A Method to Improve Reproducibility in Detergency Tests

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Introduction

NUMEROUS methods have been employed for the evaluation of detergents. Some of these have been based on measurement of physical properties such as surface tension, interfacial tension, wetting power, suspending power, emulsifying characteristics, foaming, and the like. However, all of these, while they undoubtedly present part of the picture, were never found too satisfactory in predicting the value of a detersive agent.

In our opinion the best approach to the problem has been the direct one; i.e. the actual washing of a standard soiled fabric under fixed conditions with subsequent measurement of the amount of soil removed. A great deal of work along these lines appears in the literature.

Probably the method which enjoys greatest popularity at present consists of washing swatches of a fabric, soiled with some oily composition containing carbon black, in an Atlas Launderometer under fixed conditions of time, temperature, concentration, etc. The soil removal is then evaluated by measurement of the reflectance of the fabric before and after washing. This procedure has been employed in this laboratory for many years and, though moderately successful, has left much to be desired.

For workers in the field of detergency it is not necessary to discuss the shortcomings of a method of this type. We had occasion last year to make a statistical study (1) of the method as we employed it, and found the reproducibility to be about ±13% in terms of Standard Deviation when calculating the results as "Detersive Efficiency."*

This study suggested that probably the greatest source of variation was in the soiled fabric. It further suggested that if the method could be so modified that *a large number of swatches of soiled fabric, all coming from different lots, were washed in the same solution at the same time,* greater reproducibility might be expected. This led to the work described in this paper, and the development of a method which we feel offers improvement in the measurement of detersive action. *Probably the most important factor in the method to be described is the random selection, for each test, of many pieces of soiled fabric each made at different times.*

To date we have carried it out only in a washing machine of the ordinary home type. We feel that it approaches more closely the conditions of actual laundering in the home, and, in addition to improved reproducibility, should have value in the study of various types of laundering equipment, finding optimum conditions for soil removal, and study of the many factors involved in the practical use of detergents.

Experimental

I. Equipment and Materials Used

1. Standard soiled cotton fabric prepared by a method previously reported by Van Zile (2) was used.

2. The washing was done in an electric washing machine of the common household type. A Hotpoint Electric Washing Machine (Cat. No. 302CB71) with a Pyrex glass tub was found suitable.

3. A photoelectric reflectometer of the Lange type was employed to measure the reflectance of swatches.

4. The dish towels employed were of the ordinary type available commercially. Before each test the towels were given a hot water-Calgon treatment to remove any insoluble lime soaps which may have been deposited during a previous wash.

5. Soap A was an unbuilt all-tallow soda soap, of about 40°C. titre. It is employed in this laboratory as a standard for detergency studies.

6. Soap B was a sprayed laundry soap of the usual home type containing silicate, soda ash, and tetrasodium pyrophosphate as builders.

7. Tap water as referred to later means regular Jersey City tap water of about 50 ppm. hardness.

II. Experimental Runs

Series A (Table I)

Twenty-one sets (20 swatches to a set) of soiled fabric, all from a single lot, were used in this test.

Alignment of Soiled Swatches. Twenty-one sets for this series were prepared from one and the same lot of soiled fabric. Starting at one end of the lot, 21 swatches (5¼"x5¼") were laid out side by side. Following in exactly the same order with consecutive portions of the lot, another swatch was placed on each of those previously laid out. This procedure was repeated until 20 pieces were stacked in each set, making 21 sets of 20 swatches each.

Washing Solution. Twenty of the 21 sets were washed in 10-gallon portions of 0.3% tap water solutions of Soap A. The remaining set was not washed. It was held for control purposes to give the average per cent blackness of the soiled fabric before washing.

Series B (Table II)

Twenty runs were made. In a given run the set of swatches used was composed of 20 pieces all from a single lot. However, each of the runs used soiled fabric made at a different time (different lots).

Alignment of Soiled Swatches. Twenty (5¼"x 5¼") swatches were taken from each of 20 different lots of soiled fabric ranging in age from just a few weeks, to over a year old. Thus, each set contained 20 swatches from the same lot; but different sets contained swatches from different lots.

For controls, 5 swatches were taken from each of the 20 different lots used to prepare the above mentioned 20 sets. This gave one control set for each of the 20 different sets.

* % Detersive Efficiency $= \frac{\text{Units soil removed by experimental product}}{\text{Units soil removed by Standard Detergent}} \times 100.$

Washing Solution. Each of the 20 sets of soiled fabric was washed in a 10-gallon portion of 0.3% tap water solution of Soap A.

Series B-1 (Table III)

This series was parallel to Series B differing only in that Soap B was used in place of Soap A.

Alignment of Soiled Swatches. The same lots of soiled fabric used in Series B were again used to prepare sets for this series. They were lined up in the same way, but only 16 out of the 20 lots remained for use.

The same control sets used in Series B were also used for Series B-1.

Washing Solution. Washing was the same as in Series B except that Soap A was used.

Series C (Table IV)

Proposed Method for Greatest Reproducibility

Each set of swatches was composed of one piece from each of 20 different lots. Twenty such sets were washed.

Alignment of Soiled Swatches. A single lot was taken and 21 swatches (5¼"x5¼") were laid out side by side. Another swatch from a different lot was then placed on each of the 21 swatches already laid out. This process was continued, repeating each cycle with a different lot until 20 swatches were stacked in each of the 21 piles. This gave 21 sets of 20 swatches each. Every set then contained one swatch from 20 different lots.

Washing Solution. Each of the 20 sets of soiled swatches was washed in a 10-gallon portion of 0.3% tap water solution of Soap A. The remaining set was held as the control.

Series C-1 (Table V)

This series paralleled Series C except that Soap B was used instead of Soap A.

Alignment of Soiled Swatches. Same lot composition and method of alignment as in Series C.

Washing Solution. Each of the 20 sets was washed in a 10-gallon portion of 0.3% tap water solution of Soap B.

III. Washing Procedure

1. A washing machine of the type already mentioned was filled with 10 gallons of tap water which was adjusted to 110°F.(43.3°C.).

2. A calculated weight of the product to be tested was added to the tub and dissolved by stirring.

3. The machine was started and 15 clean, processed towels (weight approx. 3 lbs.) were added, one at a time.

4. A set of soiled swatches was then added, one by one, in rapid succession. Time was measured immediately after the last swatch had been added to the tub.

5. Agitation was stopped at the end of 20 minutes* and all the towels and all the swatches of soiled fabric were lifted out of the tub as a mass and placed in a pan. The soiled pieces were separated from the towels and were then rinsed together once in lukewarm tap water.

6. Excess water was squeezed out of the swatches by hand, and they were then hung to dry at room temperature.

* The time can be adjusted to meet the requirements of the soiled fabric that may be available for this test.

IV. Measurement of Reflectivity

For any particular series one swatch from each of the sets in that series, including the control sets, was selected at random. These swatches were read in rapid succession as a group. This process was repeated until all of the swatches in each set had been read.

Reading a swatch consisted of taking the average of ten readings, 5 on one side and 5 on the opposite side.

All readings are in per cent black as compared to an arbitrary standard selected as 100% black.

V. Calculation of Results

The spread, or units of soil removed, was calculated by subtracting the average reflectivity (per cent black) of the 20 washed swatches in a set from the average reflectivity (per cent black) of the 20 unwashed swatches (Control).

Discussion of Results

I. Series A—Reproducibility of a Determination Repeated on the Same Lot of Soiled Fabric.

IN ALL, 20 sets of 20 swatches each were washed in Series A; a total of 400 pieces from the same lot. The results are summarized in Table I. In one of the runs (run No. 1), reflectance readings of the swatches after washing, varied from a high of 33.8 to a low of 23.2 per cent black; a difference of 10.6 units. Considering all 400 pieces, the highest reading was 33.8 and the lowest 14.2 per cent black; a difference of 19.6 units. The unwashed set of control swatches showed a variation of only 5.7 between the highest and lowest.

SERIES A—TABLE I.
All Swatches From One Lot of Soiled Fabric.
Washed in Soap A.

Run No.	Average reflectance % black for 20 swatches after washing	Individual reflectance of swatches % black		Spread (Units of soil removed)
		High	Low	
Control	60.5	63.8	58.1	
1	29.1	33.8	23.2	31.4
2	29.2	33.4	25.9	31.3
3	25.0	29.6	19.7	35.5
4	23.3	30.7	17.2	37.2
5	24.2	28.3	18.6	36.3
6	24.7	29.4	17.9	35.8
7	24.7	29.0	20.1	35.8
8	24.7	29.3	19.9	35.8
9	24.9	30.6	18.4	35.6
10	24.9	29.4	14.2	35.6
11	25.1	30.0	18.1	35.4
12	24.8	30.5	18.8	35.7
13	24.7	30.5	19.8	35.8
14	25.6	32.1	19.7	34.9
15	25.7	28.7	19.9	34.8
16	25.2	32.7	18.5	35.3
17	25.1	28.5	19.9	35.4
18	24.1	30.3	19.8	36.4
19	24.2	29.5	19.4	36.3
20	24.9	30.0	19.5	35.6
Average spread				35.3

In one case variations between unwashed swatches from typical lots of soiled fabric ranged from 57.2 to 63.5 per cent black, involving 200 swatches. In another case involving 300 swatches the range extended from 61.0 to 67.0 per cent black. Whereas, in a typical unwashed lot of soiled fabric 72% of the deviations from the average were within 0.9 unit, Series A showed only 22% of the washed swatches to fall within this limit. Also, the greatest variation from the average in the unwashed lot was 2.5 units, while in the washed lot it was 11.1 units.

In other words, washing the soiled fabric spreads the range of unevenness or variation within a lot. Assuming the original variation of about 6 units to persist after washing, there is a considerable additional variation introduced by washing. It is believed that this variation is due to differences in the degree of firmness with which the soil is held by the fabric.

The Standard Deviation for any single swatch of the 400 washed in Series A was found to be ±3.3 (units of soil removed). This value was cut to ±1.4 by comparing the averages of the 20 swatches in each set for the 20 runs made. This significant improvement in reproducibility may be attributed to the distribution of internal variations in the original lot of soiled fabric among the 20 different sets, this being accomplished by the manner of aligning the swatches.

SERIES B—TABLE II.

Twenty Swatches From One Lot of Soiled Fabric in Each Run. A Different Lot for Each Run. Washed in Soap A.

Run No.	Age of soiled fabric at time of washing	Average reflectance % black for 5 control swatches (not washed)	Average reflectance % black for 20 swatches (washed)	Individual reflectance of swatches % black		Spread (Units of soil removed)
				High	Low	
	weeks					
1	53	65.6	38.0	39.4	34.6	27.6
2	48	64.7	38.5	40.1	31.2	26.2
3	42	67.2	37.0	39.5	31.5	30.2
4	40	66.5	39.1	41.3	36.5	27.4
5	38	64.3	32.7	36.7	29.9	31.6
6	36	59.7	34.0	36.0	31.8	25.7
7	33	67.4	37.0	38.8	35.0	30.4
8	31	67.2	38.0	40.4	36.7	29.2
9	29	69.1	34.3	36.8	30.6	34.8
10	27	66.4	36.4	39.6	33.4	30.0
11	26	66.2	34.4	38.3	31.1	31.8
12	25	67.7	32.6	38.0	26 9	35.1
13	23	62.9	30.3	38 2	25 8	32.6
14	22	63.2	31 4	36 2	26.6	31.8
15	19	63.5	26.3	28.2	24.2	37.2
16	18	62.2	26.7	28.7	24.3	35.5
17	15	63.1	22.8	32.5	18.7	40.3
18	13	62.0	24.0	30.0	17.5	38.0
19	8	61.3	22.9	25.7	20.7	38.4
20	2	62.2	22.2	26.1	20.0	40.0
	Average spread					32.7

II. Series B and B-1—Reproducibility of a Determination Performed Each Time on a Different Lot of Soiled Fabric.

IN SERIES B 20 runs were made using 20 swatches in each. In any run the 20 pieces were all from the same lot, but in different runs the swatches were from different lots, ranging in age from one year to just one or two weeks at the time of washing.

It is apparent from the data (see Table II) that age definitely influences the ease of soil removal. The older the soiled fabric the more difficult it was to wash out the soil. Thus, the spread (units of soil removed) with the older lots was lower than the spread with the more recent ones. The average spread for 20 pieces of the one year old soiled fabric was 27.6, while for a lot only two weeks old it was 40.0 units.

Of the 400 swatches involved in the 20 sets, the lowest reflectance of an individual swatch was 17.5 and the highest 41.3 per cent black; a difference of 23.8.

The Standard Deviation of the average for the 20 runs was high; ±5.8 (units of soil removed). This is about four times as large as the Standard Deviation of ±1.4 for the 20 runs in Series A.

This means that if a determination is repeated using the soiled fabric alignment as in Series A, relatively high reproducibility can be attained. However, if the determination is repeated using the alignment of Series B, where each run uses a different lot of soiled fabric, unreliable results may be expected.

SERIES B-1—TABLE III.

Twenty Swatches From One Lot of Soiled Fabric in Each Run. A Different Lot for Each Run. Washed in Soap B.

Run No.	Age of soiled fabric at time of washing	Average reflectance % black for 5 control swatches (not washed)	Average reflectance % black for 20 swatches (washed)	Individual reflectance of swatches % black		Spread (units of soiled removed)
				High	Low	
	weeks					
1	....	.....	.....	.....	.....	.....
2	....	.....	.....	.....	.....	.....
3	42	67.0	38.4	40.0	37.1	28.6
4	....	.....	.....	.....	.....	.....
5	38	64.3	33.1	35.8	31.2	31.2
6	36	59.7	33.0	36.2	30.9	26.7
7	33	67 4	35.4	37.4	31.6	32.0
8	....	.....	.....	.....	.....	.....
9	29	68.9	32.2	34.9	25.8	36.7
10	27	65.7	34.5	35.8	32.0	31.2
11	26	66.2	35.3	37.7	32.1	30.9
12	25	67.2	32.3	36.0	26.1	35.1
13	23	62.7	27.7	31.6	24.5	35.0
14	22	62.9	28.3	33.8	23.6	34 6
15	19	61.5	27.6	29.3	25 1	35.5
16	18	63.1	28.6	34.7	23 8	32.9
17	15	62.8	23.2	26.3	20.3	39.6
18	13	61.9	20.3	29.2	17.8	41.6
19	8	61.4	20.4	24.9	15.4	41.0
20	2	62.2	21.6	27.2	18.7	40.6
	Average spread					34.6

"Detersive Efficiency" as a Means of Correcting Variations Between Lots of Soiled Fabric

A METHOD has been in use in this laboratory, when comparing two or more products, which largely corrects for the variations between different lots of soiled fabric. The spread (units of soil removed) of a standard detergent is arbitrarily considered to be 100%. The spreads of all other products are related to this spread, and the results calculated as per cent Detersive Efficiency in the following manner:

$$\% \text{ Detersive Efficiency} = \frac{\text{Spread of Product Tested}}{\text{Spread of Standard Detergent}} \times 100$$

Proof of the correcting effect of calculating results as per cent Detersive Efficiency was obtained from Series B-1. This series differed from Series B only in that a different soap was employed. The sets of swatches in Series B were washed in solutions of Soap A, and the sets of swatches in Series B-1 were washed in solutions of Soap B. The per cent Detersive Efficiency was calculated by dividing the spread of Soap B by the Spread of Soap A (Standard Detergent) for corresponding runs.

Table VI shows the results of this calculation and indicates that correction for the different ages of the lots is obtained. To illustrate, on one year old soiled fabric Soap B gave an average spread of 28.6 and Soap A 30.2 (units of soil removed) to give an efficiency of 95%. On two weeks old soiled fabric Soap B gave a spread of 40.6 and Soap A 40.0 (units of soil removed) to give an efficiency of 102%. Thus, while the spreads (units of soil removed) from lot to lot are far apart, the efficiencies are in closer agreement.

Although a large correction is made by calculating results as efficiencies, nevertheless one value which is subject to variation is being divided by another which is also subject to variation. The quotient must therefore be more uncertain than either dividend or divisor.

SERIES C—TABLE IV.

Swatches From Twenty Lots of Soiled Fabric in Each Run. Washed in Soap A.

Run No.	Average reflectance % black for 20 swatches (after) washing)	Individual reflectance of swatches % black		Spread (units of soil removed)
		High	Low	
Control	63.9	68.7	59.2	
1	32.3	38.3	21.7	31.6
2	31.7	39.0	22.9	32.2
3	30.9	38.9	22.9	33.0
4	32.2	39.5	23.4	31.7
5	32.3	39 3	23 3	31.6
6	32.2	41.7	22.2	31.7
7	32 5	39.1	20.0	31.4
8	32 8	40.2	23.4	31.1
9	32.2	39.6	21 5	31.7
10	32.6	41 9	21 5	31.3
11	33.1	38.7	22.7	30.8
12	32 2	40.3	22.7	31.7
13	32.7	42.1	22.2	31.2
14	31.4	39.6	22.9	32.5
15	30.5	37.7	21.1	33.4
16	31.3	38.7	21.6	32.6
17	32.6	40.5	23.5	31.3
18	32.8	39.7	21.7	31.1
19	32.7	38.7	24.0	31.0
20	32.2	38.3	21.2	31.7
Average spread				31.7

This means that while a large correction is obtained, at the same time a small error, independent of the experiment is being introduced. Using the data from Series B and B-1 the Standard Deviation for results calculated as % Detersive Efficiency was ±5.1.

Up to this point the highest reproducibility was given by the tests in which all runs contained soiled fabric from the same lot (Series A) with a Standard Deviation of ±1.4 (units of soil removal).

III. Series C and C-1—Reproducibility of Method Using Proposed Swatch Alignment.

The soiled swatch arrangement which yielded the highest degree of reproducibility was that used in Series C and C-1 (see Tables IV and V). The alignment used in these runs was designed to evenly distribute variations between swatches of soiled fabric. A set of 20 swatches for a run in this series was made up of pieces of different ages, different shades of blackness, and different degrees of binding of soil to fabric.

The method of distributing the pieces for the mixed sets in Series C and C-1 is purely empirical, for the time being. The fact that it has repeatedly produced the desired result of high reproducibility has encouraged further investigation of the factors controlling the reproducibility of results. This work is under way at present.

In Series C, 20 sets of mixed lot composition were washed in solutions of Soap A. Each of the sets was composed of 20 swatches, one from each of 20 different lots of soiled fabric. Using similar soiled fabric, 20 more sets were washed in solutions of Soap B (Series C-1, Table V). The Standard Deviation given by Series C was ±0.67; for Series C-1 ±0.66 (units of soil removal); a considerable improvement over the best previous result of ±1.4.

The Detersive Efficiencies have been calculated for Series C and C-1 because they afford a convenient manner of expressing a comparison between products. The calculation does not in any way correct for differences between lots of soiled fabric as was shown in Series B and B-1, inasmuch as this factor is already taken care of in the arrangement of swatches in each set. Using the data from Series C and C-1 the Standard Deviation for results calculated as per cent Detersive Efficiency was ±3.4.

SERIES C-1—TABLE V.

Swatches From Twenty Lots of Soiled Fabric in Each Run. Washed in Soap B.

Run No.	Average reflectance % black for 20 swatches (after washing)	Individual reflectance of swatches % black		Spread (units of soil removed)
		High	Low	
Control	64.5	67.3	60.0	
1	32.4	36.5	25.9	32.1
2	31.2	37.9	22.7	33.3
3	31.2	37.4	26.1	33.3
4	30.7	35.8	20.1	33.8
5	31.6	36.0	26.8	32.9
6	31.4	37.5	23.0	33.1
7	31.1	35.4	23.8	33.4
8	30.3	36.3	24.4	34.2
9	30.7	36.5	22.9	33.8
10	30.4	36.5	23.4	34.1
11	30.6	36.0	24.1	33.7
12	30.8	36.7	24.1	33.7
13	31.4	36.2	25.9	33.1
14	32.7	36.3	27.1	31.8
15	30.9	37.4	24.6	33.6
16	30.4	35.0	24.5	34.1
17	30.6	38.6	21.4	33.9
18	30.5	38.1	21.8	34.0
19	30.1	35.9	24.6	34.4
20	31.1	37.6	24.7	33.4
Average spread				33.5

TABLE VI.

Results Calculated From Spreads as Detersive Efficiency

$$\% \text{ Detersive Efficiency} = \frac{\text{Spread of Soap B}}{\text{Spread of Soap A}} \times 100.$$

Run No.	Series B spreads Soap A	Series B-1 spreads Soap B	% Detersive Efficiency	Series C spreads Soap A	Series C-1 spreads Soap B	% Detersive Efficiency
1	27.6	*	.....	31.6	32.1	102
2	26.2	*	.....	32 2	33.3	103
3	30.2	28.6	95	33.0	33.3	101
4	27.4	*	.....	31.7	33.8	107
5	31.6	31.2	99	31.6	32.9	104
6	25.7	26.7	104	31.7	33.1	104
7	30.4	32.0	105	31.4	33.4	106
8	29.2	*	.....	31.1	34 2	110
9	34.8	36.7	105	31.7	33.8	107
10	30.0	31.2	104	31.3	34.1	109
11	31.8	30.9	97	30.8	33.7	109
12	35.1	35.1	100	31.7	33.7	106
13	32.6	35.0	107	31.2	33.1	106
14	31.8	34.6	109	32.5	31.8	98
15	37.2	35.5	95	33.4	33.6	101
16	35.5	32.9	93	32.6	34.1	105
17	40.3	39.6	98	31.3	33.9	108
18	38.0	41.6	109	31.1	34.0	109
19	38.4	41.0	107	31.0	34.4	111
20	40.0	40.6	102	31.7	33.4	105

* There was not sufficient soiled fabric, of this age, to run tests

The question arises as to how small a difference can be measured between the performance of two products. Tables IV and V indicate that Soap B removes a trifle more soil than Soap A. These products were deliberately chosen for comparison because long experience had shown them to be very close in performance. Out of the possible 400 combinations of the spreads of Soap A and Soap B (Table VII) 382 or 95.5% showed that Soap B had a higher soil removal than Soap A. Based on these 382 cases, the spread of Soap B was an average of 1.8 units higher than the spread of Soap A. It is also true that in 18 out of the 400 possible combinations the spread of Soap B was only equal to or less than that of Soap A. But the frequency of this occurrence is small indeed.

The data presented indicate that the proposed method as outlined in Series C and C-1 might reasonably be expected to show valid differences when products differ in performance by at least 1.8 units

TABLE VII.

Difference Between Any Soap-A Spread and Any Soap-B Spread.
(From Tables IV and V)

Soap-A Spreads	Soap-B Spreads (Units of Soil Removed)																			
	32.1	33.3	33.3	33.8	32.9	33.1	33.4	34.2	33.8	34.1	33.7	33.7	33.1	31.8	33.6	34.1	33.9	34.0	34.4	33 4
31.6	0.5	1.7	1.7	2.2	1.3	1.5	1.8	2.6	2.2	2.5	2.1	2.1	1.5	0.2	2.0	2.5	2.3	2.4	2.8	1.8
32.2	−0.1	1.1	1.1	1.6	0.7	0.9	1.2	2.0	1.6	1.9	1.5	1.5	0.9	−0.4	1 4	1.9	1.7	1.8	2.2	1.2
33.0	−0.9	0.3	0.3	0.8	−0.1	0.1	0.4	1.2	0.8	1.1	0.7	0.7	0.1	−1.2	0.6	1.1	0.9	1.0	1.4	0.4
31.7	0.4	1.6	1.6	2.1	1.2	1.4	1.7	2.5	2.1	2.4	2.0	2.0	1.4	0.1	1.9	2.4	2.2	2.3	2 7	1.7
31.6	0.5	1.7	1.7	2.2	1.3	1.5	1.8	2.6	2.2	2.5	2.1	2.1	1.5	0.2	2.0	2.5	2.3	2.4	2.8	1.8
31.7	0.4	1.6	1.6	2.1	1.2	1.4	1.7	2.5	2.1	2.4	2.0	2.0	1.4	0.1	1.9	2.4	2.2	2.3	2.7	1.7
31.4	0.7	1.9	1.9	2.4	1.5	1.7	2.0	2.8	2.4	2.7	2.3	2.3	1.7	0.4	2.2	2.7	2.5	2.6	3.0	2.0
31.1	1.0	2.2	2.2	2.7	1.8	2.0	2.3	3.1	2.7	3.0	2.6	2.6	2.0	0.7	2.5	3.0	2.8	2.9	3.3	2.3
31.7	0.4	1.6	1.6	2.1	1.2	1.4	1.7	2.5	2.1	2.4	2.0	2.0	1.4	0.1	1.9	2.4	2.2	2.3	2.7	1.7
31.3	0.8	2.0	2.0	2.5	1.6	1.8	2.1	2.9	2.5	2.8	2.4	2.4	1.8	0.5	2.3	2.8	2.6	2.7	3.1	2.1
30.8	1.3	2.5	2.5	3.0	2.1	2.3	2.6	3.4	3.0	3.3	2.9	2.9	2.3	1.0	2 8	3.3	3.1	3.2	3.6	2.6
31.7	0.4	1.6	1.6	2.1	1.2	1.4	1.7	2.5	2.1	2.4	2.0	2.0	1.4	0.1	1.9	2.4	2.2	2.3	2.7	1.7
31.2	0.9	2.1	2.1	2.6	1.7	1.9	2.2	3.0	2.6	2.9	2.5	2.5	1.9	0.6	2.4	2.9	2.7	2.8	3.2	2.2
32.5	−0.4	0.8	0.8	1.3	0.4	0.6	0.9	1.7	1.3	1.6	1.2	1.2	0.6	−0.7	1.1	1.6	1.4	1.5	1.9	0.9
33.4	−1.3	−0.1	−0.1	0.4	−0.5	−0.3	0.0	0.8	0.4	0.7	0.3	0.3	−0.3	−1.6	0.2	0.7	0.5	0.6	1.0	0.0
32.6	−0.5	0.7	0.7	1.2	0.3	0.5	0.8	1.6	1.2	1.5	1.1	1.1	0.5	−0.8	1.0	1.5	1.3	1.4	1.8	0.8
31.3	0.8	2.0	2.0	2.5	1.6	1.8	2.1	2.9	2.5	2.8	2.4	2.4	1.8	0.5	2.3	2.8	2.6	2.7	3.1	2.1
31.1	1.0	2.2	2.2	2.7	1.8	2.0	2.3	3.1	2.7	3.0	2.6	2.6	2.0	0.7	2.5	3.0	2.8	2.9	3.3	2.3
31.0	1.1	2.3	2.3	2.8	1.9	2.1	2.4	3.2	2.8	3.1	2.7	2.7	2.1	0.8	2.6	3.1	2.9	3.0	3.4	2.4
31.7	0.4	1.6	1.6	2.1	1.2	1.4	1.7	2.5	2.1	2.4	2.0	2.0	1.4	0.1	1.9	2.4	2.2	2.3	2.7	1.7

In 382, or 95.5% of the total number of 400 cases, the Soap-B spread was higher than the Soap-A spread.

of soil removal; or about 6% when expressed as Detersive Efficiency.

Conclusions

1. A method for detergency tests has been described which, it is felt, yields a higher degree of reproducibility than the soiled fabric-Launderometer Method commonly employed.

In terms of Standard Deviation, the reproducibility of a determination was found to be about ±0.7 when results were expressed as units of black removed, and under the conditions described in this paper.

2. This method makes it possible to determine with reasonable assurance differences between detergents which are greater than 6% (Detersive Efficiency).

3. The simplicity of apparatus required for the test should make it available for use in other laboratories. There is also the possibility that any type of standard soiled fabric could be used in the test, inasmuch as the manner of using the soiled fabric more than the manner of preparing it, largely determines the reproducibility of the method. (This point is at present under investigation.)

4. The method, it is thought, might be adapted to measure relative efficiencies of various types of washing machines, as well as for evaluating detergents.

LITERATURE

(1) G. Peirce and coworkers. Unpublished work carried out in this laboratory.

(2) Van Zile, B. S. Oil & Soap *20*, 55-57 (1943).

Abstracts

Oils and Fats

Edited by
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REFINING EDIBLE FATS AND OILS—PROCEDURES AND PROBLEMS. J. Davidsohn and A. Davidsohn. *Food Industries 16*, 717-8, 761-3 (1944).

THE PREPARATION OF NUTRITIONALLY VALUABLE EDIBLE FATS, A PROBLEM WHICH CAN BE SOLVED TECHNICALLY. Hans Th. Twisselmann. *Fette u. Seifen 50*, 38-41 (1943). Undamaged raw beef tallow contains substances which will prevent deterioration. The admixt. of carefully prepd. premier jus with ordinary beef tallow considerably improves the keeping characteristics of the latter. This method permits the conversion of as much as 95% of the raw tallow to premier jus. The use of soybean oil as a stabilizer of refined oils is mentioned. (*Chem. Abs.*)

PHYSICAL CONSTANTS OF THE METHYL ESTERS OF SOME OF THE NATURALLY OCCURRING FAT ACIDS. Paul M. Althouse. *Univ. Microfilms* (Ann Arbor, Mich.), *Pub. No. 631*, 80 pp. (*Chem. Abs.*)

A RAPID METHOD FOR THE DETERMINATION OF FAT IN CREAM CONTAINING 40-50% FAT. A. Mohr and A. Pasveer. *Deut. Molkerei-Ztg. 63*, 602-3 (1942). Weigh 15 g. cream into a 250-cc. beaker and evap. the water over an open flame, detg. the end point by means of a watch glass placed over the beaker, cool the beaker and contents in a desiccator and weigh. Melt the fat and ext. with hot petr. ether, decant the residue 3 times with petr. ether. Calc. the fat content as 100 (water + solids—not fat). Because some fat is not extd., a correction factor of +0.1% is applied. The method is not applicable to cream of low fat content (20%) because during evapn. of the water, the milk solids are scorched. (*Chem. Abs.*)

RAMAN SPECTROSCOPY OF FATTY ACIDS. A. van den Hende and R. Fonteyne. *Natuurw. Tijdschr. 25*, 24-9 (1943). The results of measurements of the Raman spectra of the following acids and esters are presented in tables and graphs: butyric acid, isobutyric