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# REFINING OF FATTY OILS AND FATS

Frank E. Sullivan, Staten Island, N. Y., assignor to The De Laval Separator Company, Poughkeepsie, N. Y., a corporation of New Jersey

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This invention relates to the refining of fatty oils and fats, particularly vegetable oils and fats, with the use of caustic soda as a refining agent. It has for its principal object the provision of an improved refining process of this character for removing free fatty acids from the material, with a smaller refining loss than has been possible heretofore.

Crude vegetable and animal oils and fats are commonly refined with caustic soda in order to remove free fatty acids, coloring matter and non-glyceride impurities. In the conventional caustic soda refining method, the oil is treated with fairly strong lye and intimately mixed, the lye reacting with free fatty acids and any phosphatides present to form soap. The resulting soapstock or "foots" is removed from the refined oil by settling or centrifuging.

The difficulties encountered in caustic soda refining are principally those of entrainment of neutral oil in the soapstock and saponification of neutral oil by the lye, both of these resulting in high refining losses, which are very undesirable. In certain non-phosphatidic oils, entrainment is due principally to the soaps formed during the refining operation, while in phosphatidic oils, such as corn oil, soybean oil and cottonseed oil, the soaps are also aided by the phosphatides in emulsifying or entraining the neutral oil.

I have found that when intimately mixed, phosphoric acid reacts with various components in crude vegetable oils and fats (which are here regarded as oils) to form a complex addition compound with the phosphatides present in the crude. I have further found that the reaction compounds thus formed will then react with the refining lye or caustic soda in the conventional neutralizing process, thereby forming de-emulsifying agents concurrently with the neutralization of the fatty acids, which results in lower refining losses.

My tests have shown that the intimate mixture of crude vegetable oil and small amounts of phosphoric acid requires less than the calculated amount of sodium hydroxide or lye to neutralize the fatty acids and phosphoric acid present in the mixture (the calculated amount of NaOH being that normally expected to react with the fatty acids plus the added phosphoric acid in the mixture). This indicates that the phosphoric acid is at least partially reacted with the phosphatidic compounds present in the crude oil. The addition compounds of this reaction then have a very important effect on the formation of the soap in the ensuing neutralization step, in that they cause a liquefication of the soapstock and, by their buffer action, tend to reduce the saponification of the neutral oil while at the same time lowering the amount of occluded neutral oil in the soapstock. This treatment thus permits more complete separation in the centrifuges used for separating the soapstock from the oil, giving an overall decrease in the refining loss.

The amount of phosphoric acid required in the new process is small, the amount on a full strength basis being in the order of 0.1% to 0.4% by weight of the crude oil. Thus, when using a standard commercial 75% solution of phosphoric acid, amounts in the order of 0.13% to 0.53% by weight of the crude oil are required. Generally, the equivalent of full strength of phosphoric acid in an amount of about 0.2% by weight of the crude oil is sufficient for most purposes. The phosphoric acid is added to and intimately mixed with the crude oil prior to the introduction of the refining lye, so that the addition compounds of the reaction are formed by the time



the lye is added. The lye is preferably added in an amount which is only slightly in excess of that theoretically required (the stoichiometric amount) for neutralization of the free fatty acids in the oil, an excess of 0.1% to 0.5% of sodium hydroxide being preferred. The latter may be added continuously to a stream of the oil after the phosphoric acid and oil have been thoroughly mixed. The refining lye is thoroughly mixed in the oil and phosphoric acid mixture. The resulting mixture of oil and soapstock is then passed to a centrifugal separator at an emulsion-breaking temperature, usually 60°–80° C., so that the soapstock is continuously separated from the refined neutral oil. The centrifuge may be of any conventional type used for separating soapstock from oil.

The following are specific examples of the practice of the invention:

*Example 1*

To a batch of crude cocoanut oil, 0.2% (by weight) of a 75% solution of phosphoric acid was added, and the entire mass was well agitated and heated to 60° C. This mixture was then pumped through a high speed mixer, at which time the refining lye (NaOH) was continuously proportioned into the flow of the mixture of crude oil and phosphoric acid. The refining lye was continuously added to the mixture in the proportion of 11.7% by weight, using 12° Bé. lye (which is a 0.1% excess of NaOH over the theoretical amount required to neutralize the free fatty acids). The refining mixture was heated to 70° C. while flowing through the high speed mixer and was then fed continuously to a continuous centrifugal separator, where the soapstock was removed continuously from the refined neutral oil. The refining loss on a dry basis was 6.3%. The crude cocoanut oil had a free fatty acid content of 6.0% and an absolute Wesson loss of 6.3% on a dry basis. A refining loss equal to the theoretical loss of the crude oil was obtained.

*Example 2*

To a batch of crude cocoanut oil with a free fatty acid content of 6.6%, 0.15% (by weight) of a 75% solution of phosphoric acid was added with sufficient agitation to insure an intimate mixture. The entire mixture was heated to 60° C. and was then refined by the procedure described in Example 1. The amount of lye used was 13.9% (by weight) of 12° Bé. sodium hydroxide (which is a 0.12% excess over the theoretical amount required to neutralize the free fatty acids), the lye being proportioned continuously into the crude oil-phosphoric acid mixture. The refining loss on a dry basis was 6.9%. The crude cocoanut oil had an absolute Wesson loss of 6.8% on a dry basis. A refining loss was obtained which was very close to the theoretical loss of the crude oil.

*Example 3*

A crude peanut oil at 30° C. was continuously proportioned or fed to a high speed mixer, at which time a small amount of a 75% solution of phosphoric acid (0.2% by weight) was continuously fed into the oil and intimately mixed with it. The crude oil-phosphoric acid mixture, after emerging from the mixer, was fed to a second high speed mixer, where the refining lye was continuously proportioned into the crude oil-phosphoric acid mixture in the amount of 8.4% of 12° Bé. lye (0.36% excess NaOH over the theoretical amount required to neutralize the free fatty acids). The entire intimate mixture was heated to 60° C. for a "break" and then fed to a continuous centrifugal separator. There the soapstock was continuously separated from the refined neutral oil. The refining loss, on a dry basis, was 6.5%, while the AOCS cup loss was 8.1% on a dry basis. The absolute Wesson loss was 5.5% on a dry basis. A reduction of 20% in cup loss was obtained, or, based on the Wesson loss, a ratio of 1.19 times Wesson loss. This particular peanut oil was of very poor quality and had a very high phosphatide content.

*Example 4*

A small amount of 75% phosphoric acid (0.1% by weight) was continuously added to a continuous stream of heated crude cottonseed oil (FFA 20) at a temperature

of 40° C., in such a manner as to form an intimate mixture. Sodium hydroxide in the form of 16° Bé. lye, using 0.4% excess as NaOH, was accurately proportioned in a continuous manner into the crude cottonseed oil containing the phosphoric acid. The mixture was then intimately mixed and heated to 70–80° C. in order to break the emulsion. The mixture was then passed through a centrifugal separator in a continuous manner in order to separate the refined oil from the soapstock. The soapstock was discharged continuously as a dark, very fluid material. The resulting refining loss was 4.5% on a dry basis. The cup loss was 9.0% on a dry basis. The reduction in refining loss was 50%.

I claim:

1. In the refining of fatty oils, wherein caustic soda is mixed with the crude oil to neutralize the free fatty acids therein, and in which the resulting soapstock is separated from the refined oil, the improvement which comprises adding phosphoric acid to the crude oil in an amount, on a full strength basis, in the order of 0.1 to 0.4% by weight of the crude oil, and reacting it with the oil to form addition compounds prior to the mixture of the caustic soda with the oil, thereby reducing the subsequent refining losses, and then introducing the caustic soda into the mixture and centrifuging the mixture at an emulsion-breaking temperature.



2. The improvement according to claim 1, in which the caustic soda is added to the oil in an amount approximating the theoretical amount required to neutralize the free fatty acids in the crude oil.

3. The improvement according to claim 1, in which the caustic soda is added to the oil in an amount approximating 0.1–0.5% in excess of the theoretical amount required to neutralize the free fatty acids in the crude oil.

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