compression, freon compression and steam-jet vacuum.

Since the major portion of the work must be done at relatively high temperatures, the freon compressor would seem to be preferable to the ammonia machine, because of the greater efficiency of the former at high temperatures.

The steam-jet-vacuum equipment, in cases where steam is relatively less costly than other forms of power, offers attractions in that it does not require any chemical other than water and is extremely efficient at moderately high temperatures.

When the type of refrigeration machine to be used has been selected it is necessary to determine the means of application of refrigeration to the cooling room and thus to the fatty acids in the pans.

With the freon machine, direct expansion coils may be used in the chilling room, or with the steam-jet machine, the refrigerating medium, water, may be pumped through similar coils in the room.

Modern tendency, however, is toward positive circulation of the air in the cooling room, which calls for adoption of air-conditioning methods, generally involving a bunker room containing the direct-expansion or cooling-water coils; a fan to develop positive air circulation through a system of insulated ducts leading to the cooling room and returning to the bunker room. Such a system can be equipped for positive circulation of air from outdoors during the winter season.

The design of this type of air-circulating system involves many problems, including selection of the proper volume and velocity of air, proper design of distributing system to insure contacting of all the pans by the cold air, suitable sizing of the refrigeration coils, the fan and the ducts, proper insulating of the ducts and correct proportioning of the return ducts to those used for cold air in order to avoid building excessive atmospheric pressure in the chilling room.

The correct mean temperature differences between the cooling air and the fatty acids and between the return air and the refrigerant coils are of utmost importance.

Freon and cold water here demonstrate their superiority over ammonia as refrigerant mediums in that they can be handled at higher temperatures in the cooling coils and are thus less likely to cause icing of the coils from precipitation of moisture from the circulating air.

In general terms, moving a relatively large volume of air at low velocity through a duct system so designed as to insure maximum contact of the air with the fatty acids in the pans and returning the air over refrigerant coils of large surface in which the refrigerant medium flows at temperature high enough to avoid excessive frosting or icing, will result in efficient solution of the problems involved. In some instances it may be necessary or desirable to interpose some type of air dryer such as one utilizing activated alumina, in the return ducts between the cooling room and the refrigerant coils.

In the light of modern progress of air-conditioning design those engineers specializing in this art are able to reduce to positive mathematical formulae all of the factors inherent in the design of such chilling equipment as has been herein discussed.

REPORT OF SOAP STOCK COMMITTEE AMERICAN OIL CHEMISTS' SOCIETY 1937-38

THE work of the Soap Stock Committee has been confined to a study of the official and optional official methods for the determination of total fatty acids in acidulated and non-acidulated soap stock. In order to compare the results given by the two methods, identical samples of acidulated soap stock were analyzed by the members of the committee (Table I).

TABLE I

Acidulated Soya Bean and Corn Oil Soap Stock (Sample 1).

	Official Method % T.F.A.	Optional Official or Wet Extraction Method % T.F.A.
Barrow	94.17	93.84
Lappen	90.33	94.31
Long	94.12	93.82
Reese	93.45	*91.79
Rich	95.09	94.78
Watkins	93.66	92.09
Average	93.47	93.44
High	95.09	94.78
Low	90.33	91.79

*1-125 cc. and 5-25 cc. extractions. 2-100 cc. and 2-50 cc. extractions 92.93% T.F.A.

Next, using the official method, experiments were conducted in which the fatty acid cake was dried at room temperature and at 50-55° F. With the optional official, or wet extraction method, the fatty acids were extracted with warm petroleum ether, varying quantities of solvent, and the solvent held in contact with the fatty acids over night. Tests were also made in which the fatty acids were dried at 100° C. and 105° C. The results of these tests are given in Table II. Two samples of acidulated corn oil soap stock were analyzed by several members of the committee using some of these modifications (Table III).

The data in Table II and III indicate that either method as now written gives satisfactory results. However, it appears that definite improvement can be made by rewriting both methods, making the directions more specific and consistent. Drafts of the methods containing these modifications were submitted to the committee. Additional improvements were suggested and incorporated.

In order to determine the effect of different amounts of solvent in the proposed wet extraction method, tests were made on two samples of acidulated soap stock using varying quantities of petroleum ether. These samples were also analyzed by the proposed dry extraction method (Table IV). Tests were made to determine the minimum number of extractions required in the wet extraction method (Table V).

Making only minor changes in the proposed methods a total of nine samples of soap stock and seven of acidulated soap stock were analyzed. In order to obtain as much data as possible, the work was divided so as to have most of the samples analyzed by three or four members. The results of the tests are given in Table VI, and summarized in Table VII.

The methods which were approved by the committee are as follows:

PROPOSED DRY EXTRACTION METHOD FOR TOTAL FATTY ACIDS OF ALL SOAP STOCK AND ACIDULATED SOAP STOCK, EXCEPT FROM COPRA AND PALM KERNEL OILS

Weigh out from a weighing bottle 8 to 10 grams of a well mixed sample of soap stock or 4 to 5 grams of acidulated soap stock and transfer to a 400 cc. beaker. Sa-

TABLE II

Results (As % T.F.A) Obtained Using Various Modifications in Procedure.

	Sample 2 Acidulated Corn Oil Soap Stock	Sample 3 Acidulated Corn Oil Soap Stock	Sample 4 Acidulated Soya Bean Soap Stock	Sample 5 Soya Bean Soap Stock	Sample 6 Refined & Bleached S/B Oil	Sample 7 Acidulated Cotton Seed Soap Stock	Sample 8 Cotton Seed Soap Stock	Sample 9 Cotton Seed Soap Stock	Sample 10 Acidulated Corn Oil Soap Stock	Sample 11 Soya Bean Soap Stock
OFFICIAL METHOD										
Fatty acid cake on filter paper dried at room temp. Fatty acids dried at 100° C.	93.43	91.86	88.46	47.02	95.53	94.18	38.04	48.64	92.53	25.34
Fatty acid cake on filter paper dried at 50-55° F. Fatty acids dried at 100° C.	92.65	91.67	88.72	47.04	....	93.88	38.16	48.49	....	25.22
OPTIONAL OFFICIAL OR WET EXTRACTION METHOD										
1-125 cc. and 5-25 cc. extractions. Fatty acids dried at 105° C.	91.99	92.13	88.60	47.27	94.84	94.24	38.33	48.77	92.61	25.02
1-125 cc. and 5-25 cc. ext. Held over night on first ext. Fatty acids dried at 105° C.	93.13	....	....	....	95.15	....	....	....	....	....
1-125 cc. and 5-25 cc. ext. with warm petroleum ether. Fatty acids dried at 105° C.	92.31	....	....	....	....	....	....	....	....	....
1-100 cc. and 5-50 cc. extractions. Fatty acids dried at 105° C.	92.60	92.80	88.60	47.49	....	94.36	38.28	48.62	92.99	24.79
1-100 cc. and 5-50 cc. extractions. Fatty acids dried at 100° C.	92.35	93.04	88.85	47.29	....	....	38.44	48.70	....	24.79
1-100 cc. and 5-50 cc. ext. Held over night on fifth ext. Fatty acids dried at 105° C.	92.51	92.52	88.82	47.28	....	94.40	38.61	48.85	92.76	24.94
1-100 cc. and 4-50 cc. ext. Held over night on third ext. Fatty acids dried at 105° C.	92.48	....	....	....	....	....	....	....	....	....
2-100 cc. and 2-50 cc. extractions. Fatty acids dried at 105° C.	92.15	....	....	....	94.56	....	....	....	....	....
2-100 cc. and 2-50 cc. ext. Held over night on first ext. Fatty acids dried at 105° C.	92.84	....	....	....	95.10	....	....	....	....	....
2-100 cc. and 2-50 cc. ext. Held over night on second ext. Fatty acids dried at 105° C.	92.34	....	....	....	....	....	....	....	....	....
2-100 cc. and 2-50 cc. ext. with warm petroleum ether. Fatty acids dried at 105° C.	92.48	....	....	....	....	....	....	....	....	....

TABLE III

Results (As % T.F.A.) on Two Samples of Acidulated Corn Oil Soap Stock Using Several Modifications of the Official and Optional Official Methods.

	Official Method				Optional Official Method			
	Fatty acid cake dried at 50-55°F.		Fatty acid cake dried at room temperature		1-125 cc. and 5-25 cc. extractions		1-100 cc. and 5-50 cc. extractions	
	Extract dried at 100° C.	Extract dried at 105° C.	Extract dried at 100° C.	Extract dried at 105° C.	Extract dried at 100° C.	Extract dried at 105° C.	Extract dried at 100° C.	Extract dried at 105° C.
Sample 2								
Long	93.40	93.26	*93.74	93.14	93.24	92.88	93.06	93.02
Rich	94.66	....	94.60	....	....	92.34	....	90.34
Watkins	92.65	....	93.43	....	....	91.99	92.35	92.60
Average	93.57	....	93.92	....	....	92.40	....	91.99
Sample 3								
Long	*93.60	93.20	93.28	93.00	93.16	93.04	93.06	92.96
Rich	93.65	....	92.89	....	....	92.10	....	92.87
Watkins	91.67	....	91.86	....	....	92.13	93.04	92.80
Average	92.97	....	92.68	....	....	92.42	....	92.88

*Fatty acid extract cloudy but was not refiltered.

ponify with 50 cc. of 95 per cent alcohol and 2 to 3 grams of stick potassium hydroxide or an equivalent of stock alcoholic solution of potassium or sodium hydroxide by heating on the steam bath under a watch glass with frequent stirring for at least 30 minutes. After saponification is complete, remove the watch glass and continue heating on the steam bath, with stirring, until the alcohol is driven off. To avoid oxidation, the soap should not be evaporated dryer than to a pasty mass. If necessary, a small amount of water may be added when most of the alcohol has evaporated.

When the alcohol has evaporated, add 200 to 250 cc. of distilled water and heat to complete solution of the soap. Add 3-5 drops of methyl orange indicator, acidify with dilute hydrochloric acid (1:1) using only a small excess, cover with a watch glass and continue heating until the fatty acid layer is clear. Cool the sample in an ice bath or refrigerator until the fatty acid layer is solid, filter off the liquor through a wet filter paper (Reeve-Angel No. 230, Eaton & Dykeman No. 617, or other filter paper which will give a clear filtrate) and wash thoroughly with cold water (ice water if the fatty acids are liquid at room temperature).

Allow the washed fatty acids to dry on the filter paper, most conveniently overnight. If they are liquid at room temperature place the original beaker under the funnel to catch any fatty acids that drip through the paper. Dissolve the dried fatty acids in warm petroleum ether (see Specifications, Rule 272, Section 3), and make a total volume of approximately 125 cc. with the solvent before filtering. Filter through a dry filter paper into a tared Soxhlet flask. If the petroleum ether extract is cloudy it should be refiltered.

Wash the filter thoroughly with warm petroleum ether, transfer to an extraction tube, and extract with petroleum ether. Evaporate off petroleum ether and heat in an oven at 100 degrees C. to constant

TABLE IV

Comparison of Proposed Dry Extraction and Proposed Wet Extraction Methods Showing the Effect of Different Quantities of Solvent in the Wet Extraction Method. (Results as % T.F.A.)

	Proposed Dry Extraction Method	Proposed Wet Extraction Method: 1-125 cc. and 5-25 cc. extractions	Proposed Wet Extraction Method: 1-100 cc. and 5-50 cc. extractions
Sample 3. Acidulated Corn Oil Soap Stock			
Barrow	91.74	92.14	93.38
Lappen	[1]93.18	92.75	93.21
Reese	[2]92.85	[3]92.38	92.66
Average	92.59	92.42	93.08
Sample 4. Acidulated Soya Bean Oil Soap Stock			
Barrow	87.58	87.36	88.74
Lappen	[1]90.13	89.38	89.70
Long	89.66	[4]89.48	89.56
Reese	[5]0.09	[5]90.09	89.69
Rich	[6]87.39	87.41	87.40
Average	88.97	88.74	89.02

[1]Fatty Acid Cake dried over night at 40° F.
[2]Extract did not filter clear.
[3]3-100 cc. extractions 91.65% T.F.A.
[4]Fatty acid extract dried at 105° C.
[5]3-100 cc. extractions 88.96% T.F.A.
[6]Fatty Acid Cake dried at 50-55° F. 89.92% T.F.A.

TABLE V

Comparison of Results Obtained by Proposed Wet Extraction Method. When Extractions Were Made With 1-125 cc. and 4-25 cc. Portions, and With 1-125 cc. and 5-25 cc. Portions of Petroleum Ether.

	1-125 cc. and 5-25 cc. extractions % T.F.A.	1-125 cc. and 4-25 cc. extractions % T.F.A.
Sample 19. Corn Oil Soap Stock	52.00	51.94
Sample 2. Acidulated Corn Oil S. S.	92.51	92.22
Sample 3. Acidulated Corn Oil S. S.	92.63	92.65
Sample 10. Acidulated Corn Oil S. S.	92.61	92.51
Sample 18. Acidulated Corn Oil S. S.	93.93	93.87
Sample 5. Soya Bean Oil Soap Stock	47.27	47.28
Sample 11. Soya Bean Oil Soap Stock	25.02	24.96
Sample 16. Soya Bean Oil Soap Stock	40.83	40.52
Sample 17. Soya Bean Oil Soap Stock	41.38	41.21
Sample 4. Acidulated Soya Bean S. S.	88.77	88.09
Sample 12. Acidulated Soya Bean S. S.	95 58	95.54
Sample 8. C/S Oil Soap Stock	38.28	38.33
Sample 9. C/S Oil Soap Stock	48.77	48.72
Sample 13. C/S Oil Soap Stock	42.59	42.44
Sample 14. C/S Oil Soap Stock	47.13	47.11
Sample 15. Acidulated C/S Soap Stock	94.32	94.38
Average 16 Samples	64.60	64.52

weight. Report as per cent "total fatty acids."

PROPOSED WET EXTRACTION METHOD FOR TOTAL FATTY ACIDS OF ALL SOAP STOCK AND ACIDULATED SOAP STOCK, EXCEPT FROM COPRA AND PALM KERNEL OILS

Weigh out from a weighing bottle 8 to 10 grams of a well mixed sample of soap stock or 4 to 5 grams of acidulated soap stock and transfer to a 400 cc. beaker. Saponify with 50 cc. of 95 per cent alcohol and 2 to 3 grams of stick potassium hydroxide or an equivalent of stock alcoholic solution of potassium or sodium hydroxide by heating on the steam bath under a watch glass, with frequent stirring, for at least 30 minutes. After saponification is complete remove the watch glass, continue heating on the steam bath, with stirring, until the alcohol is driven off. To avoid oxidation, the soap should not be evaporated dryer than to a pasty mass. If necessary, a small amount of water may be added when most of the alcohol has evaporated.

When the alcohol has evaporated, add 100 cc. of water and heat until the soap is dissolved. Wash the contents of the beaker into a glass

TABLE VI

Comparison of Results (As % T.F.A.) Obtained With Proposed Dry Extraction and Proposed Wet Extraction Methods. Unless Otherwise Indicated Six Extractions Were Made in the Proposed Wet Extraction Method.

	Barrow		Lappen		Long		Reese		Rich		Watkins		Average		Mean Deviation from Average	
	Dry Ext. Method	Wet Ext. Method	Dry Ext. Method	Wet Ext. Method	Dry Ext. Method	Wet Ext. Method	Dry Ext. Method	Wet Ext. Method	Dry Ext. Method	Wet Ext. Method	Dry Ext. Method	Wet Ext. Method	Dry Ext. Method	Wet Ext. Method	Dry Ext. Method	Wet Ext. Method
Sample 19. Corn Oil Soap Stock	....	....	....	....	[2]52.20	[3]52.50	....	....	52.06	[4]52.24	52.07	52.00	52.11	52.25	0.06	0.17
Sample 2. Acid. Corn Oil Soap Stock	93.07	92.06	[1]92.56	92.26	....	....	[2]93.57	91.32	....	....	93.43	92.51	93.16	92.04	0.34	0.38
Sample 3. Acid. Corn Oil Soap Stock	91.74	92.14	[1]93.18	92.75	....	....	92.85	92.38	....	....	91.86	92.63	92.41	92.48	0.61	0.22
Sample 10. Acid. Corn Oil Soap Stock	....	....	....	....	92.69	92.55	....	....	91.38	91.32	92.53	92.61	92.20	92.16	0.55	0.56
Sample 18. Acid. Corn Oil Soap Stock	93.17	93.47	[1]93.28	[4]93.17	....	....	[5]94.86	[6]94.37	....	....	94.02	93.93	93.83	93.74	0.61	0.42
Sample 5. Soya Bean Oil Soap Stock	....	....	....	....	....	....	....	....	....	....	47.02	47.27	47.02	47.27	....	....
Sample 11. Soya Bean Oil Soap Stock	....	....	....	....	....	....	....	....	....	....	25.34	25.02	25.34	25.02	....	....
Sample 16. Soya Bean Oil Soap Stock	40.03	40.36	[1]40.83	[2]40.35	....	....	39.97	40.42	....	....	40.69	40.83	40.38	40.49	0.38	0.17
Sample 17. Soya Bean Oil Soap Stock	....	....	....	....	[2]41.05	[7]41.55	....	....	41.20	[4]41.13	40.74	41.38	41.00	41.35	0.17	0.15
Sample 4. Acid. Soya Bean Soap Stock	87.58	87.36	[1]90.13	89.38	89.66	[8]89.48	89.49	90.09	87.39	[8]87.41	88.46	88.77	88.79	88.75	0.96	0.91
Sample 12. Acid. Soya Bean Soap Stock	....	....	....	....	95.50	95.40	....	....	95.05	[8]95.34	94.71	95.58	95.09	95.44	0.28	0.09
Sample 8. Cotton Seed Oil Soap Stock	....	....	....	....	....	....	....	....	....	....	38.04	38.28	38.04	38.28	....	....
Sample 9. Cotton Seed Oil Soap Stock	....	....	....	....	....	....	....	....	....	....	48.64	48.77	48.64	48.77	....	....
Sample 13. Cotton Seed Oil Soap Stock	42.81	42.69	42.75	42.42	....	....	42.18	[2]42.16	....	....	42.49	42.59	42.56	42.47	0.22	0.18
Sample 14. Cotton Seed Oil Soap Stock	....	....	....	....	[2]47.27	[3]47.67	....	....	47.51	47.27	46.85	47.13	47.21	47.36	0.24	0.21
Sample 15. Acid. C/S Oil Soap Stock	94.55	[4]94.09	94.39	[4]94.35	....	....	94.75	94.30	....	....	94.33	94.32	94.51	94.27	0.15	0.09

[1]Fatty Acid Cake dried overnight at 40° F.
[2]Fatty acid extract refiltered.
[3]Nine extractions made.
[4]Five extractions made.
[5]Fatty acid extract slightly cloudy after three filtrations.
[6]One sample refiltered three times and the other six times. Neither cleared entirely.
[7]Eight extractions made.
[8]Fatty acids in cylinder heated to 90° C. and cooled at 50° C. before extracting with petroleum ether.
[9]Fatty acid extract dried at 105° C.

TABLE VII

Summary of Results Obtained With Proposed Dry Extraction and Proposed Wet Extraction Methods.

	Number Samples	Proposed Dry Extraction Method % T.F.A.	Proposed Wet Extraction Method % T.F.A.
Corn Oil Soap Stock	1	52.11	52.25
Acid. Corn Oil Soap Stock	4	92.95	92.63
Soya Bean Oil Soap Stock	4	39.65	39.81
Acid. Soya Bean Oil Soap Stock	2	90.89	90.98
Cotton Seed Oil Soap Stock	4	44.28	44.33
Acid. C/S Oil Soap Stock	1	94.51	94.27
Average of Soap Stock	9	43.42	43.53
Average of Acid. Soap Stock	7	92.51	92.33

stoppered cylinder with hot water, taking care not to exceed 130 cc. total volume in the cylinder. Add 3-5 drops of methyl orange indicator, acidify with dilute hydrochloric acid (1:1), carefully avoiding too large an excess. Mix gently by rotating the cylinder. When the cylinder has cooled to 50° C., add 125 cc. of petroleum ether. (See Specifications, Rule 272, Section 3.) It is not necessary for the fatty acids to have cleared thoroughly. Stopper cylinder and shake gently, then allow to stand until the petroleum ether layer has separated. Siphon off this petroleum ether layer through a 9 cm. paper (see Specifications, Rule 276, Section 2) into a 400 cc. beaker or directly into a tared Soxhlet flask. If this extract is cloudy it should be refiltered, but any subsequent cloudiness may be disregarded. Make at least four more extractions, using 25-30 cc. of petroleum ether and shaking the cylinder vigorously for at least 30 seconds for each extraction.

Filter each petroleum ether extract through the same filter paper as the first, allow the filter paper to drain well, transfer to an extraction tube, and extract with petroleum ether. If the extractions are transferred to the 400 cc. beaker rather than directly to the tared Soxhlet flask, all, when drawn off, should be added to the first extraction in the beaker, the combined extracts partially evaporated, and transferred to a tared Soxhlet flask. Wash all traces of the fatty acids from the beaker with petroleum ether from a wash bottle. If the extracts are filtered directly into the Soxhlet flask, it may be necessary to evaporate part of the solvent from the flask before adding the remaining extractions. Evaporate all petroleum ether and heat in oven at 100° C. to constant weight. Report as per cent "total fatty acids."

Recommendations: The committee recommends (1) that the method for analyzing soap stock and acidulated soap stock, except from copra or palm kernel oils, as outlined above, be suggested to replace the ones now given in the Methods of the American Oil Chemists' Society; (2) that the methods be designated as "Dry Extraction Method for Total Fatty Acids of All Soap Stock and Acidulated Soap Stock, except from Copra or Palm Kernel Oils," and "Wet Extraction Method for Total Fatty Acids of All Soap Stock and Acidulated Soap Stock, except from Copra or Palm Kernel Oils"; (3) that the term "petroleum ether" be adopted throughout all methods of the society for the solvent variously referred to as petroleum and petrolic ether; (4) the method for testing petroleum ether is not specified in the Methods of the American Oil Chemists' Society, but it is given in Rule 272, Section 3, of the Rules of the National Cotton Seed Products Association. These rules should be made identical.

The committee wishes to thank the following for sample materials:

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Wilson & Co., Chattanooga, Tenn.

Respectfully submitted,

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ABSTRACTS

Oils and Fats

Edited by
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Use of animal cadavers for manufacture of technical fats and animal body meals. W. Steinmann. *Fette u. Seifen.* **45**, 338-42 (1938).—Several rendering methods are described.

Continuous hydrogenation process for oils and fats. L. H. Manderstam. *Fette u. Seifen.* **45**, 251 (1938).—The process is used by Technical Research Works (London), and was developed by Bolton and Lusk. The process is illustrated and described.

Amount of saturated fat acids in whale oil. J. Lund. *Fette u. Seifen.* **45**, 290-2 (1938).—The catches from 1934-1937 contd. 18 to 23.2% satd. acids. Solid acids were 22-27.9% of I no. 16-22.3 and m.p.'s 48-50°. The data for blubber oil, bone oil and flesh oil of blue and fin whale are tabulated. The figures are within the above limits as reported for total catches.

The viscosimetry of fats. H. P. Kaufmann and S. Funke. *Fette u. Seifen.* **45**, 255-62 (1938).—Data on several pure glycerides and many oils are presented. With fat acids double bonds reduce the viscosity. Trans-comps. have higher viscosity than cis-compds. It was impossible to develop a formula for detg. viscosity from I and sapon. nos. Polymerization is detected by detg. viscosity. The value of viscosity detns. to industry is discussed.

Cause of analytical differences between refractometric and gravimetric fat determination methods. A. Scharrer and H. Lamel. *Fette u. Seifen.* **45**, 262-6 (1938).—Results from the two methods vary from 0.2 to 0.4%. Using soy bean oil for the test the authors found that by the gravimetric method 10 times more phosphatides, a difference of .11, are extd. than by the refractometric method. The difference in unsaponifiable extd. by the two methods was 0.15%.