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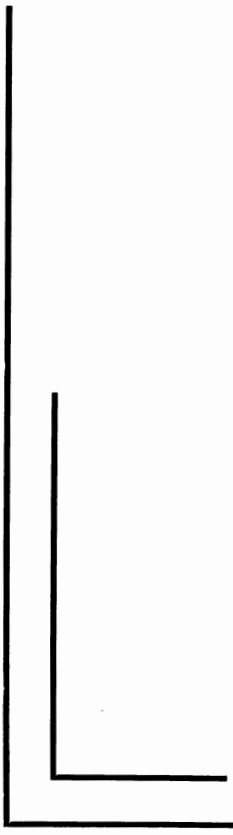

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Content

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Fabric softeners have been added to the list of home laundry aids in recent years. Softeners in laundering are said to improve the hand and wrinkle recovery characteristics of fabrics, maintain tearing and seam strength, and contribute germicidal and antistatic effects. Also, fabrics are said to dry in as much as 25 percent less time and to be easier to fold and to iron[1-2].

Most softeners are organic compounds, although inorganic softeners have been developed[3]. Softeners commonly found on the retail market are dilkyl quaternary ammonium salts in an alcohol and water solution. The active ingredient in these softeners generally varies from 5 to 15 percent of the formulation[4].

Fabric softeners are added to the rinse water in a proportion based on the weight of cloth in a wash load, not on the amount of water in the washer or tub. Because softeners are cationic and most fabrics are anionic, softener in the rinse water is attracted to the fabric[5]. An excess quantity of softener for a wash load may produce undesirable effects in the fabric, and the presence of soap or other detergent may decrease the effectiveness of fabric softeners because of the reaction between the two compounds.

This publication reports results of a study to determine the effects of fabric softener on several properties of two staple cotton fabrics. The specific objectives of the study were to determine the effect of fabric softener on: number of yarns per inch, weight, cerase recovery, reflectance as a measure of yellowness (of the white), stiffness, air permeability, breaking strength and elongation of the fabric.

Materials and Methods

Fabrics

The experimental fabrics were Indian Head and percale, two staple cotton fabrics which were used as examples of coarse yarn and fine yarn fabrics and which differ considerably in texture. Both fabrics were white and neither had any special (resin type) finish.

Samples from the two fabrics were cut in pieces 12 x 15 inches in size and numbered. All samples were hemmed except those used for determining breaking strength, crease recovery and stiffness before laundering.

Thirty samples of each fabric were used throughout the experiment for determining yarns per inch, weight, reflectance (yellowness) and air permeability. It was possible to use the same samples for these four physical measurements at the several test periods, as the samples were unaffected by the test procedures.

Fabric Softener

The fabric softener used in the study was a brand sold on the retail market. The active ingredient was a dialkyl quaternary ammonium salt. The softener was tinted and slightly perfumed.

Laundry Procedure

The fabric samples were laundered in two equal groups. One group was laundered without the addition of fabric softener and is referred to as Treatment 1 in this report. The laundering with the fabric softener is referred to as Treatment 2. Both launderings were handled in the same way except for rinsing when softener was added in Treatment 2.

An agitator type automatic machine was used for the washing. The wash load was 4 pounds. Water temperature was 145° F. plus or minus two degrees, and the wash period was 10 minutes. Because the water was moderately hard, a synthetic detergent was used. In Treatment 2, the recommended amount of fabric softener, 1 ounce of fabric softener to 8 pounds of cloth, was added after the tub had filled for the final rinse.

The samples receiving each washing treatment were dried separately in an electric automatic dryer. When the samples were removed from the dryer, they were smoothed by hand and stored between washings. After washing numbers 5, 10, 20 and 30, the samples were dampened and ironed on a rotary ironer.

Measurements

All measurements were made on the fabrics before they were laundered and all except breaking strength and elongation were made on the laundered fabrics after 5, 10, 20 and 30 launderings. Breaking strength and elongation were determined only at the beginning and at the end of the experiment.

Reflectance was measured with a Gardner Multipurpose Reflectometer having green, blue and amber filters. The tristimulus reflectance readings were used in a simple equation to obtain a measure of the

yellowness in the white of the fabrics. As compared with a standard having a zero value, positive numbers indicate an increasing yellowness and negative numbers indicate decreasing yellowness or more blueness in the white than at the zero value.

After the last laundering of the samples and the completion of measurements of count of yarns, weight, reflectance and air permeability, specimens were cut from these samples for determination of fabric breaking strength and elongation. Fifteen unlaundered samples were used for determining breaking strength and elongation of the unlaundered fabrics.

Breaking strength was determined by the raveled strip method and the results reported in pounds. Fabric elongation was obtained at the same time breaking strength was determined and is expressed as a percentage increase in length of a specimen at the time it breaks.

Ten samples of each fabric were used to determine the crease recovery and stiffness of fabrics before laundering and after they were laundered 5, 10, 20 and 30 times by each of the two laundry treatments. In the determination of crease recovery, measurement was made with a vertical strip appartus in which a previously creased sample was suspended for a fixed period of time and the recovery angle of the crease measured. Stiffness was determined by the cantilever method and reported as bending length. The test is used to measure the resistance of a fabric to bending under its own weight.

Results

Texture appeared to be unaffected by use of a fabric softener. No complete subjective evaluation was made of changes in appearance or in the hand of the fabrics due to laundry treatment. However, build-up of softener was not apparent.

Determination of absorption was not included in the study because absorption is not an especially important property in the two fabrics as it is in some others, but results on air permeability and the availability of means to measure absorption led to determination of absorption of several samples of each fabric after 30 launderings by the two treatments. Results indicated lower absorption in the fabrics laundered with softener, but data were insufficient for definite conclusions.

Number of Yarns Per Inch

Although no difference in number of yarns per inch due to the laundry treatment was expected and none occurred, the results were used as an indication of shrinkage. As may be seen in Table 1, laundering resulted in a greater increase in count in the percale than in the Indian Head, and the count in the percale increased more in the filling than in the warp.

Table 1. Number of yarns per inch and weight of Indian Head and percale before and after laundering without fabric softener (Treatment 1) and with fabric softener (Treatment 2). Mean of measurements from 15 samples.

No. of Launderings	No. of yarns per inch				Weight in grams	
	Warp		Filling			
	Treat. 1	Treat. 2	Treat. 1	Treat. 2	Treat. 1	Treat 2
			Indian Head			
0	54	53	47	48	19.7	19.9
5	55	55	49	48	19.6	19 8
10	55	55	48	48	19.6	19 8
20	55	55	48	49	19 6	19.8
30	55	55	48	48	19.5	19.8
			Percale			
0	85	85	76	76	12.3	12.2
5	88	88	81	80	12.2	12.1
10	87	88	80	80	12.1	12.1
20	87	87	81	81	12.1	12.1
30	87	88	81	82	12.0	12.0

Weight

The Indian Head was a considerably heavier fabric than the percale, but it may be seen from results in Table 1 that, except for the probable removal of a small amount of sizing, neither laundry treatment affected weight of the two fabrics.

Crease Recovery

Both Indian Head and percale increased in their ability to recover from creasing during the first ten launderings but changed little thereafter. The Indian Head had better crease recovery than the percale in the unlaundered state, but after the first five launderings the two fabrics were similar in crease recovery. The warp and filling directions were much alike in each of the fabrics.

Laundering with a fabric softener improved the crease recovery in the filling direction of the Indian Head but the difference was not pronounced. Crease recovery in the percale was unaffected by the laundry treatment. (See Table 2.)

Yellowness

Considerable difference in the white of the two fabrics was found before the fabrics were laundered and in the first launderings. The amount of bluing used in finishing the percale was sufficient to give the white a bluish tint which is reported in Table 2 as a negative value.

Table 2. Crease recovery and yellowness of Indian Head and percale before and after laundering without fabric softener (Treatment 1) and with fabric softener (Treatment 2). Mean of measurements from 15 samples.

No. of Launderings	Crease recovery in percent				Yellowness Value*	
	Warp		Filling			
	Treat. 1	Treat. 2	Treat. 1	Treat. 2	Treat. 1	Treat 2
			Indian Head			
0	36	36	37	37	0.96	0.96
5	38	39	41	42	1.19	1.24
10	43	42	44	45	1 36	1.52
20	41	42	42	44	---	---**
30	41	41	43	44	2.24	2 37
			Percale			
0	28	28	27	27	-0.67	-0.67
5	38	39	39	38	0 78	0.81
10	44	46	44	46	1.17	1.59
20	46	44	44	44	---	---**
30	46	46	46	45	2.17	2.65

* A zero value is standard. Positive numbers indicate increasing yellowness. Negative numbers indicate decreasing yellowness.

**Data on reflectance at 20 launderings was omitted due to a discrepancy between the 20 and 30 laundry intervals which was considered to be caused by an adjustment made in the Reflectometer.

The fabrics laundered with a fabric softener become more yellowed than did the fabrics laundered without softener, and the difference in yellowness was greater in the percale than in the Indian Head. The yellowness in a white fabric may appear to be present in different amounts depending upon how it is viewed; that is, whether the fabric is viewed by itself, or adjacent to a white fabric with more yellow or less yellow in it.

Stiffness

Both fabrics were less stiff when laundered with a softener than when washed without softener. Differences in stiffness due to laundry treatment are illustrated in Figures 1 and 2. No attempt was made to determine if these differences were of practical importance. With removal of sizing and stabilization of dimensions of the fabrics in the first five launderings, the changes in stiffness thereafter were less. Both treatments caused an increase in the stiffness of Indian Head during the first five washings. In both the unlaundered and laundered fabrics, stiffness was greater in the Indian Head than in the percale.

Air Permeability

The laundry treatment affected air permeability, and those fabrics which were laundered with softeners were less permeable (had great resistance to the flow of air) than the fabrics laundered without softener.

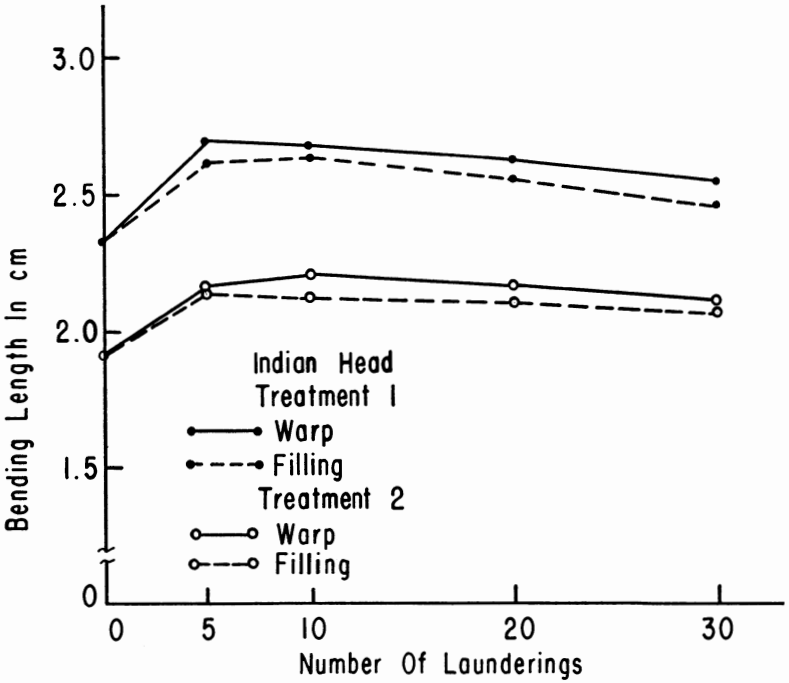

Figure 1. Stiffness of Indian Head as denoted by bending length of warp and filling before and after laundering without fabric softener (treatment 1) and with fabric softener (treatment 2).

See Figure 3. The percale was less permeable than the Indian Head. Although the percale was lighter weight than the Indian Head, its finer yarn and closer weave offered greater resistance to a flow of air.

Breaking Strength and Elongation

After 30 launderings, the fabrics washed with softener had less strength, except in the filling direction of Indian Head which showed no difference. However, the maximum difference in strength of fabrics laundered by the two treatments was only 3½ pounds, a difference which probably would have little or no effect on the wear of the fabric. See Table 3. The increases in strength of percale with laundering may be attributed to shrinkage which caused an increase in yarns per inch, especially in the filling direction.

Both laundry treatments resulted in an increase in fabric elongation, but the increase was greater in the fabrics laundered without softener. As with breaking strength, the difference might be too small to have a bearing on fabric wear.

Table 3. Breaking strength and elongation of Indian Head and percale before and after laundering without fabric softener (Treatment 1) and with fabric softener (Treatment 2). Mean of measurements from 15 samples.

No. of Laundering	Fabric	Breaking strength in lbs.				Elongation in percent			
		Warp		Filling		Warp		Filling	
		Treat. 1	Treat. 2	Treat. 1	Treat. 2	Treat. 1	Treat. 2	Treat. 1	Treat. 2
0	Indian Head	61.8	61.8	57.4	57.4	8.96	8.96	18.47	18.47
30	Indian Head	60.3	59.2	55.7	55.8	11.59	11.17	22.26	22.04
0	Percale	44.6	44.6	29.3	29.3	6.98	6.98	14.17	14.17
30	Percale	47.0	43.5	33.3	30.1	11.07	10.44	16.44	15.80

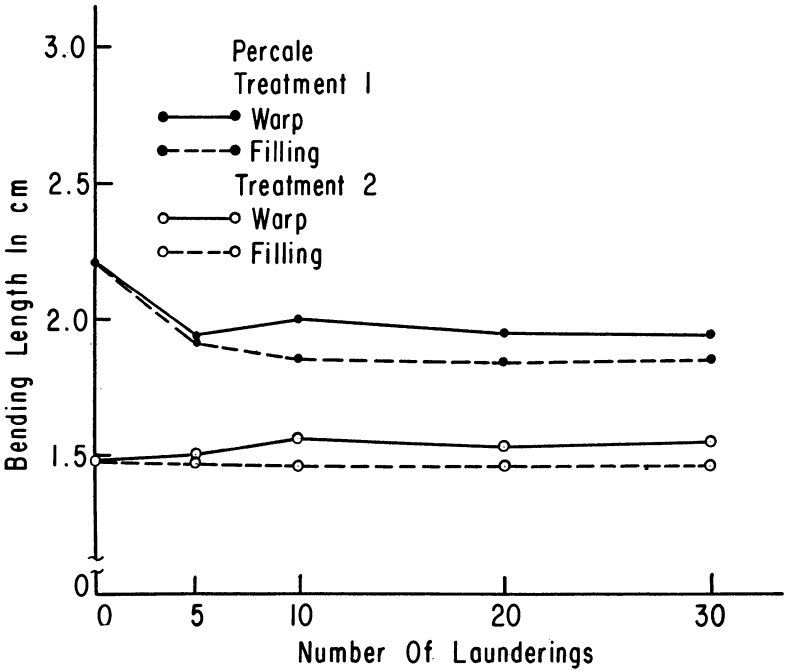

Figure 2. Stiffness of percale as denoted by bending length of warp and filling before and after laundering without fabric softener (treatment 1) and with fabric softener (treatment 2).

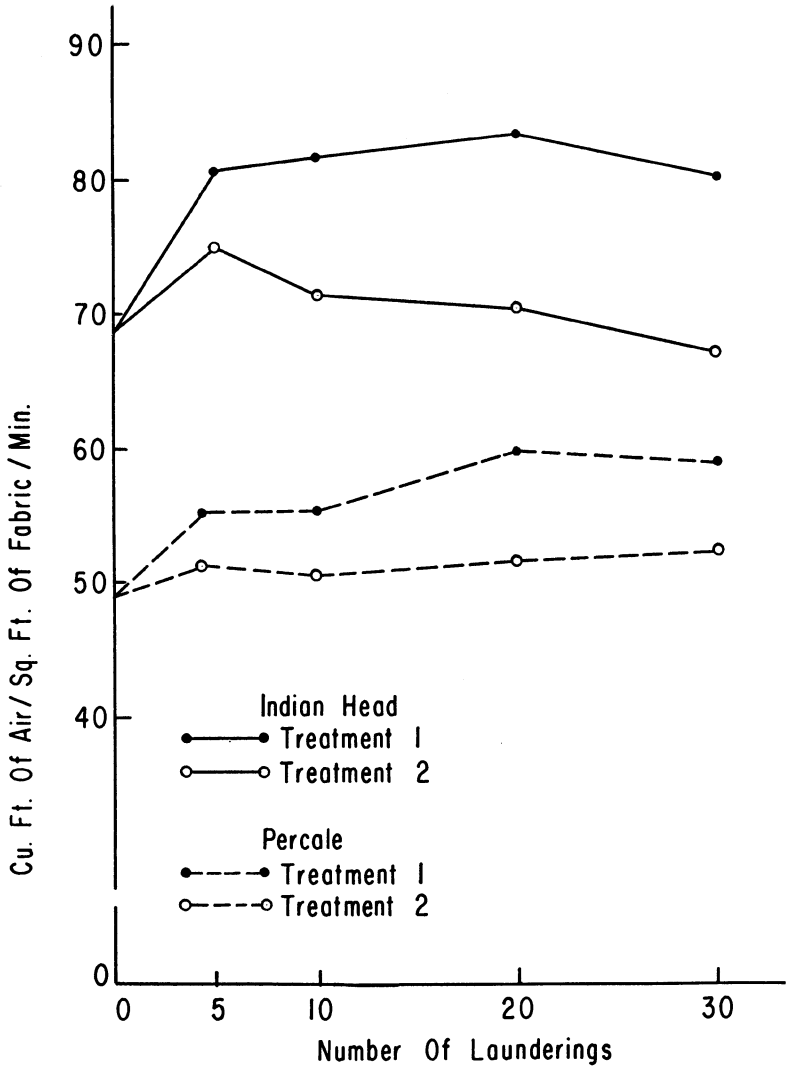

Figure 3. Air permeability or resistance to a flow of air of Indian Head and percale before and after laundering without fabric softener (treatment 1) and with fabric softener (treatment 2).

Summary

Measurement of number of yarns per inch, weight, crease recovery, yellowness, stiffness, air permeability, breaking strength and elongation were made on white Indian Head and percale to find how these fabrics properties were affected by laundering with a fabric softener as compared with laundering without a softener. Measurements were made at four intervals during a period of 30 launderings.

The laundry treatment made no difference in yarns per inch or in weight. In all cases, crease recovery in warp and filling was as great or greater in the fabrics treated with softener as in those laundered without. Stiffness was reduced by laundering with a fabric softener.

Fabrics laundered with a softener were more yellowed than those washed without softener; they had greater resistance to a flow of air; and they had less elongation. Breaking strength in warp and filling was the same or was lower than in the fabrics laundered without softener.

Since the fabrics were subjected to laundering only, no conclusion can be drawn on the significance of the effects of the laundry treatments on the serviceability of the fabrics.

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