Bleaching Practices in the U.S.

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ABSTRACT

The differences between European and U.S. vegetable oils with respect to their influence on bleaching requirements are discussed. Based on the information supplied by over 50 refiners, a summary gives an insight into bleaching conditions with earth and heat. These data are condensed in a chart relative to most used oils and fats. General information on pre- and post-bleach is also indicated.

When I was assigned to present this paper and scheduled after the presentation of bleaching practices in Europe by Mr. Patterson, I started to contemplate immediately about the possible processing differences between Europe and the U.S. Since technical processes are designed and executed according to objective necessities, different necessities must be the cause—in our case as well—for differences in practices in bleaching. If there were no differences, it would make no sense to present this paper at all.

Europe of necessity imports most of its oilseed and crude oil requirements. The U.S., however, is partly self-supplying, partly exporting (as in the case of soybean, cottonseed oil, and tallow), and partly also an importer of vegetable oils (as in the case of palm, safflower, sesame, and castor oil). That means that the European refiner deals mostly with raw materials from overseas which are normally harder to bleach because of their age. The U.S. refiner, however, has to cope with both very fresh local oils just out of the press one day and aged oils from abroad the next. These aged oils may have been exposed for months between harvesting, shipping, and storing to all kinds of climatic changes—oxygen, humidity, and temperature.

All these changes increase and fix the color of an oil. Consequently, requirements for the bleaching process also increase with respect to temperature, type, and amount of bleaching clay applied.

There are also some regional differences in color and color fixing of an oil. For example, a cottonseed oil from Texas is normally much lighter than the same oil from Mexico or Colombia; colors get darker from the north towards the equator and lighter again when we go further south into Brazil or Peru.

Finally, there is a seasonal difference in the harvest of an oil which is also reflected in its bleachability. Oils are normally easier to bleach at the beginning than at the end of a season.

As a matter of fact, American oil producers try—sometimes successfully, sometimes not—to influence the bleachability of an oil right from the harvest. A classic example is the harvest of palm fruit: choice of the right maturity, avoidance of bruising the fruit, immediate sterilization, avoidance of exposure to water, high temperature, air, and contact with iron or copper.

Practically all these measures are taken for one reason—to minimize the increase of free fatty acids (FFA), which grow in amount completely parallel to the bleachability or the bleaching requirements of an oil. As an extreme example, the negligence of these measures could increase the FFA content in a palm fruit from 3 to 60% during harvesting and inadequate storage and greatly increase the bleaching problems.

As producers of bleaching clays, we had to become quite familiar with all these differences because we supply practically all different regions with clays for use with the whole range of oils and fats to be bleached. We also continually countercheck with our parent company in Europe. From our experience in bleaching, we can say that a crude oil is not just a stable chemical composition with fixed properties: it is an ever changing material which, by refining and bleaching, is stabilized and transformed into a more durable product.

Let us look now at our process chart (Fig. 1), which demonstrates two alternate refining processes for palm oil. This chart can be considered representative for other oils, which more or less follow the same process pattern, the main difference being that some oils are degummed, some not. Whatever process or modification is followed, bleaching is always in the *heart* of the refining process. Its conduct is essential for the quality and economy of the finished product.

To present you with an unbiased and more or less representative picture about bleaching practices in the U.S., I conducted—with the help of our U.S. representative, Henry Salomon, and Augi Rossetto—a poll with questions that I thought would be important for our purpose. From about 100 experts who received questionnaires from us, we got almost 50 answers before closing time. I want to thank all who contributed their information, and also Augi Rossetto for collecting the replies.

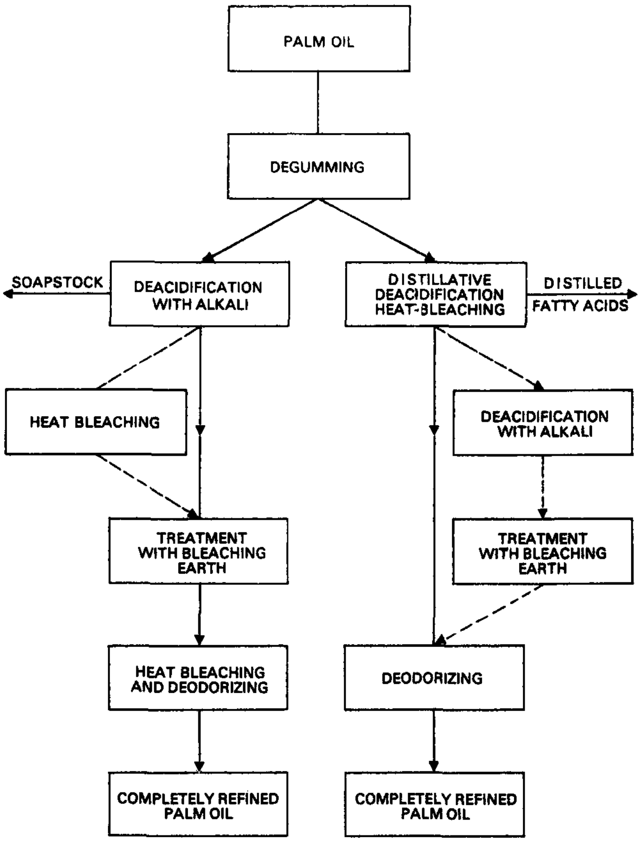

FIG. 1. Processing of palm oil.

PRODUCT	Bleaching Temperature C	Bleaching Temperature F	Bleaching Clay applied: Grade of Activation	Percentage range	Percentage average	Remarks
OILS:						
1) Cottonseed	85-95	185-195	high	0.5-2.0	1.0	
2) Soybean	90-95	190-205	high	0.4-1.5	1.0	
3) Sesame	80	175	mild	0.5-1.5	0.6	If there is Chlorophilla, some activated carbon is added.
4) Safflower	85-90	185-190	medium	0.8-1.2	1.0	
5) Peanut	80-85	175-185	medium	0.8-2.0	1.2	
6) Palm (Pulp)	140-150	280-305	high	1.0-2.0	1.2	
7) Palm (Kernel)	90	195	mild	none-0.8	0.5	
8) Coconut	90	195	mild, when fresh; extra high after storage	none-0.8	0.5	
9) Sunflower	90	195	medium	0.6-1.0	0.8	
10) Fish (anchovetta)	90-95	195-205	high	1.0-1.5	1.2	
11) Castor	90-95	195-205	high	0.8-1.5	1.0	
12) Corn	85-90	185-195	mild	0.5-1.0	0.7	
13) Babaçu	90	195	medium	0.5-1.0	0.8	
14) Linseed	90	195	medium	0.8-2.0	1.2	
15) Rapeseed	90-95	195-205	high	0.8-1.5	1.0	
16) Olive	80-85	175-185	mild	0.6-1.2	0.8	
17) Mineral regenerat.	200-250	390-480	mild + high (extra)	1.0-2.0	1.5	
FATS & WAXES						
18) Tallow	90-95	195-205	high (extra)	1.0-2.0	1.2	+ acid
19) Paraffin	140-150	280-300	high (extra)	1.0-2.0	1.5	+ acid
20) Waxes nat.	110-120	230-250	high (extra)	1.0-2.5	1.8	
21) Carnauba	125	280	high (extra)	1.5-2.5	2.0	+ Peroxide

FIG. 2. Bleaching conditions for oils, fats, greases, and waxes under atmospheric pressure. Contact time (reaction between clay and product) varies between 15 and 30 min.

We got information about almost all the usual oils which are used in the U.S.: soybean, cotton, palm, coconut, peanut, safflower, sesame from Mexico, and also tallow from the U.S., fish oil from Peru, castor oil from Brazil, and coconut from Jamaica.

The questions posed were the following:

1. Which crude oils or fats are refined?
2. a. If degumming is necessary, is pre-bleach applied during this process (palm oil)?
   b. Is heat or earth bleach applied, or a combination of both?
   c. What is the type and percentage of clay used?
   d. Are the bleaching temperature and pressure applied normal or vacuum?
   e. Is batch or continuous bleach used?
3. Is post-bleach or polishing used?
4. For hydrogenated products, which bleaching practices are applied (pre- or post-or both)?
5. What percentage of bleaching effect is contributable to the deodorizing effect (heat bleach)?

In the very short resume that our limited time allows, we can make the following conclusions:

1. Almost all vegetable oils, including animal fats and marine oils, are earth bleached, with different grades of activation of the bleaching clay used.
2. The percentages of the clays used vary in a wide range from 0.15 to 3% according to the type of oil and its state of color required; only in extreme cases are higher percentages of clays used. In case of chlorophyll impurities which result in a greenish color, as in sesame oil, small amounts of activated carbon are added to the bleaching clay. This wide percentage range of clay applied and also its grade of activation reflect very logically the wide range of oils processed in the U.S., as mentioned before, to fulfill the color requirements for the different uses (margarine 4-5 red, first grade frying fat 2-2.5, cooking fat 2.0, and white shortening 1.5 red max. in the 5-1/4 lovibond cell).
3. Heat bleach is considered highly responsible for the reduction in color, especially the destruction of carotenes in the deodorizer. However, many experts feel strongly that bleaching should be sufficient and according to color requirements *before* the oil goes through the deodorizer as the final stage of the refining process.
4. The tendency seems to go in the direction of a combination of heat and earth bleach, with the inclination to keep the bleaching and deodorizing temperature as low as possible. Figure 2 shows a summary of the bleaching conditions for different oils, temperature at normal pressure, and type and percentage of clay used. Some extremes are not mentioned here. However, they would most probably fit into our pattern if we consider the special conditions of the oil in its crude stage.

PRE-BLEACH	Improving of oil for further treatment (heat, vacuum, or steam distillation, miscella, etc.) Degumming aid, replacement of phosphoric acid
MAIN-BLEACH	Decolorizing
POST-BLEACH	Polishing Removal of catalyst traces in hydrogenated products

FIG. 3. Function of bleaching clays and derivatives in different stages of oil refining.

One last short word may be said about what is called pre-bleach and post-bleach in our questionnaire as an addition to the regular classical main bleach process. Some refining processes, which in themselves include the decoloration of an oil, may be greatly improved by the addition of bleaching clay in the preparation of the oil for further treatment (i.e., in the degumming stage of palm oil) or the preparation of an oil for steam refining or during the filtering of miscella refined oils. This we classify as pre-bleach. Polishing of some oils is called post-bleach such as, for example in the removal of catalyst traces after hydrogenation. The purpose of this is to prevent the negative influences of nickel or copper on the stability of a finished oil or fat (Fig. 3).