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A Serviceability Study on Kitchen Towelings of Various Fiber Contents

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SUMMARY

At the time this study was undertaken, tea towelings made of all cotton, all linen, cotton-linen mixtures and rayon-linen mixtures were found on the local market. Since the properties of the 3 fibers vary in producing characteristics desirable for kitchen towelings, a serviceability study on 26 towelings was undertaken to determine the qualities found in each. Measurements were made on the fabrics as purchased, after one laundering and on the towels that had been used and laundered 50 times. Some of the results noted were:

1. The all linen towelings and the rayon mixtures were the most expensive.
2. Yarn twists and yarn counts were lowest in the all linen and in the rayon mixed towelings.
3. Weight decreased in the all linen and in the rayon mixtures but remained more nearly the same in the all cotton and cotton-linen mixtures.
4. Shrinkage was greater in the cotton-linen and in the all cotton towelings than in the all linen and the rayon mixtures.
5. Absorption increased from 1 to 50 launderings and was greatest in the rayon mixtures.
6. Dry breaking strengths after 50 launderings decreased most in the all linen towelings and in the rayon mixtures. The wet strength of the linen towelings after 50 launderings was slightly less than the dry strength; in the rayon mixtures decided losses were found.
7. The towelings of rayon mixtures retained their whiteness better than the others; the cotton towelings changed most in whiteness.

From the results obtained in this study it would seem that not all the best qualities can be obtained in any one towel and that the homemaker will have to make her choice on the basis of the qualities she considers most important.

A Serviceability Study on Kitchen Towelings of Various Fiber Contents

ADELLA GINTER AND GRADUATE STUDENTS:
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INTRODUCTION

Tea towels in the past have been made largely of flour and feed sacks. In a study by Coles in 1939 she reported that flour and feed sacks were preferred by 64.6 per cent of small town buyers and 55.1 per cent of city buyers^{1*}. She further stated that although cotton dish towels were most frequently used, 30 per cent of the small town and 37 per cent of the city buyers said they would use other fibers if price were no consideration. Linen was thought preferable by a large majority because of its appearance, durability, and absence of lint.

In another survey of women's preference among selected Textile Products reported in 1947, one-third of the homemakers bought ready made dish towels and two-thirds did not. More than 8 in 10 of the women who did not buy dish towels said they made their own from used flour, sugar or feed sacks. About one in 10 buys toweling from which to make dish cloths. About two-fifths of the women who buy ready-made dish towels said they prefer cotton towels and one-third favored linen; about one in 7 said she liked a cotton-linen mixture.

The most common reasons given for preferring cotton were its good absorbency, softness and pliability, and ease of laundering. Those who preferred linen said they did so because of the absorbency, low linting quality, ease in laundering and good appearance after laundering².

Towels of rayon mixtures seemed to be unimportant in either of the above studies. Towels of these fibers were used by less than one per cent of the homemakers in Coles' study.

In 1942 a study of towels and toweling for consumer use reported that rayon had been recently included in large quantities in both towels and towelings of mixed fibers³. The authors noted a scarcity in all linen toweling with greater numbers of fabrics of mixed fibers.

The studies on Consumer Demand and Women's Preferences indicate that women are quite well agreed on the qualities they are looking for in tea towels. Absorbency, durability, softness and pliability, ease of laundering, good appearance and non-linting qualities were desired. There seemed to be some difference of opinion as to the fibers that were superior in the various qualities. With rayons added to the fibers used for toweling the problem of selecting the

*Superscript numerals in this bulletin refer to Literature Cited, page 20.

best fiber may be even more difficult. Spun rayon in toweling is believed to have good absorptive and non-linting qualities at a price lower than that of linen toweling⁴.

The study reported in this bulletin was planned to show how towelings made of all linen, all cotton, cotton and linen and rayon mixtures compare in the qualities considered most desirable for tea towelings. The varieties, based on fiber content, were chosen because they represented those available to home-makers in Missouri at the time of purchase, which was in the summer of 1945. The problem was set up as a serviceability study in which laboratory tests were made on the unused towelings and again on the towels made from the same fabrics after they had been used and laundered 50 times.

FABRICS

Twenty-six towelings, most of which were about 17 inches wide and varying in price from 11 cents to 90 cents a yard, were selected. According to fiber content they might be grouped as follows:

1. Four were all linen, plain weave, 3 of which had a colored cotton stripe.
2. Eight were all cotton; 4 had a plain weave and colored stripe; 1 was a plain flour sack; 1 was plain weave with an all-over printed pattern; 2 were twill weave with an all-over printed pattern.
3. Six were cotton and linen plain weave towelings with colored cotton stripe, 3 of which were bleached and 3 unbleached.
4. Eight were rayon mixtures of plain weave; the colored stripes and warp yarns in the selvages were all cotton. Four of the eight rayons were made of bright and dull spun rayon in the warp with a filling made mostly of linen and rayon; one had a bright and dull spun rayon warp with a filling of mostly linen and rayon and a very small amount of cotton; one had a warp of mostly bright rayon and linen with a filling of mostly linen and rayon; one had a warp of bright filament rayon with a filling of mostly linen and rayon; one had a bright filament rayon warp with an all linen filling.

PROCEDURE

Each toweling was divided as follows:

1. One length was set aside for tests on the fabric as purchased.
2. Another length was cut off, laundered and used for tests on the fabric after laundering and before use.
3. The remaining yardage was made into towels and laundered before it was given out for use in various homes. In the homes, the towels were used and laundered 50 times, then returned to the laboratory for testing. Each home used the laundry procedure in practice in that home, which in most cases was a combination of home laundering and an occasional commercial laundering.

The results of tests on 3 towels of each variety were averaged together for the effects of 50 uses and launderings.

TESTS USED

All tests unless otherwise specified were performed according to methods specified by the American Society for Testing Materials, Committee D 13^s. A definite plan of testing was worked out whereby random sampling could be obtained on the fabrics.

Yarn count. A Lowinson thread counter was used for this test. An average of 5 tests each in the warp and filling direction was used. Yarn counts were determined on the fabrics as purchased, after one laundering and after 50 uses and launderings.

Yarn twist was made on a Scott tester using an average of 10 tests each in the warp and filling directions. This was made on the towelings after one laundering.

Shrinkage was determined on the towels after one laundering and again after being used and laundered 50 times. An average of 3 measurements each in the warp and filling directions was used.

Weight in ounces per square yard was determined on the fabric as purchased and on the fabrics after being used and laundered 50 times.

Tensile strength. The raveled strip method of testing was used on a Scott tester geared to travel at a rate of 12 inches a minute, with jaws set 3 inches apart. Tests were made on the fabric as purchased, on the towelings laundered once and on the towels after being used and laundered 50 times. Tests were made on the wet fabrics laundered once and on the towels after being used and laundered 50 times.

Absorption. The spray method of the A. S. T. M. was used. Tests were made on the towelings after one laundering and on the towels that had been used and laundered 50 times.

Fiber content and percentage composition of the total fiber content was given for some towelings at the time of purchase but it was considered better to find out how the fibers were distributed in both the warp and filling yarns of the rayon mixtures. To do this, microscopic determinations were made.

Light reflection. A reflectometer constructed by the Physics Department was used to compare the amount of light reflected from the various towelings. This measure was expressed as the percentage of light reflected by the darker towel, using the lighter towel as the standard. With the exception of the three unbleached towelings, the towels after 50 launderings were darker than the new varieties. Because the three unbleached towels became lighter due to bleaching, the laundered, bleached towels were used as the standard. In these cases the reflection was expressed as a fraction.

RESULTS

The towelings were grouped as to fiber content and results of the tests were compared. To simplify the wording, tests on the discarded towels are

TABLE 1.--DESCRIPTION, COST, AND FIBER CONTENT OF TOWELINGS AS PURCHASED

Fabric	Description	Cost		Fiber Content
		A.P.	Sq. Yd.	
<u>Linen:</u>				
1.	All white, no border	\$.69	\$1.45	Warp and filling linen
2.	White with colored striped border	.98	2.05	Warp and filling linen, cotton warp stripe
3.	White with colored striped border	.89	1.89	Warp and filling linen, cotton warp stripe
4.	White with colored striped border	.90	1.95	Warp and filling linen, cotton warp stripe
	Mean:	.87	1.84	
<u>All Cotton:</u>				
1.	White with colored striped border	.27	.57	Warp and filling all cotton
2.	White sack	.19	.24	Warp and filling all cotton
3.	White with colored striped border	.11	.26	Warp and filling all cotton
4.	White with colored striped border	.26	.55	Warp and filling all cotton
5.	White with colored striped border	.16	.35	Warp and filling all cotton
6.	All over design	.59	1.19	Warp and filling all cotton
7.	All over design with solid border	.52	1.07	Warp and filling all cotton
8.	All over design with solid border	.56	1.12	Warp and filling all cotton
	Mean:	.33	.67	
<u>Cotton and Linen:</u>				
1.	White with colored striped border	.22	.45	Warp and filling cotton with small amount linen, cotton stripes - $\frac{1}{2}$
2.	White with colored striped border	.18	.37	Warp and filling cotton with small amount linen, cotton stripes - $\frac{1}{2}$
3.	White with stripes every inch, border	.29	.63	Warp and filling cotton with small amount linen, cotton stripes
4.	Unbleached with striped border	.21	.42	Warp and filling cotton with small amount linen, cotton stripes - $\frac{1}{2}$
5.	Unbleached with striped border	.17	.36	Warp, and filling cotton with small amount linen, cotton stripes - $\frac{2}{3}$
6.	Unbleached with colored striped border	.17	.36	Warp and filling cotton with small amount linen, cotton stripes - $\frac{1}{2}$
	Mean:	.21	.43	

Fabric	Description	Cost		Fiber Content
		A.P.	Sq. Yd.	
<u>Rayon Mixtures:</u> *				
1.	White with colored striped border	\$.36	.76	Warp: bright and dull spun rayon; filling: linen (mostly) and rayon (bright & dull)
2.	White with colored striped border	.49	1.01	Warp: bright and dull spun rayon; filling: linen (mostly) and rayon (dull)
3.	White with colored striped border	.49	1.02	Warp: bright filament rayon; filling: linen (mostly) and rayon (bright & dull)
4.	White with colored striped border	.49	1.10	Warp: bright and dull spun rayon; filling: linen (mostly) and rayon (bright)
5.	White with red stripe every inch	.33	.74	Warp: bright and dull spun rayon; filling: linen (mostly) and rayon (dull) - <u>3/</u>
6.	White with red stripe every inch	.35	.79	Warp: bright and dull spun rayon; filling: linen (mostly) and rayon (bright & dull) and cotton - <u>4/</u>
7.	White with colored striped border	.36	.75	Warp: bright filament rayon; filling: linen- <u>5/</u>
8.	White with colored striped border	.39	.74	Warp: rayon (mostly) and linen; filling: linen (mostly) and rayon (bright)
	Mean:	.41	.83	
	Mean of All:	.41	.85	

* All of these fabrics had cotton stripes and selvage.

1/ Sold as 75% cotton, 25% linen.

2/ Sold as 80% cotton, 20% linen.

3/ Sold as 54% rayon, 44% linen, 2% cotton stripe.

4/ Sold as 45% spun rayon, 50% linen, 5% cotton stripe.

5/ Sold as 46% spun rayon, 51% linen, 3% cotton stripe.

referred to as tests after 50 launderings although these towels were used before each laundering.

Cost Per Square Yard. The mean cost per square yard of the 26 towelings was 85 cents. The plain all cotton towelings were decidedly cheaper than the average; the cotton and linen combinations came next; the rayon mixtures were about average for the whole group; the printed cotton towels were higher; the linen towelings were more than twice the cost of the average for all. See Table 1.

Fiber content. The typical decoration for kitchen towelings is a colored cotton stripe regardless of the fiber content of the rest of the towel. The cotton-linen towelings were made of yarns of blended fibers with relatively small percentages of linen. The rayon towelings in most cases were made of bright and dull spun rayon warp yarns; the filling yarns were made mostly of linen blended with smaller amounts of rayon; two of the towelings had bright filament rayon warp yarns; one had a small amount of linen blended with spun rayon in the warp. See Table 1.

Yarn twist. The average yarn twist of both warp and filling was about 10 turns per inch. On the whole, the yarns in the rayon towelings had the least twist; very little twist was found in the warp yarns made of filament rayon; the yarns in the cotton towelings had the highest number of turns per inch. See Table 2.

Yarn count. The mean warp count for all the towelings was 44 yarns per inch; the filling count was 31. The rayon towelings had the lowest count in both warp and filling. Two of the cotton towelings with the printed designs had the highest warp and filling count; these 2 fabrics were made with a twill weave. After laundering, individual changes were noted but the average warp count remained the same. The filling counts increased, more after 50 launderings than after one. See Table 2.

Weight. The mean towel weight was about 7 ounces per square yard. The cotton towelings were the lightest in weight; the rayon towelings were the heaviest. After 50 launderings there was a slight increase in the weights of the cotton towelings and those of cotton-linen blends; the linen towelings as well as the rayon mixtures decreased in weight. See Table 3. It will be later noted that the groups of towelings that increased most in weight were those that shrank the most and lost the least strength; the 2 groups that lost the most weight shrank the least and lost the most strength. See Tables 4 and 6.

Shrinkage. After one laundering, the mean warp shrinkage was about 5 per cent; filling shrinkage was almost negligible; after 50 launderings, warp shrinkage was about 8 per cent; filling shrinkage was about 2 per cent. On the whole, the cotton towelings and the cotton-linen combinations shrank the most; the all linen and the rayon mixtures shrank the least with lesser differences shown between warp and filling shrinkage than in the other 2 groups. See Table 4.

TABLE 2.--YARN TWIST AND COUNT

Fabrics	Yarn Twist Direction & Number		As Purchased		Yarn Counts After One Laundering		Average at 50 Launderings	
	As Purchased		Purchased		Laundering		Launderings	
	Warp	Fill.	Warp	Fill.	Warp	Fill.	Warp	Fill.
<u>Linen:</u>								
1.	z 6.10	z 6.38	26	22	26	22	26	22
2.	z 8.01	z 8.19	32	28	31	29	31	28
3.	z 9.10	z 12.30	65	37	65	41	61	41
4.	z 8.18	z 7.63	33	32	34	32	34	32
Mean:	7.82	8.63	39	30	39	31	38	31
<u>All Cotton:</u>								
1.	z 15.66	z 13.71	54	42	59	45	56	49
2.	z 16.59	z 9.00	52	52	52	46	50	49
3.	z 22.48	z 18.67	34	27	34	27	35	30
4.	z 16.74	z 13.88	56	43	58	48	55	48
5.	z 14.30	z 11.88	38	32	38	34	38	36
6.	z 6.20	z 16.24	68	41	69	46	69	46
7.	z 17.57	z 13.44	113	58	108	62	117	62
8.	z 17.50	z 12.68	112	57	108	62	116	62
Mean:	15.88	13.69	66	44	66	46	67	48
<u>Cotton and Linen:</u>								
1.	z 11.93	z 9.34	40	32	40	33	40	36
2.	z 10.23	z 9.80	31	25	32	28	33	30
3.	z 12.81	z 9.43	54	28	54	32	44	34
4.	z 11.91	z 9.96	40	33	39	36	41	36
5.	z 11.61	z 9.91	32	26	32	31	34	31
6.	z 13.35	z 13.35	33	27	33	29	34	31
Mean:	11.97	10.30	38	29	38	32	38	33
<u>Rayon Mixtures:</u>								
1.	z 6.00	z 6.45	29	20	28	21	28	21
2.	z 6.57	z 5.69	29	20	28	22	28	21
3.	s 2.24	z 5.92	29	20	28	21	28	21
4.	z 5.75	z 6.79	33	28	33	29	35	29
5.	z 6.19	z 6.88	28	21	27	21	26	21
6.	z 6.99	z 5.83	26	20	28	21	26	21
7.	0.0	z 6.57	23	20	22	22	23	21
8.	z 6.53	z 8.72	33	27	33	39	33	20
Mean:	5.03	6.37	29	22	28	25	28	23
Mean of All:	10.42	9.96	44	31	44	33	44	34

Absorption. The mean absorption for the 26 towelings was greater after 50 launderings than after one laundering. The rayon towelings absorbed the most after both one and 50 launderings; the unbleached cotton-linen towelings (Numbers 4, 5, 6) absorbed the least after one laundering but showed the biggest increase in absorption after 50 launderings. The all cotton towels ranked next to highest in absorption after one, but decreased after 50 launderings, when they ranked lowest of the 4 groups. The linen towelings absorbed less than the average amount after one laundering but increased greatly after 50 launderings. See Table 5, Fig. 1.

TABLE 3.--WEIGHT AS PURCHASED
AND AFTER 50 LAUNDERINGS

Fabrics	Weight in oz. per Sq. Yd.	
	As Purchased	After 50 Launderings
<u>Linen:</u>		
1.	6.760	4.742
2.	6.843	5.347
3.	5.745	5.630
4.	6.886	5.460
Mean:	6.559	5.295
<u>All Cotton:</u>		
1.	5.428	6.405
2.	4.637	3.890
3.	4.238	4.608
4.	5.988	6.416
5.	7.343	8.657
6.	5.613	5.840
7.	5.402	5.930
8.	7.419	8.554
Mean:	5.759	6.287
<u>Cotton and Linen:</u>		
1.	6.951	7.308
2.	5.951	6.293
3.	7.496	8.748
4.	8.035	8.717
5.	5.746	7.012
6.	6.527	6.558
Mean:	6.799	7.439
<u>Rayon Mixtures:</u>		
1.	8.642	7.527
2.	7.247	7.166
3.	8.146	7.425
4.	8.828	8.202
5.	7.994	6.799
6.	8.733	7.645
7.	8.548	6.684
8.	6.632	6.527
Mean:	8.096	7.247
Mean of All:	6.803	6.567

Tensile strength. On the towelings as purchased in the warp direction, the linens were the strongest; the rayons were next; the all-cotton towelings were third and the cotton-linen mixtures were the lowest. In the filling direction the rayon towelings were slightly higher than the all linen; the all cotton

TABLE 4.--SHRINKAGE IN PER CENT
AFTER ONE AND FIFTY LAUNDERINGS

Fabrics	Per Cent After One Laundering		Per Cent After 50 Launderings	
	Warp.	Fill.	Warp.	Fill.
<u>Linen:</u>				
1.	2.57	2.15	2.50	4.66
2.	3.24	0.54	3.94	2.62
3.	5.58	† 1.66	7.02	1.35
4.	2.50	0.20	1.74	4.72
Mean:	3.47	0.31	3.80	3.34
<u>All Cotton:</u>				
1.	6.23	1.12	11.05	1.62
2.	0.83	† 1.27	7.19	† 5.02
3.	3.91	† 0.58	12.49	3.93
4.	5.59	0.29	11.2	† 1.02
5.	3.87	0.36	9.62	0.33
6.	4.16	† 1.58	8.05	0.81
7.	4.36	† 1.11	11.50	† 0.56
8.	5.58	† 1.84	10.93	† 2.21
Mean:	4.32	† .67	10.25	† 0.27
<u>Cotton & Linen:</u>				
1.	5.88	2.52	11.63	0.61
2.	5.38	1.81	10.70	3.20
3.	7.97	† 1.16	14.51	† 0.26
4.	10.10	0.90	12.64	4.44
5.	8.73	0.69	12.21	4.21
6.	8.28	† 0.51	11.78	3.55
Mean:	7.72	0.71	12.24	2.62
<u>Rayon Mixtures:</u>				
1.	5.49	† 0.73	5.96	0.10
2.	6.15	† 1.97	5.58	2.53
3.	5.27	† 0.79	5.22	1.34
4.	5.61	3.83	6.01	6.79
5.	4.70	† 1.83	6.31	0.85
6.	4.52	2.14	4.41	† 0.67
7.	5.03	† 0.74	5.00	2.73
8.	5.45	2.19	6.94	4.79
Mean:	5.27	0.26	5.68	2.31
Mean of all:	5.23	0.09	7.99	1.74

† Indicates stretch.

came next; the cotton-linen group were the lowest. In the all-cotton group were 2 fabrics of very high tensile strength and correspondingly high yarn counts. These 2 fabrics brought up the average for the group. See Table 6.

After one laundering, the warp and filling breaking strengths of the 26 towelings were slightly lower than the corresponding strengths on the fabrics as purchased; in the warp direction there were 8 exceptions; in the filling direction there were 9 exceptions.

The wet strengths after one laundering were greater than the dry strengths both warpwise and fillingwise for all the towelings except the rayons. Warpwise, the rayon mixtures were weaker wet than dry; fillingwise, most of the same fabrics were stronger or of more nearly the same strength. It is an established fact that rayons lose a high percentage of their dry strength when wet⁶.

TABLE 5.--ABSORPTION IN PER CENT AFTER
1 AND 50 LAUNDERINGS

Fabrics	After One Laundering	After 50 Launderings
<u>Linen:</u>		
1.	150.25	240.84
2.	122.19	187.15
3.	105.50	113.62
4.	100.70	164.57
Mean:	119.66	176.55
<u>All Cotton:</u>		
1.	100.01	83.22
2.	253.23	177.81
3.	165.44	231.35
4.	122.05	109.10
5.	181.92	173.50
6.	129.63	117.83
7.	122.78	81.95
8.	130.40	107.78
Mean:	150.65	135.32
<u>Cotton & Linen:</u>		
1.	155.73	127.48
2.	185.50	196.96
3.	149.77	118.22
4.	49.21	108.08
5.	78.83	190.97
6.	69.90	205.24
Mean:	114.82	157.82
<u>Rayon Mixtures:</u>		
1.	186.75	208.72
2.	216.23	252.20
3.	190.25	230.49
4.	159.64	183.29
5.	191.99	251.70
6.	213.13	207.51
7.	156.11	172.17
8.	169.78	219.28
Mean:	185.48	215.67
Mean of All:	142.70	171.58

Since in most of the rayon towelings the entire warp was of rayon, this was to be expected.

After 50 launderings there was a marked decrease in breaking strength in all the fabrics. The linen towelings and those of rayon mixtures showed the most decided losses. Individually, most of the linen, cotton, and cotton-

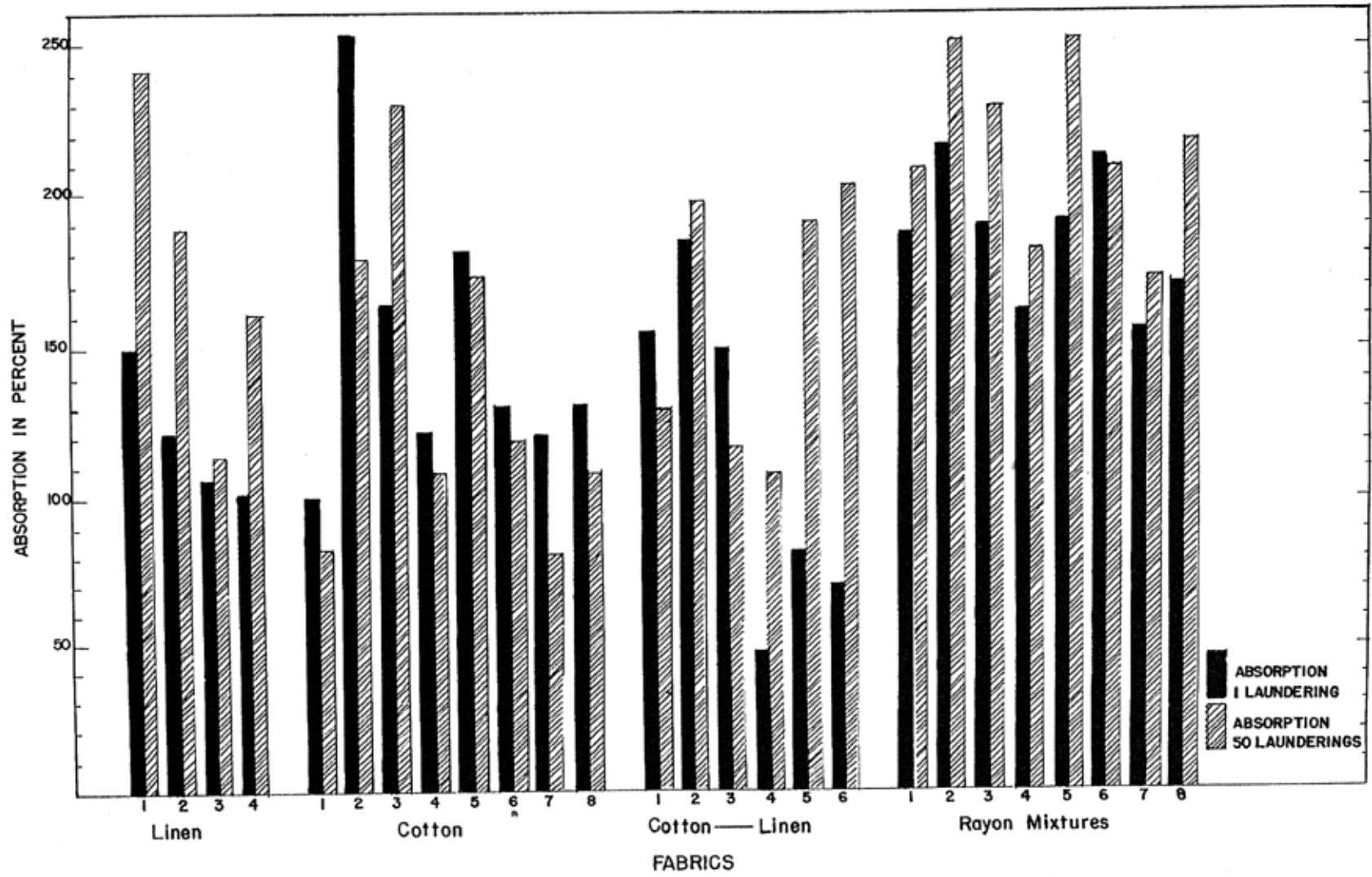


Fig. 1.—Absorption in per cent of fabrics of various fiber contents.

TABLE 6.--BREAKING STRENGTH - RAVELED STRIP METHOD
AS PURCHASED, DRY AND WET STRENGTHS AFTER ONE AND FIFTY LAUNDERINGS AND WEAR

Fabrics	As Purchased Dry		After 1 Laundering				After Wear & 50 Launderings				Per Cent Decrease in Strength 50 Launderings Vs. 1 Laundering			
											Dry at 50 vs. Dry at 1		Wet at 50 vs. Wet at 1	
	Warp	Fill.	Warp	Fill.	Warp	Fill.	Warp	Fill.	Warp	Fill.	Warp	Fill.	Warp	Fill.
Linen:														
1.	90.0	68.2	60.8	52.8	126.6	83.2	15.7	12.1	16.1	7.8	74.1	77.0	73.5	85.2
2.	72.4	60.6	70.0	58.0	116.2	108.2	22.1	18.3	19.1	15.7	71.2	68.4	72.7	72.9
3.	116.7	47.0	123.0	45.8	151.0	71.2	46.3	20.5	35.7	21.5	62.3	55.2	70.9	53.0
4.	55.2	75.6	67.4	56.0	97.0	85.0	29.0	22.1	23.2	16.1	56.9	60.5	65.5	71.2
Mean:	83.6	62.8	80.3	53.2	122.7	86.9	28.3	18.3	23.5	15.3	66.1	65.3	70.7	70.6
Cotton:														
1.	56.3	40.4	53.0	53.6	71.4	57.8	27.0	27.5	23.5	22.3	49.0	48.7	55.6	58.4
2.	38.2	43.8	27.0	31.2	32.8	39.2	13.8	16.7	11.2	11.2	48.8	46.4	54.8	64.0
3.	40.8	41.2	38.2	39.4	34.0	39.6	13.8	16.3	12.7	14.6	63.8	58.6	66.8	62.9
4.	54.2	47.8	53.4	48.8	62.4	51.4	28.7	29.8	31.3	24.3	46.2	59.2	41.3	50.2
5.	64.2	55.0	63.6	63.8	66.7	70.8	23.3	24.2	24.0	20.0	63.4	62.0	62.2	68.6
6.	88.6	49.6	86.4	51.0	92.0	54.6	40.7	30.2	37.2	29.2	52.9	40.8	57.0	42.7
7.	100.4	79.6	117.4	85.6	120.8	90.0	66.7	57.3	51.7	39.5	43.1	33.0	56.0	53.8
8.	116.7	89.4	98.0	84.3	122.2	104.2	58.3	54.8	63.5	53.5	40.5	33.1	35.3	36.3
Mean:	69.9	55.9	67.1	57.2	75.3	63.5	34.0	32.1	31.9	26.8	51.0	47.7	53.6	54.6
Cotton & Linen:														
1.	64.8	46.0	51.4	45.4	69.0	52.2	27.5	27.3	21.5	22.3	46.4	39.9	58.1	50.8
2.	48.8	38.0	45.6	35.4	47.4	43.2	21.3	18.4	16.0	17.3	53.3	48.0	64.9	51.1
3.	67.0	54.2	49.5	51.8	77.3	75.0	39.2	37.8	37.2	31.2	20.8	27.0	24.8	39.7
4.	79.6	60.2	58.6	53.3	88.4	84.0	44.8	38.7	43.2	39.8	23.5	27.3	26.2	25.3
5.	64.8	47.6	41.6	46.0	62.4	61.6	34.8	31.2	33.8	29.6	16.3	32.2	18.7	35.6
6.	61.8	49.6	54.6	53.4	57.7	72.8	29.5	29.0	28.5	28.0	45.9	45.7	47.7	47.5
Mean:	64.5	49.3	50.2	47.6	67.0	64.8	32.8	30.4	30.0	28.0	34.4	36.7	40.1	41.7
Rayon Mixtures:														
1.	69.4	75.6	74.4	61.0	34.0	74.6	42.3	27.8	13.1	18.3	43.1	54.4	82.4	70.0
2.	67.4	59.8	61.4	51.8	25.6	55.4	42.7	31.8	12.5	13.7	30.4	38.6	79.6	73.5
3.	71.2	53.6	70.8	54.4	28.5	63.0	23.5	16.3	8.5	9.2	66.8	70.0	88.0	83.0
4.	87.0	61.8	95.6	69.5	60.6	66.8	57.7	34.5	17.8	15.0	39.7	50.4	81.3	78.4
5.	67.6	63.8	68.0	62.0	22.0	78.0	30.1	30.1	8.6	14.3	55.7	51.4	87.3	76.9
6.	65.6	79.4	62.8	71.0	30.0	78.0	41.3	42.0	13.3	22.8	34.2	40.8	78.8	67.8
7.	95.6	85.0	96.2	60.0	85.2	108.0	66.3	17.8	34.2	17.2	31.0	70.8	64.4	71.3
8.	65.2	54.8	70.8	68.2	30.2	59.8	38.2	26.2	16.5	14.5	46.1	61.5	76.7	78.7
Mean:	73.6	66.7	75.0	62.2	39.5	73.0	42.8	28.3	15.6	15.6	43.4	54.7	79.8	75.0
Mean of All:	71.9	58.8	67.7	55.9	69.6	70.3	35.5	28.4	25.1	21.9	47.0	50.1	61.3	60.4

linen towelings were slightly weaker wet than dry, in both the warp and filling direction. In the rayon mixtures, there was a marked decrease both warpwise and fillingwise in the wet strengths over the dry at this same period. See Table 6 and Figs. 2, 3, 4, 5, 6.

TABLE 7.--REFLECTION IN PER CENT*

Fabrics		Fabrics	
<u>Linen:</u>		<u>Cotton & Linen:</u>	
1.	96	1.	95
2.	94	2.	95
3.	96	3.	97
4.	94	4.	100/79
Mean:	95	5.	100/77
		6.	100/79
<u>All Cotton:</u>		<u>Rayon Mixtures:</u>	
1.	91	1.	96
2.	93	2.	98
3.	89	3.	98
4.	96	4.	100
5.	96	5.	98
6.	95	6.	98
7.	91	7.	97
8.	90	8.	98
Mean:	93	Mean:	98

*The reflection of the towels laundered 50 times was compared with the new, unused toweling since the laundered towels were generally greyed or stained. In the three unbleached towels (Cotton & Linen, 4, 5, 6) the new towels were darker than the laundered, consequently the reflection is expressed as a fraction.

Light reflection. From visual observation it was noted that many of the towels after use and laundering 50 times had become greyed and stained; the unbleached towelings had become bleached. Since this change would be difficult to express accurately, differences in light reflection as determined by a reflectometer were used. The results showed that the towelings of rayon mixtures after 50 uses and launderings reflected very similar to the new; the all linen fabrics were next in similarity; the all cotton towels reflected less light than those in other groups. Half the cotton and linen towels were unbleached, consequently became bleached with repeated launderings; the other half were similar to the linen group. See Table 7.

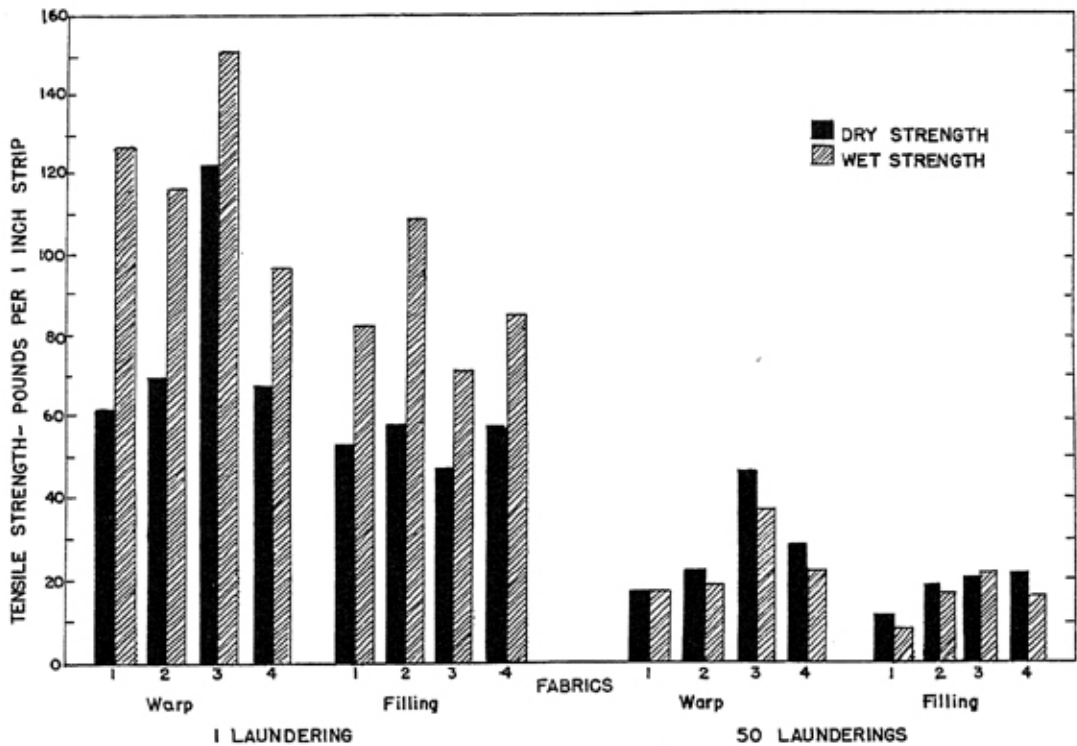


Fig. 2.—Linen fabrics, dry and wet strengths, after one and 50 launderings.

Staining and greying in these fabrics might be attributed to the construction of the fabric as well as the fibers from which the fabric is made. The ability of rayon fabrics to retain their original whiteness is recognized. From a study of Table 2, it can be noted that the towels of rayon mixtures were less firmly woven and those of cotton the most firmly woven.

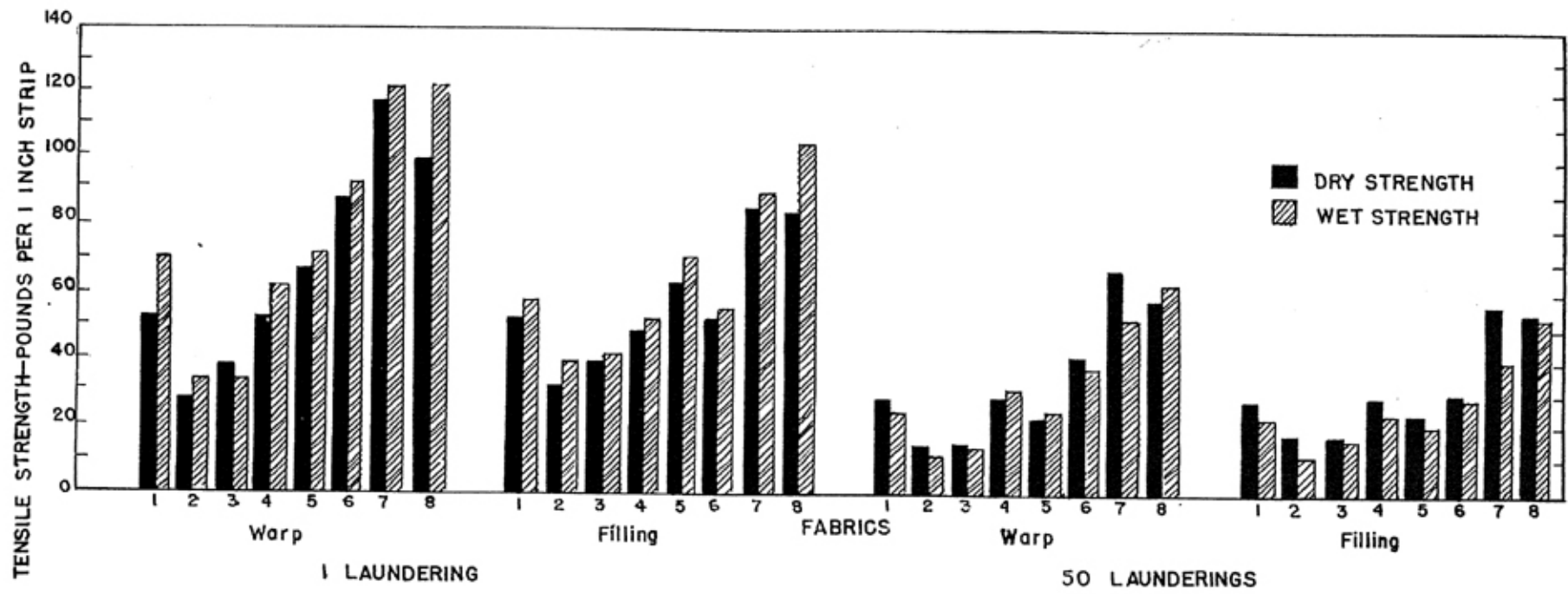


Fig. 3.—Cotton fabrics, dry and wet strengths, after one and 50 launderings.

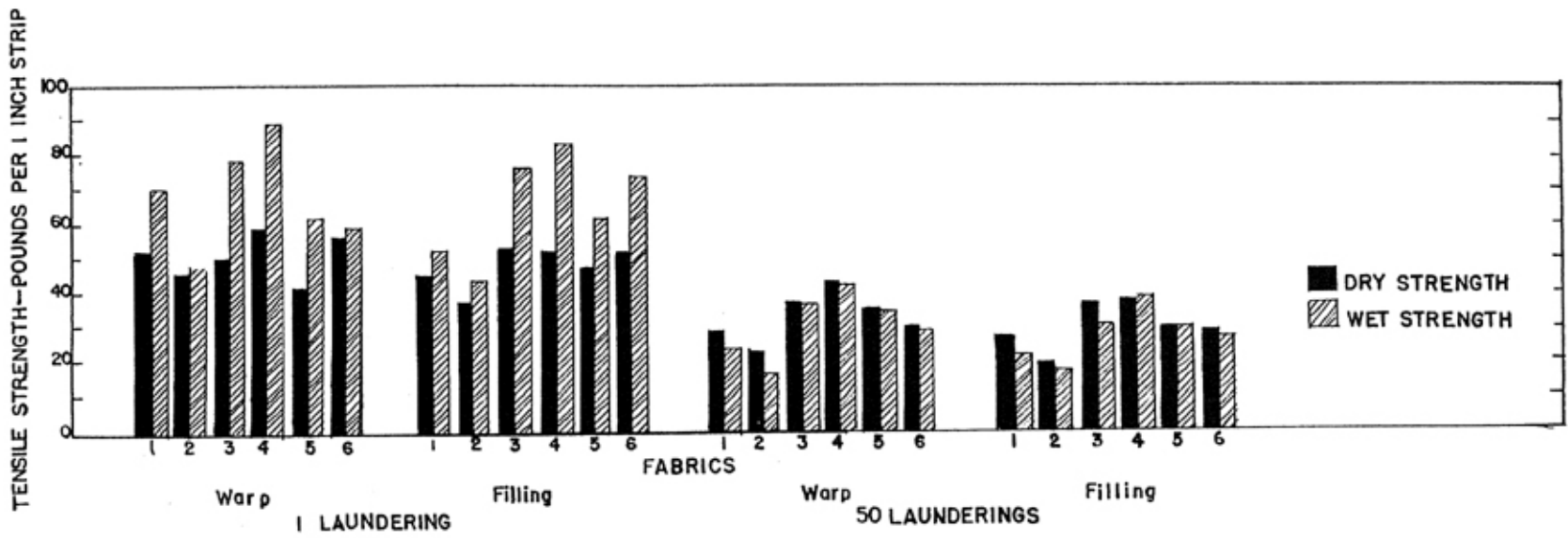


Fig. 4.—Cotton-linen fabrics, dry and wet strengths, after one and 50 launderings.

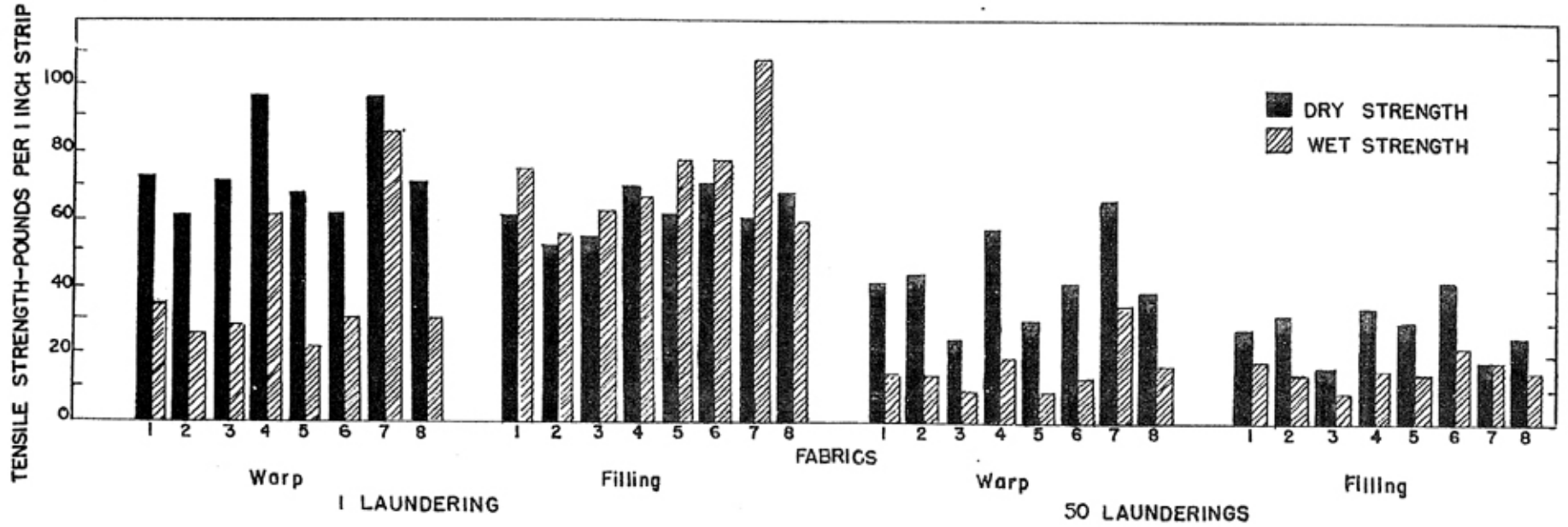


Fig. 5.—Rayon mixtures, dry and wet strengths, after one and 50 launderings.

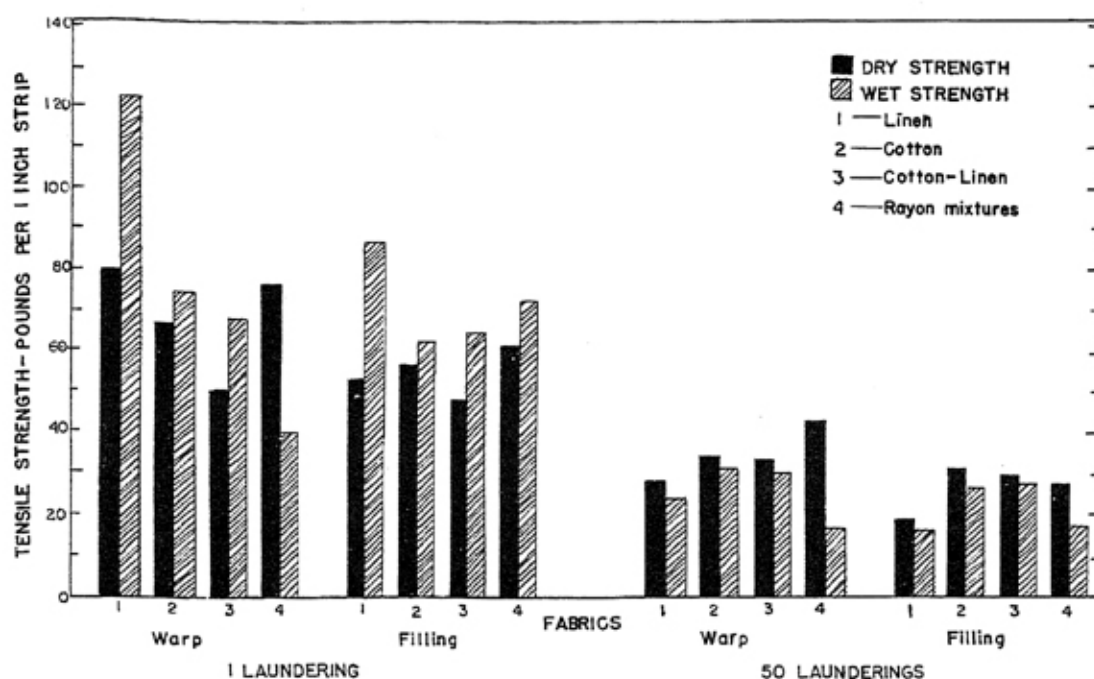


Fig. 6.—All fabrics, dry and wet strengths, one and 50 laundering.

LITERATURE CITED

1. Coles, J. V., 1939, *Consumer Demand in Missouri for Selected Articles of Household Textiles*. University of Missouri Research Bulletin 301:39-41.
2. U. S. Bureau of Agricultural Economics, 1947, *Women's Preferences Among Selected Textile Products*. USDA Miscellaneous Publication 641:30-31 105-106.
3. Bennett, N. C. and Keeney, P. E., 1942, *A Study of Towels and Toweling for Consumer Use*. University of Missouri Experiment Station Bulletin 452:31.
4. 1934-40, *Household Textiles Bulletin*. Household Finance Corporation, Chicago, Illinois, p. 35
5. 1946, *American Society for Testing Materials Standards on Textile Materials*. A. S. T. M., Philadelphia, Pennsylvania.
6. 1947, Matthews, *Textile Fibers*. 5th Edition, Wiley, p. 37.