Factors in the Decolorizing of Tallow. I. Addition of Water with the Adsorbent

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CONSIDERABLE information has been published describing the various factors involved in decolorizing (bleaching) vegetable oil, such as deterioration of bleaching response of any oil upon ageing (2), optimum decolorizing temperature (8), optimum temperature at which the adsorbent is added (8), effect of decolorizing upon the keeping quality of the oil and upon color stability (6). There has been correspondingly little published on animal fat decolorizing although such information is important to the refiner of animal fat because the quality of the finished detergent, emulsifier, or industrial oil produced from the fat is greatly dependent upon these factors. Filtrol Corporation has conducted work in its laboratory on the various phases of tallow decolorizing, and this article represents the first of a series on the subject.

It is generally believed by refiners of tallow that, in atmospheric batch decolorizing with an activated adsorbent, the presence of water in the tallow gives a lower bleached color than when the tallow is dry. There also is evidence that the tallow bleach is enhanced by the addition of water at the time the decolorizing adsorbent is introduced. On the other hand, in vegetable oil decolorizing the improvement has been either very slight, nil, or negative when the oil is wet compared to its being dry, or when water is added with the adsorbent. The work reported herein was conducted to confirm the enhancement of the tallow bleach when the adsorbent is supplemented with water, and to determine the relative degree of enhancement with activated compared to natural adsorbents.

Effect Upon Bleached Color of Adding Water with the Decolorizing Adsorbent

Each of three tallows, dry rendered under vacuum, was decolorized with an activated adsorbent, using varying percentages of the latter, first on the tallow with no water added, then with water added at the same time the adsorbent was introduced. The results are illustrated in Figures 1-3, each figure representing the results on a different tallow.

The tallow in the Fig. 1 tests merely was filtered through duck cloth at 125° F. before decolorizing. The tallows used in the Figure 2 and Figure 3 tests were dried and clarified by mixing 0.5% Hyflo Super Cel with 100-lb. batches of fat at 125°F., under 7 mm. vacuum for one hour, and filtered before decolorizing. All three tallows were melted overnight at 120°F. before use, and their analyses just prior to decolorizing were as follows:

	Fancy Tallow, Figure 1	Fancy Tallow, Figure 2	Fancy Tallow, Figure 3
Free fatty acid (%)	1.62	1.45	3.15
Titer (°C.)	43.0	.....	42.1
Moisture (%)	0.20	0.07	0.00
Lovibond color (5¼" col.) (Y–R)	100–19.0	90–20.5	70–9.0[a]

[a] One-inch column.

Each of the three tallows was decolorized in the laboratory with varying percentages of the Official A.O.C.S. Activated Adsorbent (a selected lot of Special Filtrol[1] adsorbent), employing a modification of the A.O.C.S. Official Method Cc 8c-49. The modified method, henceforth referred to as the "modified standard method," was as follows:

1. Three hundred grams of melted tallow at 120-130°F. are added to the refining cup specified in Method Cc 8c-49, followed by the adsorbent.
2. Employing the equipment designated in the A.O.C.S. Method, the fat is agitated at 250 ± 10 r.p.m. throughout the bleach.
3. Heat is applied and the temperature increased to 250°F. in 5-7 minutes.
4. Temperature is maintained at 250°F. for 15 minutes.
5. The fat is filtered immediately following (4) through a dry Whatman No. 2 filter paper, and Lovibond color determined.

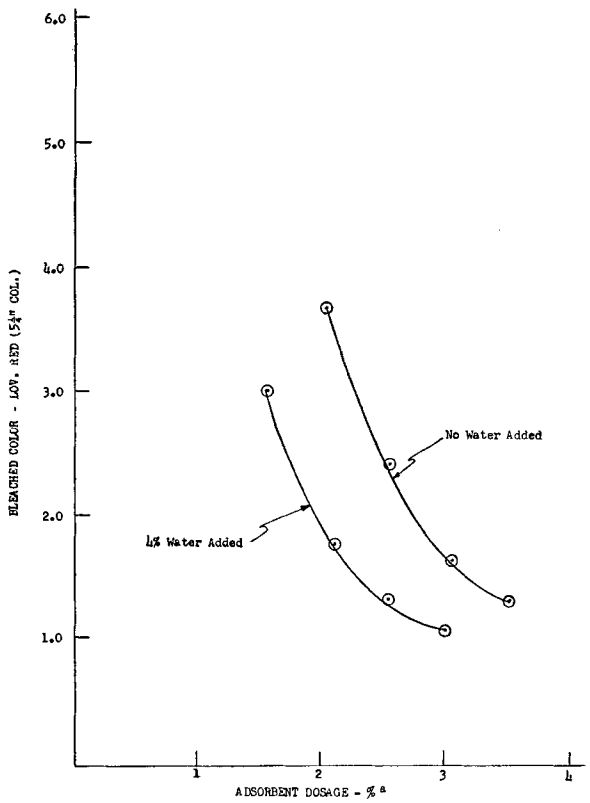

FIG. 1. Laboratory bleach tests on Fancy Tallow with Official A.O.C.S. Activated Adsorbent varying the adsorbent dosage.
[a] Basis weight of tallow.

The three tallows next were decolorized by the modified standard method, again using varying dosages of the adsorbent but adding 4% of water with the adsorbent, basis the weight of fat, in the case of the tallow used in Figure 1 and 3% in the cases of the tallow in Figure 2 and Figure 3.

It will be observed from Figures 1-3 that in every case the addition of water with the adsorbent was

[1] T. M. Reg. U. S. Pat. Office.

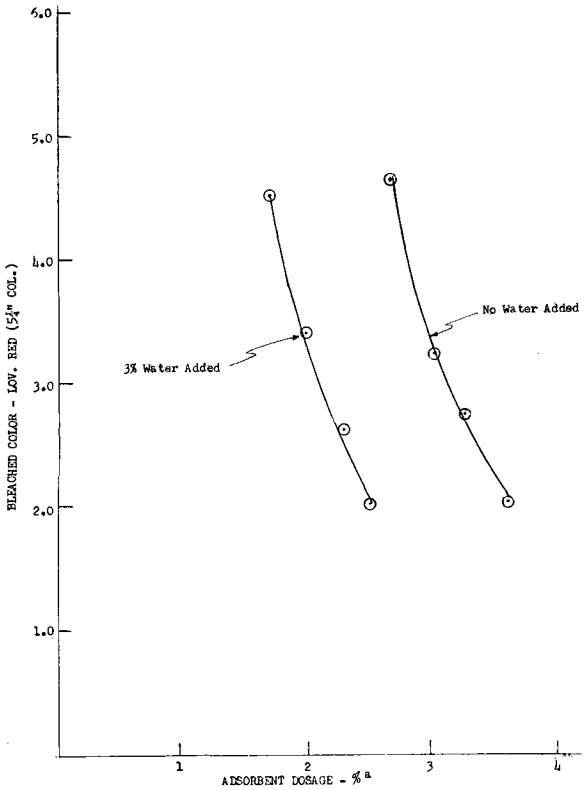

FIG. 2. Laboratory bleach tests on Fancy Tallow with Official A.O.C.S. Activated Adsorbent varying the adsorbent dosage.
[a] Basis weight of tallow.

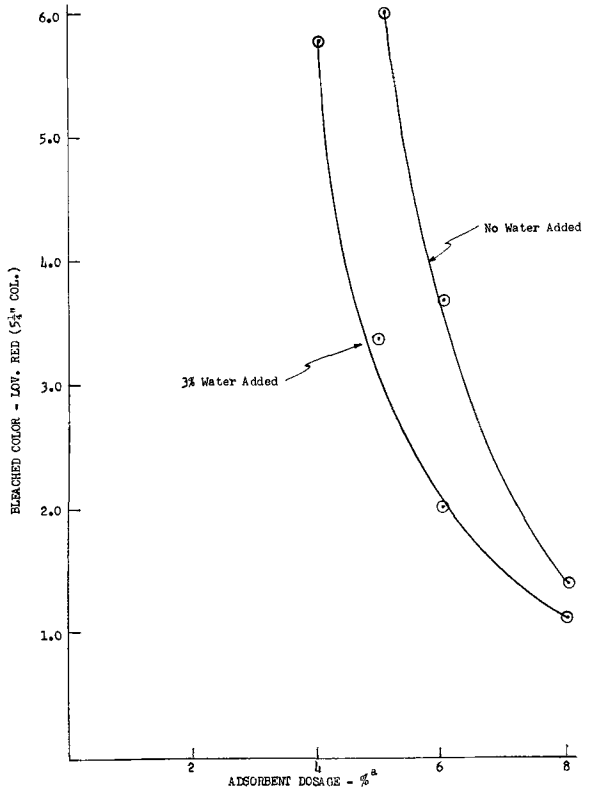

FIG. 3. Laboratory bleach tests on Special Tallow with Official A.O.C.S. Activated Adsorbent varying the adsorbent dosage.
[a] Basis weight of tallow.

accompanied by a reduction in color over that obtained when no water was used. This occurred both on the tallow containing 0.20% water (Figure 1) and on the dry tallow (Figure 3).

Effectiveness of Adding Water with Different Types of Adsorbent—Laboratory Bleach Tests

A Fancy Tallow and Special Tallow, each dry rendered under vacuum, respectively, were bleached with varying dosages of an activated adsorbent, first with no water added, then with water added. The tests were repeated using a natural adsorbent. The results on the Fancy Tallow are given in Figure 4, on the Special Tallow in Figure 5.

The tallows before decolorizing were dried and clarified by mixing 0.5% diatomaceous earth with 100-lb. batches of fat at 160°F. under 7 mm. vacuum for 30 minutes and by filtering. This was carried out just prior to decolorizing, and the analyses of the tallows at that point were:

	Fancy Tallow, Figure 4	Special Tallow, Figure 5
Free fatty acid (%)	2.60	9.72
Moisture (%)	0.98	0.34
Color (FAC)	9	19

The modified standard method was used to decolorize, and the amount of water added when used was 1% basis the weight of fat. The activated adsorbent was the Official A.O.C.S. Activated Adsorbent while the natural adsorbent was a prominent commercial grade produced in Texas.

On both tallows, when water was added, a lower bleached color resulted with a given percentage of activated adsorbent, but the reverse occurred when the natural adsorbent was used. In the case of the activated adsorbent, the improvement effected with water was more pronounced at the lower dosage levels. There was no evidence that the no-water and water-added color curves approached each other at the higher dosage levels.

Effectiveness of Adding Water with Different Types of Adsorbent—Pilot Plant Bleach Tests

The same type of test, as was run in the laboratory-scale test just described, was conducted in a 90-lb. capacity batch open tank pilot plant. This work was undertaken because laboratory bleach results seldom agree quantitatively with those of the commercial scale plant. Normally the plant bleached color is better with a given percentage of adsorbent than is the laboratory bleached color. This is attributed 1) to the larger volume of fat used in the plant with less attendant oxidation, causing in turn less fixation of color during the operation, and 2) to the additional bleaching that occurs in the plant's filter press.

The variation between plant and laboratory results created a factor that needed to be investigated in the case of water addition to prove that its incorporation would be effective on a plant as well as on a laboratory scale. Use of the 90-lb. pilot-sized unit therefore provided a means of more closely approaching the conditions of the commercial operation.

The same Fancy and Special Tallows and same activated and natural adsorbents used in the laboratory tests were employed. The pilot unit was an open tank type with steam coils and 100 r.p.m. constant-speed, propeller-type agitator. A centrifugal pump conveyed the fat from the bleach tank to the filter press, a 12-in. plate and frame type fitted with cotton duck cloth.

Ninety pounds of melted tallow were introduced into the tank at 120°F., and the temperature was raised to 160°F. under agitation. At the latter level the adsorbent, or adsorbent plus water, was introduced, and the temperature raised to 235°F. The dosages of activated adsorbent used were 2 and 4% in the case of the Fancy Tallow and 3 and 5% in the case of the Special Tallow. Dosages of natural adsorbent were 4% on Fancy Tallow and 5% on Special Tallow. Each adsorbent dosage run was accompanied by another run, using the same dosage plus 1% added water.

Time to increase the temperature from 160°F. to 235°F. was approximately 30 minutes when no water was added and 40 minutes when water was added, the additional 10 minutes being required to boil off the water in the latter case.

The fat was held at 235°F. until samples taken every 5 minutes failed to show further decolorization, the time at 235°F. ranging from 15 to 20 minutes. At this point the tallow was recirculated through the press for 10 minutes to clarify it, then was pumped to storage. The filter press cloth used was No. 8 cotton duck. Results:

Adsorbent	Adsorbent dosage (%)	Bleached color (5¼" col.) 0% added water (Y–R)	Bleached color (5¼" col.) 1% added water (Y–R)
FANCY TALLOW			
Activated adsorbent	2	35–5.0	35–3.9
Activated adsorbent	4	21–2.2	14–1.9
Natural adsorbent	4	28–4.3	24–4.4
SPECIAL TALLOW			
Activated adsorbent	3	43–6.0	28–3.6
Activated adsorbent	5	24–2.8	24–2.3
Natural adsorbent	5	40–4.6	40–4.9

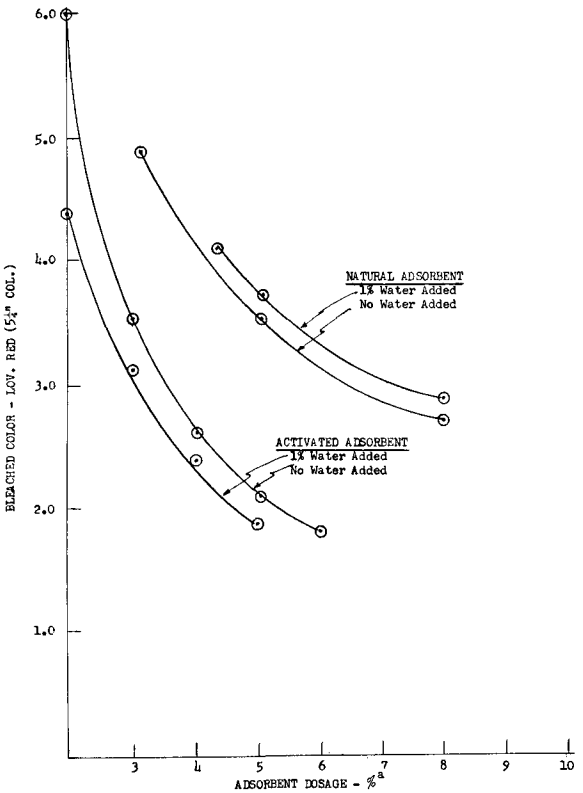

FIG. 4. Comparative laboratory bleach tests on Fancy Tallow activated *vs.* natural adsorbent.

[a] Basis weight of tallow.

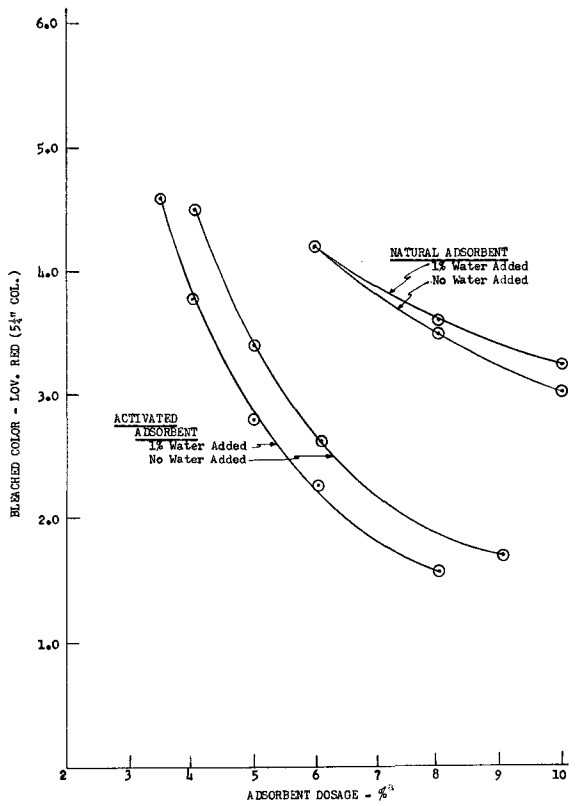

FIG. 5. Comparative laboratory bleach tests on Special Tallow activated *vs.* natural adsorbent.

[a] Basis weight of tallow.

The tests confirmed that the bleached color was markedly lower when 1% water was added and the activated adsorbent was employed. They also confirmed that the bleached color was higher when water was added in the case of the natural adsorbent.

Summary

Data have been presented demonstrating a substantial improvement in atmospheric batch decolorizing of tallow when an activated adsorbent was used by supplementing it with added water. Negative results were obtained under similar conditions with a natural adsorbent.

Studies on other phases of tallow decolorizing will be reported in subsequent articles.

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