, cellulosic materials, certain anhydrous salts, etc., possess this property to a greater or lesser degree. However, fuller's earth or equivalent activated clay is preferred in the present invention, because it serves both as adsorbent and absorbent, and so can be used not only for the removal of the bulk of aqueous matter following neutralization, but also for the further improvement of such properties as color and dielectric quality after the major portion of the aqueous material has been removed.

The removal of the "foots" or aqueous neutralization products may be accomplished in either of two ways:

(1) The neutralized aqueous-oily mixture may be percolated through a layer of relatively coarse-mesh suitable absorbent material, or

(2) It may be treated (for example, agitated) with a quantity of relatively fine-mesh suitable absorbent material, and the resultant water-wet absorbent, containing any water-soluble matter such as soap and neutralizing agent that may be present, subsequently, separated from the oil by known methods such as gravity settling, centrifugal action, or filtration.

When the contact treatment with finely-divided absorbent of the type which also has strong adsorbent properties (for example fuller's earth) is resorted to, it is advisable to employ the minimum quantity that will effect a satisfactory complete removal of the foots. If a large excess be used, a portion of the soap stock present may be reconverted to fatty acid. Thus, the applicants found that a sample of castor oil neutralized with a 50 per cent excess of aqueous caustic soda, after treatment with 5 per cent fuller's earth and filtering, had a free acid content of .25 per cent calculated as oleic acid. However, on neutralizing with 50 per cent excess of caustic, treating with only 1 per cent earth, and filtering, the product had only .12 per cent free fatty acid calculated as oleic.

The cause of this free acid increase is believed to be due to a selective adsorption of M and OH ions from the system:

$$RCOO^-+M^++H^++OH^-$$

leaving a preponderance of $RCOO^-$ H^+ ions which recombine to form free fatty acid, which dissolves in the oily material. Whether or not this be the correct theoretical explanation of the phenomenon referred to, it has been found advantageous to use a minimum of absorbent for the removal of the bulk of the foots, and to give additional treatment subsequently with adsorbent to further improve such properties as color, odor, and di-

electric quality to the desired extent. After the bulk of the foots has been removed, further absorbent treatments may be given without substantial rise in free fatty acid content.

In order that the quantity of water which must be removed from the mixture may be kept at a minimum, it is desirable that the neutralizing agent used in the first step be as concentrated as possible. However, aside from the limits imposed by solubility, it has been found that there is a maximum concentration for each of the various neutralizing agents, beyond which a further increase in concentration results in a decrease in activity of the neutralizing agent, so that if too concentrated a solution be used, only a partial neutralization takes place. For caustic soda, applicants have found a solution of 20 grams per 100 c. c. to be completely operative. As in the case of conventional refining methods, an excess of neutralizing agent over the theoretical quantity is usually required to effect complete neutralization. The amount of the excess will vary with the nature both of neutralizing agent and the sample to be refined. Applicants have found that an excess of 30 to 50 per cent is effective on most samples of castor oil. The attempted removal of relatively large quantities of free acid may result in clogging of the percolator or filter with the products of reaction. To obviate such clogging in such cases, the removal of such acid would be effected in two or more steps. Examples of effective procedures will be given later in the application.

It is evident that the process described herein will effect the removal not only of fatty acids but of mineral acids as well if such be present, since their salts in aqueous solution will be taken up along with other aqueous matter by the absorbent material.

Removal of adsorbable material

Chemically pure castor oil of commerce hitherto available has contained substances the presence of which is detectable by certain electrical methods of testing, owing to the fact that these substances tend to lower the resistivity of the oil and to increase its power factor. These compounds are believed to consist largely of moisture, free acid and mineral salts. Certain activated clays such as fuller's earth, "Filtrol," and bentonite, and some activated carbons likewise have a selective adsorption action upon such matter.

According to the present invention in one of its aspects a novel method of adsorbent treatment is resorted to, by which electrical methods of test are utilized to determine the degree of improvement at each stage of the process, while contamination and deterioration are avoided. The product, as has been previously stated, has outstanding electrical characteristics and special utility as a condenser impregnant.

When castor oil of the best chemically pure grade is treated repeatedly with a suitable adsorbent, in the process of the present invention, removing the adsorbent after each treatment and measuring the electrical resistivity after each treatment by a standard method, it will be found that the resistivity increases up to a certain point, beyond which no additional increase results on further treatment. When this result has been achieved, it may be assumed that a substantially complete removal has been accomplished of those substances which are adsorbable by the adsorbent used and which are detectable by resistivity measurements.

The method used by applicants for measuring electrical resistivity is to fill completely the air spaces of a fixed air condenser of 107 mmf. capacity and air gap of .078 inch (Bud air condenser FA 782, Bud Radio, Inc., Cleveland, Ohio) with the material to be tested and to measure current in microamperes at an E. M. F. of 500 volts D. C. after two minutes of voltages application. In measurements of this nature it is essential that the cell used be absolutely clean and dry. A new cell should be washed thoroughly with boiling distilled water, hot methyl or ethyl alcohol, and finally hot benzene or toluene of best quality. Power factor measurements may also be made on various dielectric materials in such a cell. Various samples of C. P. castor oil have been found to have a resistivity between 1500 and 9000 megohms at 80 degrees F. when tested in this manner. By the process of the present invention, the resistivity of such oil may readily be increased to more than 100,000 megohms at 80 degrees F. and as high as 10,000 megohms at 185 degrees F. The highest values reached were obtained using vacuum-heat-dried AA grade fuller's earth of 200-and-up mesh fineness. Comparable values were also obtained using a commercial activated clay sold under the trade name "Filtrol." Somewhat lower values, although well above those of C. P. castor oil, were obtained by using bentonite and several types of activated carbons. The power factor at 1000 cycles of our castor oils, processed to the extent just set forth, was found to be .01 per cent or less between 80 degrees and 185 degrees F., as compared with measurements of .03 per cent at 80 degrees F. and .33 per cent at 185 degrees F. for an average sample of good quality commercial castor oil.

To attain the desired results, the adsorbent treatment of the present invention, must be so conducted that no moisture or ionizable impurities are introduced. To that end, the adsorbent should be thoroughly dried preferably under vacuum before using. The oil must not be heated to such extent as to cause deterioration. In the case of castor oil, at temperatures above 185 degrees F., a detectable breakdown ensues in a relatively short time. For best results, it is advisable to keep the temperature below 170 degrees F., as long as the oil is in contact with air. In vacuum, deterioration takes place at a slower rate. Any slight breakdown in the early stages of the process can be corrected by the adsorbent treatment in the final stage.

The treatment with adsorbent may be either by percolation or by the contact method, or by a combination of both. If the contact method be employed, the finest mesh adsorbent available should be used, and agitation may be for about an hour or longer at approximately 170 degrees F. The factors governing adsorbent treatment are well known in the art, and need not be discussed here. However, the advantages attained by the methods above described would be partly or wholly defeated were the separation of the adsorbent from the oil conducted in conventional manner. Any filter medium used for this purpose should contain a minimum of ionizable or other material that would impair the dielectric qualities of the oil. Paper or cloth of superlative cleanliness are useful for the purpose, as are also sintered glass or alumina, glass cloth and porous metal. The filter medium for separating the oil from the adsorbent should be washed in distilled water and throughly dried before using, and the

first portion of the filtrate should be returned to the filter for recirculation until the oil is found to have the desired resistivity. A centrifugal clarifier is particularly desirable in that the possibility of contamination by the filter medium is precluded.

As is well known, successive contact treatments using a small percentage of adsorbent are more economical than a single treatment with a larger percentage of adsorbent. While fuller's earth of the best grade, 200 mesh and finer, is especially effective, bentonite, "Filtrol" and certain activated carbons and clays have also been found to yield good results.

In order to avoid fortuitous losses or variation in the resistivity of the oil during processing and storage it is important that all piping, handling equipment, and storage vessels be thoroughly clean. To assure the order of cleanliness required, it is desirable to wash the same successively in soap and water, in distilled water, alcohol (methyl or ethyl) and benzene or toluene (99–100%) all hot. Because of its tendency to cause the oil to lose resistivity, the processed oil should be shielded from strong light.

If the percolation method of adsorbent treatment be employed, a hot-water-jacketed percolator is suitable, to maintain a temperature of approximately 170 degrees F. 16–30 mesh fuller's earth or coarser may be used, and the oil forced through either by pressure or vacuum. The ends of the percolator may be stuffed with glass wool held in place by perforated plates or screens. If the initial resistivity of the oil is low, it is advantageous to use two percolators in series, whereupon the second can be substituted for the first after the earth in the first one is exhausted. Resistivity as high as 40,000 megohms at 80 degrees F. has been obtained using a four-foot percolator filled with 16–30 mesh dried fuller's earth. By supplementing the percolation treatment with a single contact treatment using fine-mesh earth, maximum resistivity, in the order of 100,000 megohms at 80 degrees F. can be attained.

It is understood that in its broader aspects the processes as described herein are applicable to any of a wide variety of substances that are liquid at the temperature of treatment and that are immiscible with water. They are particularly useful for the refining of fatty acid esters or mixtures thereof such as vegetable oils, fats and waxes, which have a tendency to form stable emulsions with water, and so render thorough water washing difficult, and promote hydrolysis in such water washing.

It is apparent that many other fatty acid derivatives, such as ketones of the type that form stable emulsions under the conditions of neutralization may be freed of uncombined acid or of adsorbable constituents or of both in the manner disclosed. Synthetic compounds of this type which, as a result of their method of preparation, are likely to have free mineral or other acid present therein may be freed of such acid by subjecting them to the process of the present invention. Comparatively pure esters, in the category of dielectrics such as glycerol tri-ricinoleate, which is the principal ingredient of castor oil, and others, whether isolated from natural products or synthetically prepared, will be radically improved for electrical and other purposes when processed according to the present invention.

A great many specific procedures for producing a nearly neutral castor oil of extremely high resistivity and low power factor may be worked out by those skilled in the art in the light of the foregoing teachings. In technical compliance with the statutory requirements, detailed specifications now follow of three procedures that may be taken as typical, it being understood by those skilled in the art of oil refining that details of technique may be varied within wide limits without detracting from the quality of the final product.

Method I

A sample of the oil to be neutralized is tested for free fatty acid and the bulk of the oil is then agitated with approximately one and one-half times the quantity of 20 per cent caustic soda solution theoretically needed for complete neutralization. The temperature at this stage of the process is not critical, and may conveniently be between 110 degrees and 160 degrees F. but should not exceed 185 degrees F. The mixture, thus neutralized, is agitated approximately 15 minutes with one per cent of 200-mesh fuller's earth at a temperature in the vicinity of 160 degrees F. More or less fuller's earth may be required, depending on the quantity of soap stock to be removed, but the percentage of earth used should be the lowest that will accomplish a satisfactory removal, since larger amounts, as above noted, tend to increase the free fatty acid content.

The fuller's earth, absorbed soap stock, caustic, water, etc., are separated from the oil by filtration or centrifuging in the usual manner. The first fuller's earth treatment will accomplish very nearly complete removal of water and soap, but the product will have a relatively low resistivity. A three per cent treatment with 200-and-up mesh dried fuller's earth, involving agitation for 30 minutes or longer at 170 degrees F. followed by filtering through a clean filter will increase resistivity materially, and if this treatment with three per cent fuller's earth be repeated a second time, the resistivity will be close to the maximum attainable value in most cases, although some samples may require additional treatment. The usual filter aids previously dried, may be added to the earth to obtain a satisfactory rate of flow.

In cases where the fatty acid content of the oil is comparatively large, such as five per cent or more the presence of large proportions of products of neutralization may result in great retardation of flow through the filter. In such case the foregoing method of treatment may be modified by only partially neutralizing the fatty acid present in the first neutralization step, treating with one per cent fuller's earth to remove soap stock, filtering, and then giving the product a second neutralization and one per cent absorbent treatment, whereby the remainder of the fatty acid is removed. In order to effect partial neutralization in the first step, either exactly theoretical, or, in some cases, less than theoretical quantity of caustic required to neutralize may be used. Then, in the second and final neutralization step, an excess of say 25 to 50 per cent, may be used to effect neutralization. Cases may conceivably arise where it may be advantageous to split the neutralization up into three or more fractional stages.

Method II

The warm oil is agitated 15 minutes or longer with the theoretical amount of 20 per cent caustic soda solution or other equivalent base required for complete neutralization of the fatty acid present as in Method I. It is then passed through

a sufficient depth (say 8 or 10 inches) of dried, comparatively coarse (say 16–30) mesh fuller's earth or similar absorbent at about 170 degrees F., to effect substantially complete removal of soap stock, but not so deep a layer of earth as to retard the rate of flow excessively. This treatment will result in a partial removal of the free fatty acid originally present in the oil, leaving a residual acid content which may be in the neighborhood of .25 per cent.

A second neutralization treatment is then given using approximately 50 per cent excess of caustic, and the oil is again percolated through coarse earth as in the first treatment.

The product which should now have less than .1 per cent free fatty acid is subjected to further adsorbent treatment with 200-and-up mesh fuller's earth or its equivalent, as was described under Method I. Two three per cent treatments will usually give the desired high resistivity and low power factor.

Method III

The castor oil is treated with caustic soda solution, or other suitable base, as described under Method I. The stirring should be done gently to avoid excessive emulsification. About fifteen minutes of this treatment is sufficient for the reaction to proceed to equilibrium.

The mass is then centrifuged, preferably in a high-speed centrifugal machine of either the clarifier or separator type. If a clarifier be employed, separation is carried out at low temperatures, 80 degrees F., or less, and the soap stock adheres as a stiff gel to the outside of the bowl. If the separator-type of centrifuge be used, higher temperatures are desirable, permitting the liquid soap stock to emerge as heavy component and the substantially soap-free oil to emerge as light component. If the oil being treated is of high density, as may be the case with halogenated oils, it may comprise the heavy effluent, and the soap stock would be the light effluent.

Even with high speed centrifuges of great efficiency, the oily product will still contain substantial amounts of soap stock, excess neutralizing agent, and water. These are readily removed by treating with fuller's earth, bentonite, "Filtrol," or other similar adsorbent, which has previously been dried.

As is well understood in the art,. the quantity, percentage, and kind of adsorbent used, and the number of treatments and temperature may vary widely and still give a satisfactory final result. In the present case, a 1 per cent treatment for 15 to 30 minutes with 200-and-up mesh fuller's earth at 170 degrees F. followed by two 3 per cent treatments under conditions similar to the first, will, usually, yield a product of high resistivity and less than .1 per cent free fatty acid (calculated as oleic). It is important that the filtering medium used for the removal of adsorbent be as free as possible from metallic salts, moisture, free acid, and other ionizable substances. Even when so free, it is a good practice to re-circulate the first portion of the filtrate through the filter to obtain maximum quality.

An example will now be given to show the special applicability of the process of the present invention in the manufacture of castor oil-impregnated electrical condensers.

The oil as received from the refiners is subjected to treatment according to one of the typical methods described above, to reduce the free acid content to .1 per cent or less (calculated as oleic) and to improve the resistivity to the desired high value.

Following the impregnation of condensers in the usual manner, the oil in the impregnation tank is tested for free acid. If a substantial rise in free acid has occurred for any reason, as for instance, due to oxidation, to deterioration under heat, or to contamination of the oil by traces of acid present in the paper of the condenser sections, a small amount of caustic soda or the equivalent, sufficient to neutralize the acid present, is stirred into the oil in a mixing tank at any temperature under 170 degrees F. This may conveniently be done while the oil is being heated to 170 degrees F. for subsequent fuller's earth treatment. After agitating with caustic for about 15 minutes, 1 per cent of dried 200 mesh fuller's earth is added and stirring is continued one-half hour longer, after which the mixture is filtered. Alternatively, the oil-caustic mixture may be percolated through relatively coarse fuller's earth.

The product is tested for resistivity and, if necessary, treated again with fuller's earth, preferably by contact with fine earth, to improve the resistivity to the desired value. The oil so treated is suitable for further impregnation cycles.

If no substantial rise in free acid content occurs during impregnation, the caustic treatment may be omitted and fuller's earth treatment only be resorted to. Thus, under favorable conditions, it is possible to carry on several impregnation cycles without neutralization. But, when finally the free acid content rises, neutralization and adsorbent treatments are given as described.

In this manner, a uniformly high quality of castor oil impregnant is maintained throughout successive impregnation cycles, and all waste of impregnant is avoided.

While castor oil lends itself particularly to the treatment of the present invention, it is understood that such treatment is also advantageous for the treatment particularly of water-immiscible oils or esters, of such oils and esters that have a tendency to form stable emulsions with water, those that are hydrolyzed by water and those that are thus rendered capable by treatment with aqueous neutralizing agent.

As many changes could be made in the above process and many apparently widely different embodiments of this invention could be made without departing from the scope of the claims, it is intended that all matter contained in the above description shall be interpreted as illustrative and not in a limiting sense.

What we claim is:

1. The process of removing free acid from castor oil of the type that forms stable emulsions with water which consists in bringing into contact with the oil a neutralizing agent in aqueous solution, bringing the oil together with the soap stock formed therein into contact with substantially the minimum quantity of fuller's earth capable of complete removal of the soap stock and finally separating from the oil solid and absorbed aqueous matter, including the soap stock.

2. The process of removing free acid and adsorbable matter from castor oil, which consists in bringing the oil into contact with an aqueous alkaline solution in quantity insufficient to neutralize, removing the bulk of the reaction product and of the aqueous matter, thereupon bringing the oil into contact with additional aqueous alkaline solution in quantity sufficient to effect complete neutralization, then bringing the oil into contact with a water absorbent, in the ab-

sence of further added water, removing the absorbent with the matter absorbed thereby from the oil, and finally bringing the substance into contact with fuller's earth in the absence of further added water, separating the fuller's earth from the mass and repeating said fuller's earth treatment until the electrical resistivity of the resultant product has reached substantially a maximum, each of said fuller's earth treating steps being conducted under conditions that preclude the substantial deterioration of the castor oil.

3. The process of removing free acid and adsorbable matter from castor oil, which consists in bringing the oil into contact with an aqueous solution of a neutralizing agent, bringing the product, including the soap stock formed therein, into contact with fuller's earth, removing the fuller's earth with the matter absorbed thereby from the oil and repeating said fuller's earth treatment until the electrical resistivity of the resultant oil has reached substantially a maximum, each of said steps being conducted under conditions that preclude the substantial deterioration of the oil.

4. The process of removing free acid and adsorbable matter from castor oil, which consists in bringing the oil into contact with an aqueous solution of a neutralizing agent, bringing the product including the soap stock formed therein into contact with a water absorbent material selected from the group consisting of activated clays and activated carbons, removing said water absorbent material with the matter absorbed thereby from the oil, then bringing the oil into contact with an adsorbent selected from the group consisting of activated clays and activated carbons, separating the adsorbent from the mass and repeating said adsorbent treatment until the electrical resistivity of the resultant product has reached substantially a maximum, each of said adsorbent treating steps being conducted under conditions that preclude the substantial deterioration of the oil.

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