tions of *alpha-* and *beta*-eleostearic acids should be modified. Before any further effort of the entire committee was requested, it has appeared essential to recheck these constants. When this has been completed, data received from each committee member will be recalculated, and tabulations of both sets of calculations will be tabulated and submitted with requests for recommendations, from each member, for future activity on this problem.

Investigations of an Infrared Absorption Method. Considerable agitation has been evident for the Spectroscopy Committee to investigate and, if possible, recommend a standard method for the determination of *trans*-acids in fatty acid materials in the presence of nonconjugated *cis*-monounsaturated and *cis*-nonconjugated polyunsaturated constituents. Before any collaborative work on the method proposed by Shreve *et al.* (Anal. Chem., *22*, 1261 [1950]) and Swern *et al.* (J. Am. Oil Chemists' Soc., *27*, 17 [1950]) it has been necessary to obtain standards which can be used to calibrate infrared spectrophotometers in the laboratories of the various committee members. During the past year samples of both elaidic and oleic acids have been obtained, and present plans of the committee are to submit these two standards (if possible, also a sample of pure stearic acid) along with suitable samples collaboratively to test the published methods for determination of *trans*-acids.

Future Committee Work

During the coming year the data from the collaborative work to establish a procedure for the determination of polyunsaturated acids in the presence of large quantities of preformed conjugation should be evaluated and tabulated. From a study of these results the committee should be in a position to decide what steps are next required to achieve the object, a procedure which they can recommend as a tentative A.O.C.S. method.

With reasonably good expectation of the availability of pure samples of oleic, elaidic, and possibly stearic acids, it should be possible critically to evaluate the infrared method for *trans*-acids in fatty acid materials collaboratively. Collaborative work to achieve this purpose is planned for early next year. Another problem which has been referred to the Spectroscopy Committee is the determination of polyunsaturated fatty acids in the presence of *trans*-isomers, a determination outside the scope of Tentative Method Cd 7-48. Consideration of a procedure which could be employed for this purpose will receive attention of the committee during the coming year.

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Synthetic Detergents from Animal Fats. VII. Detergent Combinations[1]

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THE SULFATED HYDROGENATED TALLOW ALCOHOLS, RCH_2OSO_3Na, are known as effective detergents and surface-active agents with perhaps some limitations on their use because they are not very soluble in water at room temperature (5, 6). Nor are the disodium salts of α-sulfonated hydrogenated tallow acids, $RCH(SO_3Na)CO_2Na$, readily soluble. However mixtures of these two tallow-based detergents with phosphate builders, at 20% active ingredient content, form clear 0.25% solutions in hard water at room temperature. It was thus of interest to explore their detergent possibilities. The readily soluble sodium alkylbenzenesulfonate (average molecular weight corresponding to $C_{12}H_{25}C_6H_4SO_3Na$) was also included as a component in the detergent combinations.

Thus four materials were selected for a laboratory study of detergent combinations: sodium salts of sulfated hydrogenated tallow alcohols (X); disodium salts of α-sulfonated hydrogenated tallow acids (Y); sodium dodecylbenzenesulfonate (Z); and an inorganic building composition (B).

Component X was prepared to simulate hydrogenated sulfated tallow alcohols. It is an intimate mixture of the following pure sodium alkyl sulfates: 6.6% sodium tetradecyl sulfate, 27.8% sodium hexadecyl sulfate, and 65.6% sodium octadecyl sulfate (8). These proportions assume tallow to have a fatty acid composition of 6.3% myristic, 27.4% palmitic, 14.1% stearic, 49.5% oleic, and 2.4% linoleic.

Similarly the α-sulfonated hydrogenated tallow acid component, Y, is an intimate mixture of the following pure disodium salts: 6.7% disodium α-sulfomyristate, 27.9% disodium α-sulfopalmitate, and 65.4% disodium α-sulfostearate (8).

The sodium alkylbenzenesulfonate component, Z, of average molecular weight corresponding to $C_{12}H_{25}C_6H_4SO_3Na$, was prepared by sulfonation of an aromatic hydrocarbon [3] with the vapor of sulfur trioxide (3, 4). The product was a hygroscopic, cream-colored solid, with absorption maxima at 224.0, 255.0, 261.5, and 267.5 mμ. Analyses: calculated for $C_{18}H_{29}NaO_3S$, 6.60% Na, 9.20%S; found 6.70% Na, 9.14%S.

The builder, B, contained 55% $Na_5P_3O_{10}$, 24% Na_2SO_4, 10% $Na_4P_2O_7$, 10% sodium metasilicate, and 1% carboxymethylcellulose (5, 9).

Detergency

The detergency of the combinations was measured, using the Terg-O-Tometer and three different kinds of standard soiled cotton, I, II, and III.[4] Detergency was measured as the increase in reflectance, Δ R, after washing in soft (90 p.p.m.) and hard (300

[1] Presented at the meeting of the American Oil Chemists' Society, Houston, Tex., April 1956.

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[3] Neolene 400. Reference to trade name does not constitute recommendation by the U. S. Department of Agriculture of a particular product over similar products not mentioned.

p.p.m.) water. The results are set forth in Table I. The values for sodium dodecyl sulfate are given in the table for purposes of comparison. The standard soiled cloths present different soil-removal problems, and a detergent mixture effective with one cloth is not necessarily as effective with the others. The sulfated hydrogenated tallow alcohol (X) was the most important component of detergent combinations. Mixtures not containing X were generally inferior detergents. A builder was required in hard water except with 0.25% solutions of X, Y, or Z.

TABLE I

Detergency of Combinations
Terg-O-Tometer, 20 min., at 60°C., 110 cycles/min., 10 swatches/l.; 3 kinds of standard soiled cotton; soft water (90 p.p.m.) and hard water (300 p.p.m.).

Component, % *				Detergency, Δ R					
				Cloth I		Cloth II		Cloth III	
X	Y	Z	B	Soft water	Hard water	Soft water	Hard water	Soft water	Hard water
			0.2	9.3	9.6	33.7	27.1	8.7	7.4
0.05				33.8	4.1	36.8	7.3	12.1	4.2
0.25				33.5	31.0	......	......	41.7	27.4
	0.25			31.3	30.1	......	......	38.9	37.6
		0.25		21.2	25.2	......	......	34.5	28.7
0.01	0.04		0.2	29.3	27.5	37.7	36.7	23.8	21.1
0.01		0.04	0.2	23.2	22.3	......	......	34.0	32.6
0.01	0.01	0.03	0.2	27.5	26.7	......	......	34.3	31.2
0.025	0.025		0.2	28.6	27.7	37.3	37.6	32.8	27.7
0.025		0.025	0.2	24.2	26.1	37.4	35.3	38.1	35.3
	0.025	0.025	0.2	17.6	16.0	37.5	37.4	20.6	13.5
0.05			0.2	26.4	27.0	38.4	35.1	38.2	35.1
	0.05		0.2	13.2	14.7	33.6	27.8	11.6	9.3
		0.05	0.2	13.9	17.7	37.8	36.6	28.5	21.3
0.25% Sodium dodecyl sulfate				22.3	19.9	......	22.9	36.8	34.6

* X = Sulfated hydrogenated tallow alcohols.
Y = Disodium salts of α-sulfonated hydrogenated tallow acids.
Z = Sodium dodecylbenzenesulfonate.
B = Builder: 55% $Na_5P_3O_{10}$, 24% Na_2SO_4, 10% $Na_4P_2O_7$, 10% sodium metasilicate, 1% CMC.

Cloth I. With cloth I, in these experiments, differences of 2.3 in Δ R in soft water and 1.7 in hard water were significant with at least 95% probability.

In soft water unbuilt 0.05%X was an excellent detergent with cloth I, superior to 0.25%Y or 0.25%Z. Built XY and XYZ combinations were more effective than similar XZ combinations. There is an apparent advantage in the detergency of 0.01%X + 0.04%Y + 0.2%B over that of built 0.05%X in soft water. Built detergents not containing X were inferior in soft or hard water.

Built detergents containing X had about the same detergency in hard water except for 0.01%X + 0.04%Z + 0.2%B which was less efficient.

Cloth II. With cloth II in these experiments, in soft or hard water, a difference of 1.1 in Δ R was significant with at least 95% probability.

The builder alone was able to remove considerable soil from this cloth, particularly in soft water. In soft water unbuilt 0.05%X was a good detergent, somewhat improved by the presence of builder. All built detergents were good except for built 0.05%Y, which had the same detergency as the builder alone.

Unbuilt 0.05%X was a very poor detergent in hard water, greatly improved by the builder. Built XY and YZ combinations were good detergents, somewhat better in hard water than an XZ combination and built 0.05%X. Built 0.05%Z was better than built 0.05%Y in either type of water and better than built 0.05%X in hard water.

[4] G.D.C. No. 26 (2), A.C.H. No. 114, and P.S.C., respectively. Reference to trade name abbreviations does not constitute recommendation by the U. S. Department of Agriculture over similar test cloths not mentioned.

Cloth III. For cloth III a difference in Δ R of 1.3 and 1.0 was significant with at least 95% probability in soft and hard water, respectively, for these experiments.

The builder was required for adequate detergency in soft or hard water for 0.05%X but not for 0.25% solutions of X, Y, or Z. In soft or hard water built 0.05% X and built mixtures containing X and Z, or X, Y, and Z were the best detergents. Built XY and YZ combinations were inferior to corresponding XZ combinations.

Foaming Properties

The foaming properties of the built detergents in hard water of 300 p.p.m. at 60° C. are shown in Table II.

Compositions containing Z had somewhat better foaming properties. Built 0.05%Y had the lowest foam height and the least stable foam.

TABLE II

Foam Height of Built Detergents in Hard Water
300 p.p.m., 60°

Component, %				Foam height, mm. (7)	
X	Y	Z	B	Immediate	After 5 minutes
0.01	0.04		0.2	200	200
0.01		0.04	0.2	225	220
0.01	0.01	0.03	0.2	225	200
0.025	0.025		0.2	190	180
0.025		0.025	0.2	220	220
	0.025	0.025	0.2	225	220
0.05			0.2	205	205
	0.05		0.2	165	10
		0.05	0.2	235	230

X = Sulfated hydrogenated tallow alcohols.
Y = Disodium salts of α-sulfonated hydrogenated tallow acids.
Z = Na dodecylbenzenesulfonate.
B = Builder: 55% $Na_5P_3O_{10}$, 24% Na_2SO_4, 10% $Na_4P_2O_7$, 10% sodium metasilicate, 1% CMC.

Summary

Laboratory measurements of detergency were made on mixtures of sodium salts of sulfated hydrogenated tallow alcohol (X), disodium salts of α-sulfonated hydrogenated tallow acids (Y), sodium dodecylbenzenesulfonate (Z), and a builder (B) using three different kinds of standard soiled cotton. Component X was the most important, and mixtures not containing X were generally inferior detergents. Built XY mixtures were better than XZ mixtures with one kind of soiled cotton (cloth I). Built XZ mixtures were better than XY mixtures with another soiled cotton (cloth III).

The results, based on laboratory measurements of detergency using standard soiled cotton, are suggestive rather than conclusive. Partial substitution of X by Y or Z, or by both Y and Z, may be possible without loss in detergency.

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