COMPARISON OF THE CREASE RESISTANT QUALITY OF FOUR SELECTED COTTON FABRICS BEFORE AND AFTER A SERIES LAUNDERINGS WITH TWO DETERGENTS WHEN MEASURED ON TWO TYPES OF INSTRUMENTS

by

CECILIA MAY ROACH

B. S., Mount St. Scholastica College, 1949

A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Clothing and Textiles

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

1953

TABLE OF CONTENTS

INTRODUCTION

Fabrics made of cellulosic fibers are known to wrinkle readily, consequently the development of a resin that will impart crease recovery is probably one of the greatest developments in the history of textile finishing. The use of a crease resistant finish to improve the appearance of fabrics probably had its beginning as early as 1906 when Eschalier accidently found "that a relatively small amount of formaldehyde caused a significant improvement in the elastic recovery of a cellulosic fiber" (1). However, no progress was made in the use of this discovery until 1927 when the first patents describing methods for rendering textiles crease resistant were filed in the London Patent Office by the British firm Tootal Broadhurst Lee Company, Ltd. (6). The patents were for phenol formaldehyde finishes (13).

In 1932 the wrinkle resistant finish was introduced to the United States by the British firm, but the attempt to sell the process to American fabric mills was unsuccessful. Even after the "Tebilized" trademark was used to designate goods finished to Tootal specifications, wrinkle resistant finishing spread slowly to the United States.

In the first place, the process added to the cost of fabrics during depression years. Secondly, the outbreak of the European war prevented the British firm from financing the process; and thirdly, the urea formaldehyde process was not so well suited to use on cottons. During the early forties Monsanto Chemical and American Cyanamid developed the melamine formaldehyde resin which is better suited for use on cotton fabrics (13). Recently the melamine formaldehyde resins have been improved by the condensation of formaldehyde with lower esters of methylol melamine derivatives (15). The urea formaldehyde and the melamine formaldehyde resins are the most extensively used at the present time.

In 1948 less than one per cent of the cotton goods produced in the United States were resin treated. Nuessle (14) in October 1951 stated, "The large scale application of synthetic resins to cotton is a relatively new endeavor. Only in the past three years has any appreciable yardage of crease resistant cotton been processed." Marsh (10) states that:

> The new property imparted to cellulosic fibers is a combination of resistance to and recovery from creasing, but much greater emphasis must be placed on the recovery; many materials resist creasing, which means they resist deformation and are therefore rigid, but what is required is a product which can be deformed but rapidly recovers from deformation--there must be a resilience which includes some resistance to creasing, but also a powerful and rapid recovery therefrom.

There is evidence that the physical dimensions of fibers affect the crease resistance of fabrics made from them, and it is not easy to distinguish between the influence of dimensional factors and the more pronounced characteristics resulting from the physical-chemical make-up of the fiber. The physical dimensions are length of staple; diameter and shape of fiber; construction, twist and diameter of the yarn; and weave and thickness of fabric (1).

The cellulose fibers lack the elasticity found in the animal fibers that enable them to recover from creasing. It is to improve upon this defect that cotton and the other vegetable fibers are impregnated with one of the many synthetic resins. The fabric to be finished is immersed in a resin solution having a molecule small enough to permeate the fibers. The fabric is then run through large rollers to remove the excess solution. After controlled drying the fabric is heated until the resin molecules polymerize to form large complicated molecules that are insoluble in water and cannot be removed by normal usage, washing or dry cleaning (4).

The effectiveness of the process depends on the individual fibers absorbing the maximum amount of the resin. If the resin coats the yarns or stays between them, it alters the hand and appearance of the fabric without imparting the desirable crease resistant quality. The amount of moisture individual fibers will absorb varies from 7 to 20 per cent of their own weight depending on the humidity (10). To improve that absorbancy, the fabric may be treated with a swelling agent such as a caustic soda solution. A recently developed process which permits a more thorough penetration of the resins is carboxymethylation and "consists of impregnating cotton cloth with a weak solution of monochloroacetic acid followed by treatment with strong sodium hydroxide" (3). The process supplies a built in catalyst and produces higher swellability of the cotton fabric which permits a more perfect distribution, easier and greater penetration of resin. The resulting fabric is superior in most physical properties.

The success of the finish is also dependent on the fabric itself. "It is a dangerous business to try to rescue substandard fabrics by fancy finishing. But given a reasonable balance between finish and basic construction, the finishing must to some degree upgrade the cloth" (13). An excess twist in the yarn may cause uneven absorption of the resins, resulting in improved crease resistance to predominate in one direction. Other factors that influence the success of the finish are proper preparation of the resin precondensate, uniform application to the fabric, proper curing and drying at a temperature that is not too high and washing to remove uncondensed resin, catalyst, and any other chemicals (1).

The crease recovery of a fabric should not exceed that of good quality wool or worsted (about 3.3 to 3.5 cm.) if the other textile qualities are to be preserved (10). Good crease resistance is indicated at 2.8 to 3.0 cm. (17). Advantages that may be attributed to the crease resistant resin finishes on cotton fabrics are increased dimensional stability, improved fastness of dyes to washing, decreased water absorption, quicker drying properties, and improved resilience, handling and draping properties.

This study was undertaken to compare the crease resistance of fabrics purchased with a crease resistant finish and similar fabrics not so treated, to determine the effectiveness of the finish on fabrics as purchased and on fabrics after a series of launderings with a soap and with a synthetic detergent, and to compare the results of two types of instruments for measuring wrinkle recovery.

REVIEW OF LITERATURE

While numerous patents dealing with crease resistant finishes have been filed and many articles have been written both here and abroad since 1927 the finishes are relatively new to the textile industry as well as to the consumer. Questions have arisen as to the effectiveness and permanency of the finishes. Many investigations have been undertaken to solve them.

The application of resins on cotton, while imparting crease resistance, may cause serious losses in other physical attributes, according to Kaswell (9) who says, "At best such chemical treatments are compromises between improved crease resistance on the one hand, and loss in wear and tear properties on the other." Other disadvantages are a tendency to form obnoxious odors upon aging and storage, become yellow in contact with chlorine, lose strength, and have a stiff, harsh hand if the finish is not properly applied. Concerning loss in strength, in 1949 Buck and McCord (1) observed that the loss may be as great as 50 per cent but it can be kept down to 25 per cent or less, and that it is mainly the result of reduced fiber and yarn extensibility. By 1950 it appeared that many lightweight cotton goods, treated in the laboratory to have greater crease resistance than necessary, had such great losses in tensile and tear strength that plans for production trials were dropped. The most recent research has been directed toward improved methods of resin application and avoiding defects. The odors may be prevented by a more thorough final washing or may be eliminated by using a non-ammonium catalyst thereby preventing the formation of the odor producing methylamine. It has been noted recently that the use of certain types of softening agents in the resin liquor tends to increase the crease resistance and also the tearing strength (15).

The even distribution of the resin in finishing was of more importance than the quantity of the finish, but after years of experience, it was found that there were certain average quantities. The usual amount required for cottons was around 10 per cent and no less than 5 per cent (11). According to Marsh (10):

> Many treated cotton goods contain between 6 and 10 per cent of resin, excellent finishes on voiles being obtained with the lower amounts.....Even with cotton goods, by special methods of manipulation, it has been possible to obtain samples containing as much as 40 per cent of resin within the fibre, leaving the fabric soft, flexible, and supple, but with a formidable recovery from creasing and draping properties.

Very little resin outside the fiber may result in a readily creasing fabric that is stiff and brittle, but if a greater amount of resin is formed within the fiber, the result would be soft, supple, and resilient fabric.

The investigations on crease resistant finishes brought another problem, that of choosing or perfecting an instrument that will measure crease recovery accurately.

Probably the earliest attempt to measure recovery from creasing of various textile fibers was made by Krais before 1919. Other tests similar to it were made, but objections to them were that they showed "little or no correlation between yarn recovery and measurements of creasability of the same yarns when measured in fabric form" (10), the weight applied was constant even though the yarns were of different deniers and counts, and measurement of the lower angular recoveries was inaccurate. The clinched fist method of testing was one of the earliest ways of estimating the wrinkle resistance of a piece of fabric. It was useful for demonstration purposes where large differences in the fabric existed, but it was not suitable for determining small differences.

The TBL method utilized by the Tootal Broadhurst Lee Company and the one suggested by Willows seemed to be the same and both were very similar to the one built to meet Federal Specification CCC-T-191-a. These methods measured the chord length of recovery and were critisized as being defective:

> In that 1) as the angle of the recovered crease increases, the change in the chord length (the distance between the ends of the inverted "V") decreases markedly, and this results in poor discrimination between samples of high crease resistance, 2) as the softness and the crease resistance of fabrics increase, the effect of gravity is more marked on the ends of the sample and lowered anticrease values are obtained, 3) twisting of certain samples made it difficult for the technician to determine accurately the chord length, particularly in samples of unbalanced fabrics, thickness and compressibility of fabrics markedly affect the test results. (8).

The advent of several other tests in which the angle of crease recovery is measured has shown more clearly the inadequacy of those measuring the chord length.

Many fabrics seemed to lose a large part of their original crease recovery after a laundering when tested by a chord recovery method, but when measured by the angle testing or clinched fist methods showed very little or no reduction in crease resistance. Washing increased the flexibility of the fabric and even though it was very resilient, when hung on a wire for testing the ends would not separate very widely; the result was a very low recovery reading (17).

The mercury method was devised to eliminate errors due to the weight of the fabrics and the curvature of the fabric ends. Instead of hanging the folded specimen, it is floated on edge on the surface of mercury and allowed to recover. Then either the angle of creasing or the distance between the ends of the cutting can be measured. The results are influenced by the condition of the surface of the mercury and handling of the cutting. This method was not widely used (9).

The creasing angle method was a modification of the TBL method whereby the angle of crease rather than the length of the chord was measured. It was an improvement over the TBL in that it had better sensitivity at wide angles and the twist or curl of the fabric did not have such a great effect. The Monsanto method was a modification of the creasing angle method designed to minimize some of the variables of earlier techniques. It was first developed by the Shirley Institute and further refined by the Textile Resin Department of the Monsanto Chemical Company. The recovery angle is the one which the free end makes with the clamped end. The influence of fabric weight and stiffness was largely eliminated in this method (1).

The roller pressure tester, another modification of the creasing angle method was manufactured by the American Cyanamid Company. A more uniform creasing pressure was obtained by the use of two rollers whose pressure was determined by a weight and lever system; also all handling of the specimen was eliminated after it was placed between the rollers of the tester.

The angle tests, with gravity eliminated seemed to correlate with use tests as far as durability of wrinkle resistance through washing was concerned. Wear tests on dress goods have shown that a recovery angle of 90 to 100 degrees was quite satisfactory. "Fabrics giving angle tests of 90 to 100 degrees both before and after washing have tested about 3.0 cm. by the TBL test before washing and as little as 2.3 cm. after washing" (17). An angle of 90 to 100 degrees when converted to percentage is from 70.6 to 76.6 percentage recovery and 3.0 cm. is 75 per cent recovery and 2.3 cm. is only 57.5 per cent recovery. "100 degrees is considered 'good' recovery (commercially acceptable)" (16).

The Monsanto recovery tester and the roller pressure tester were recommended for submission to the American Association of Textile Chemists and Colorists Research Committee membership for approval as a

> ...tentative means of measuring changes in crease recovery angles of fabrics until such a time as sufficient correlation with actual use of crease resistant fabrics justifies advancing either or both instruments as a standard, or until a new instrument with greater utility is developed (8).

The Compressometer and Flexometer methods were both more complicated than the above testers and showed greater error in testing stiff or limp material. Buck and McCord described some other methods that were variation of those already described and were not widely used.

A new type fabric testing apparatus called the Wrinklometer was developed in the Du Pont laboratories. Fabrics to be tested were wrinkled in a random manner to simulate service tests and were then analyzed with a photocell and recorder arrangement in such a manner that two numbers could be given to indicate the wrinkle resistance and wrinkle recovery of the fabric (7). Since this was new, it remained to be seen whether the Wrinklometer was a step in the right direction.

Many methods for the evaluation of crease resistance had been developed. Some, as the TBL and Monsanto methods had been used quite extensively; but all were deficient in the amount and accuracy of information they gave or ease of operation (1).

METHOD OF PROCEDURE

Fabrics used in this study were selected for Purnell Project 161, Sub-project 6, Phase B, "A Comparison of the Service Qualities of Certain Sheer Cotton Fabrics." Weight per square yard, thread count, twist, dimensional stability, breaking strength, elongation, and slippage were obtained from the project data. Specimens tested for crease resistance and analyzed for resin and sizing were likewise obtained from fabrics laundered in series for the above project. Crease resistance was measured on two types of apparatus, one measuring the length of the recovery chord, the other measuring the angle of recovery.

Fabric Selection

Four sheer cotton dress fabrics were used for this study (Plate I). A navy blue voile to which a commercial crease resistant finish had been applied was purchased from a wholesale house as "Tebilized", and will be referred to as Fabric E. A similar voile, in white, without a crease resistant finish was purchased from a retail store and will be referred to as Fabric H. A copen blue chambray to which a commercial crease resistant finish had been applied was purchased as "Tebilized" and will be referred to as fabric G. A similar chambray in royal blue without a crease resistant finish was purchased as Sanforized and will be referred to as fabric F. Both chambrays were purchased from the mill.

Crease Recovery Apparatus

Two types of apparatus for measuring crease resistance were used for this study. The one built by the United States Testing Company to meet Federal Specification CCC-T-191-a (5) used a fabric cutting 4 cm. by 1 cm. which was folded in half across the narrow direction. A 500 gram weight was placed on the fold for five minutes, after which the creased specimen was hung over

EXPLANATION OF PLATE I

Fabrics used in this study

E. Voile, Tebilized

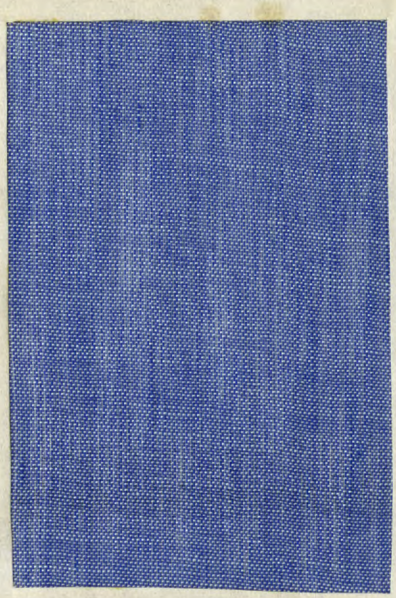
F. Chambray, Sanforized

G. Chambray, Tebilized

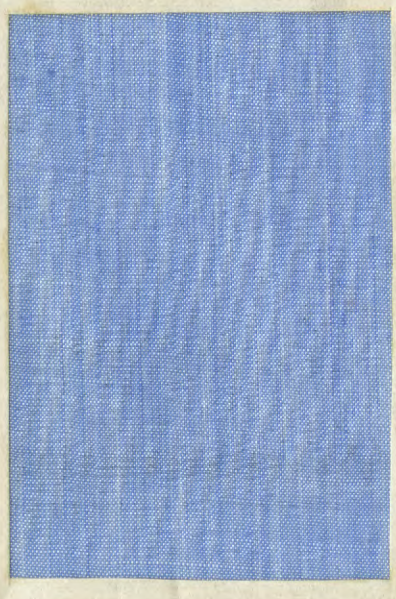
H. Voile, Untreated

PLATE I

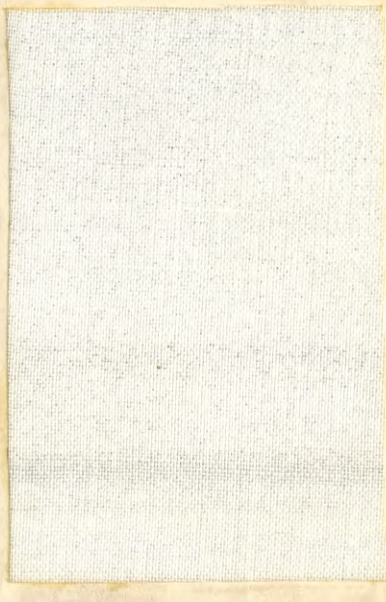
E



F



G



H

a horizontal wire at the crease and allowed to recover for three minutes. The length of chord made by the ends of the recovered cutting was measured in centimeters and recorded. This method will be referred to as the chord method in this study. The other apparatus was the Monsanto Wrinkle Recovery Tester as sold by the Monsanto Chemical Company (12). A specimen 1.5 cm. by 4 cm. was placed in a metal holder, folded in half across the narrow direction and inserted in a plastic press, then a one and one-half pound weight was applied for a five minute period after which the specimen was transferred from the plastic press to the recovery tester. As it recovered for a five minute period one end of the creased specimen was held firmly in the tester clamp while the other hung free and was kept even with the vertical line by adjustment of the tester clamp. At the end of this period the recovery angle indicated on the tester was recorded. This method will be referred to as the angle method.

Laundry Procedure

The laundry procedure conducted in the Purnell project included a five minute wash period and three 2-minute rinses. The temperature of the water for the wash and first rinse was 120° F. ± 2° F.;for the second and third rinses the temperature was 105° F. ± 2° F. The washings were done in a domestic, automatic-type washer and spun dry. The amount of water used for each load was approximately 50 times the weight of the fabric.

No softner or bleach was used. Enough detergent was used to maintain a standing suds of more than two inches throughout the 5-minute wash period. The detergents used were a mild soap, Ivory, and a mild synthetic detergent, Vel. The fabrics were air dried away from direct sunlight, dampened, allowed to stand for 30 minutes and hand pressed with the heat control of the iron set at "cotton."

Tests Conducted

Fabrics as purchased and after 1, 3, 5, 10, and 20 launderings with Ivory and with Vel were tested for crease resistance on two types of apparatus. Five warpwise specimens and five fillingwise specimens were tested on each of the testers for each of the four fabrics. All specimens were thoroughly conditioned at 65 per cent $\pm$ 2 per cent R. H. and $70^{\circ} \pm 2^{\circ}$ F. prior to testing.

Fabrics as purchased and after 1, 5, 10, and 20 launderings with a soap and with a synthetic detergent were analyzed for percentage of sizing and nonfibrous materials according to procedures recommended by the American Society for Testing Materials (2).

FINDINGS AND DISCUSSION

Analyses of the Fabrics

The four fabrics were light weight cottons of plain weave; the two voiles were very similar in weight as were the chambrays. All except E were constructed of single yarns with "Z" twist in both warp and filling. Fabric E, which had the greatest amount of twist of the fabrics tested, had two ply yarns with "Z" twist in both warp and filling; the ply of each yarn also had "Z" twist. The twist of the ply yarns in E was similar for the filling and warp; the twist in the single yarns forming the plies was about the same for the warp and filling. Fabric H was constructed of yarns containing much less twist, the yarns with the greater twist were in the warp. The filling yarns used in the construction of F had a higher twist than those used in the warp. In Fabric G the warp yarns had the higher twist; the filling yarns had the least twist of the yarns analyzed.

As may be observed in Table 1, the treated voile had a greater percentage of elongation than the untreated one. Fillingwise E had 12 per cent elongation, H, 8 per cent; warpwise E had 9 per cent elongation and H, 7 per cent. The percentage of elongation for the chambrays was similar, both stretching 12 per cent in the filling direction. Warpwise, F elongated 4 per cent and G, 3 per cent. The greater elongation was probably due to the finish, as the Tebelized and Sanforized fabrics

Table 1. Analyses of fabrics E, F, G, and H as purchased.

Fabric	Breaking strength in lbs.		Elongation in percentage		Yarns per inch		Twist per inch		Weight per sq.yard oz.	Slippage filling on warp lbs.
	warp	filling	warp	filling	warp	filling	warp	filling		
E	20.5	10.5	9	12	65.8	51.8	44.8*	45.9*	1.7	19.0
F	25.6	14.7	4	12	77.4	58.8	27.3	38.8	2.5	18.0
G	25.6	11.3	3	12	89.6	72.4	32.3	25.3	2.1	15.3
H	18.0	13.0	7	8	61.6	53.2	30.2	26.6	1.6	5.0

*Each single in the 2-ply yarn was:
warp 34.9
filling 34.8

were the ones that showed the greatest elongation; all four of the fabrics had rather high percentages of elongation.

According to analyses the treated fabrics had higher thread counts than the corresponding untreated ones, Table 2. Chambray, being a more closely woven fabric than voile, the chambrays had the highest counts in both the warp and filling directions. Of the voiles, E had the greater count in the warp and H in the filling; there was a greater difference in the warp and filling counts of E than in H. The thread count of E varied more than any of the other fabrics but not as much as would be expected from the dimensional instability. After the 20th laundering with Ivory this fabric had shrunk 3.8 per cent in the warp direction and 7 per cent in the filling, while the thread count warpwise changed from 65.8 to 69.4 yarns per inch, and fillingwise from 51.8 to 53.6. The shrinkage was not so great after the 20th laundering with Vel, 1.7 per cent in the warp and 5 per cent in the filling, the thread count changed from 65.8 to 68.4 yarns per inch. The change of both dimension and thread count was erratic; this probably was due to the high twist of the yarns. After 20 launderings H showed similar amounts of shrinkage for the two detergents, 4.3 per cent in the warp and 4.6 per cent in the filling with Ivory and 4.2 per cent in the warp and 4.5 per cent in the filling with Vel. The change in thread count after 20 launderings was very similar for the two detergents. The original was 61.6 in the warp and 53.2 in the filling; after the 20 launderings the warp count was 64.4 for the Ivory laundered and 64.2 for the Vel laundered, and

Table 2. Thread count given in yarns per inch of fabrics E, F, G, and H after 1, 3, 5, 10, and 20 launderings with Ivory and with Vel.*

No.	E				F				G				H			
wash-	warp		filling		warp		filling		warp		filling		warp		filling	
ings	Ivory	Vel	Ivory	Vel	Ivory	Vel	Ivory	Vel	Ivory	Vel	Ivory	Vel	Ivory	Vel	Ivory	Vel
1	68.4	67.8	52.0	52.0	77.8	78.0	58.8	58.2	89.6	90.2	73.0	73.4	64.0	64.6	54.8	54.8
3	68.6	68.0	52.6	51.8	78.4	78.2	58.0	58.8	89.2	89.0	73.2	73.6	63.8	65.4	55.2	55.2
5	72.0	71.0	53.4	51.6	78.0	78.4	59.0	58.4	89.6	89.2	73.8	74.4	64.2	64.4	55.2	55.4
10	69.4	67.6	52.4	52.6	78.2	78.0	59.0	59.2	89.6	89.0	73.2	73.2	64.0	64.2	55.0	56.0
20	69.4	68.4	53.6	51.8	77.4	77.8	59.2	59.0	89.6	89.4	74.0	73.0	64.4	64.2	55.8	55.6

*Original:

	warp	filling
E	65.8	51.8
F	77.4	58.8
G	89.6	72.4
H	61.6	53.2

the filling count was 55.8 for the Ivory and 55.6 for the Vel. Fabric F, the most stable of the fabrics studied, showed one per cent or less shrinkage after the series of launderings with both detergents. After the series of launderings the thread count of F showed little variation from the thread count of the fabric as purchased. Results showed that the treated chambray had a shrinkage of approximately one per cent and that the thread count varied only slightly. While the percentage of shrinkage of the fabrics studied, with the exception of E, was very little different after the Ivory launderings than after the Vel launderings, in general those laundered with Vel were slightly more stable. Percentages of shrinkage are recorded in Table 3.

The breaking strengths of the four fabrics as purchased and after each series of launderings are recorded in Table 4. After each series of Ivory launderings the loss in the warp breaking strength of E was significant. The fillingwise strength of E was greater after each series of Ivory launderings with the exception of the 10th and then the loss in strength was significant. The loss in warp breaking strength after each series of Vel launderings was significant only after the first and tenth launderings. The increase in the fillingwise strength of E after each series of Vel launderings was significant only after the first laundering. Fabric E, in general, had decreased breaking strengths warpwise and increased breaking strengths fillingwise after each of both series of launderings. The warpwise strength of H decreased significantly after the fifth laundering with both detergents and it in-

Table 3. Shrinkage in percentage of fabrics E, F, G, and H after 1, 3, 5, 10, and 20 launderings with Ivory and with Vel.

No. washings	E				F				G				H			
	warp		filling		warp		filling		warp		filling		warp		filling	
	Ivory	Vel	Ivory	Vel	Ivory	Vel	Ivory	Vel	Ivory	Vel	Ivory	Vel	Ivory	Vel	Ivory	Vel
1	2.4	0.5	4.5	4.0	0.3	0.1	0.6	0.8	0.5	0.4	0.3	0.6	2.6	2.2	4.4	4.8
3	3.7	1.6	6.5	5.3	0.6	0.3	0.6	0.8	0.6	0.6	0.4	0.8	2.9	3.1	4.2	5.4
5	3.6	1.0	7.3	4.9	0.6	0.6	0.7	0.8	0.6	0.8	0.6	0.7	3.6	3.0	4.7	4.5
10	2.7	1.4	6.8	5.8	0.9	0.7	0.7	0.8	0.9	0.8	0.7	0.7	3.7	3.8	4.0	4.7
20	3.8	1.7	7.0	5.0	1.0	0.9	0.7	0.9	1.2	1.2	0.5	0.7	4.3	4.2	4.6	4.5

Table 4. Breaking strengths, in pounds, of fabrics E, F, G, and H after 1, 3, 5, 10, and 20 launderings with Ivory and with Vel.[1]

No. washings	E				F				G				H			
	Ivory		Vel		Ivory		Vel		Ivory		Vel		Ivory		Vel	
	lbs.	S.E.[2]	lbs.	S.E.	lbs.	S.E.	lbs.	S.E.	lbs.	S.E.	lbs.	S.E.	lbs.	S.E.	lbs.	S.E.
								Warp								
1	16.8	0.55	17.7	1.57	24.0	0.32	24.2	0.85	21.7	0.19	23.3	0.77	17.3	1.03	20.3	0.39
3	15.2	0.52	19.7	0.31	24.5	0.14	23.5	2.00	24.6	0.57	25.1	0.38	16.5	0.81	18.6	0.84
5	14.4	1.13	20.4	0.30	24.2	0.61	25.4	0.13	26.4	0.65	24.9	1.05	14.6	0.51	15.2	0.46
10	13.8	0.22	18.3	1.04	25.7	0.99	24.6	0.80	25.2	0.40	25.2	0.70	17.4	0.62	17.4	1.54
20	15.3	1.14	19.2	0.88	25.7	1.43	26.6	0.73	23.1	0.52	26.6	0.38	18.1	0.25	18.6	0.32
								Filling								
1	12.2	1.18	13.1	0.54	13.3	0.19	14.5	0.23	11.1	0.62	11.6	0.85	9.7	0.78	13.7	0.31
3	10.6	0.62	11.0	0.09	13.2	0.13	13.7	0.57	9.9	0.47	12.4	0.84	11.6	0.38	11.0	0.98
5	11.0	0.69	9.7	0.59	14.2	0.78	13.4	0.88	14.3	0.13	12.1	0.09	13.0	0.54	14.3	0.14
10	9.0	0.68	10.1	0.95	11.5	1.20	12.2	0.87	11.7	1.03	12.0	0.41	8.6	0.23	13.8	0.67
20	11.8	0.55	11.5	0.84	12.8	0.46	13.9	0.21	12.8	0.35	12.9	0.64	12.4	0.62	13.5	0.24

[1] Original:

	warp	S.E.	filling	S.E.
E	20.5	.79	10.5	.7
F	25.6	.99	14.7	.32
G	25.6	.83	11.3	.54
H	18.0	.97	13.0	.67

[2] Standard error

creased significantly after the first laundering with Vel. The warpwise breaking strength of fabric H increased after the 20th laundering with both detergents but the increase was not significant. The fillingwise breaking strength of H decreased significantly after 1, 3, and 10 launderings with Ivory and after the 3rd with Vel. It was noted that the fillingwise breaking strength was greater than the original after 20 launderings with Vel but after 20 launderings with Ivory the strength was less than that of the original.

Consistent with the higher thread count, the chambrays also had the greatest breaking strength, with one exception; fabric H had greater strength in the filling than G. The fillingwise breaking strength of fabric G increased significantly after 20 launderings with both detergents and after the fifth laundering with Ivory; but it had decreased significantly after the third laundering with Ivory. The breaking strength of the warp yarns in G was greater after 20 launderings with Vel than that of the fabric as purchased, but after 20 launderings with Ivory it was significantly less than that of the fabric as purchased. The slight increase in the warpwise breaking strength of the other chambray after 20 launderings with both detergents was not significant. The decrease in the fillingwise breaking strength of F was significant after 1, 3, 10, and 20 launderings with Ivory and after 10 with Vel. In general, the fabrics laundered with Vel showed less loss of breaking strength than those laundered with Ivory. In many instances the breaking strength after 20 washings was greater than in the fabric as purchased. This may be due to shrinkage, which results in an increase in thread count, and in the case of the treated fabrics it may be due to loss of finish. It is known that the crease resistant finishes tend to lower the breaking strength of a fabric.

Slippage as determined with the filling yarns on the warp yarns is shown in Table 5. Of the fabrics as purchased, the voiles showed the greatest variation, E showed slippage at 19 pounds and H at 5 pounds. After each of the launderings with Ivory, E showed a significant decrease from the fabric before laundering in resistance to slippage, and H, a significant increase. After each series of launderings with Vel, H showed a significant increase from the fabric before laundering in resistance to slippage; E, after the Vel launderings showed a significant increase in resistance to slippage only after 3 launderings. Fabric F, after 3 and 10 launderings with Vel and after 20 launderings with Ivory showed a significant increase in resistance to slippage when compared to the fabric as purchased. Fabric G showed a significant increase over the fabric as purchased in resistance to slippage after 10 and 20 launderings with Ivory and after 5, 10, and 20 launderings with Vel. The resistance to slippage of yarns in the four fabrics had increased significantly after 20 Ivory launderings, with the exception of E which showed a significant decrease. After 20 launderings with Vel resistance to slippage increased with each fabric, significantly for G and H.

Table 5. Yarn slippage of fabrics E, F, G, and H washed with two detergents, given in pounds of tension required for the filling yarns to slip one-half of an inch on the warp yarns.[1]

No. washings	E				F				G				H			
	Ivory		Vel		Ivory		Vel		Ivory		Vel		Ivory		Vel	
	lbs.	S.E.[2]	lbs.	S.E.	lbs.	S.E.	lbs.	S.E.	lbs.	S.E.	lbs.	S.E.	lbs.	S.E.	lbs.	S.E.
1	5.3	.33	19.7	.33	18.0	.58	18.0	.58	16.3	.67	15.3	.33	10.7	.67	11.0	0
3	7.0	.58	21.3	.67	17.0	.58	20.7	.33	15.7	.33	16.3	.88	8.0	.58	14.7	.88
5	6.3	.67	19.7	1.33	18.7	.88	19.0	.58	15.7	.33	17.0	.58	8.0	.58	16.0	1.00
10	10.0	.58	18.3	.33	18.7	.67	20.3	.33	17.0	.00	19.0	.58	10.0	.00	20.3	.33
20	11.7	.33	20.0	.58	21.0	.58	19.3	.33	17.7	.67	17.3	.33	13.3	.67	21.0	.0

[1]Original:

	lbs.	S.E.
E	19	1
F	18	.58
G	15.3	.33
H	5	0

[2]Standard error

Sizing and Resin

Table 6 shows the analyses of fabrics for percentages of sizing and resin. The treated voile, E, as purchased, contained 7.3 per cent sizing and a very small percentage of resin, 1.1 per cent. After 20 launderings with Vel, analysis showed that it contained 2.3 per cent of sizing and 0.4 per cent resin finish; after 20 launderings with Ivory, 7.1 per cent of sizing and 0.5 per cent resin finish remained. Since the Ivory laundered fabric showed a decrease in sizing from 7.3 to 4 per cent after one washing, and then a gradual increase, it would appear that there was some build up of soap in the fabric. Throughout the series of launderings with Vel the percentage of sizing decreased gradually. Fabric H, as purchased, contained 6.6 per cent sizing and 4.5 per cent resin. Both finishes were temporary as they were removed in the first laundry with both detergents. After the initial loss of the Ivory laundered fabric, the percentage of non-fibrous material increased with each series of laundering, again indicating a build up of soap. The treated chambray, G, upon anlysis showed 4.3 per cent sizing and 6.5 per cent resin. After the 20th laundering with Ivory, there remained in fabric F, 8.7 per cent sizing and 3.3 per cent resin, and in G, 7.3 per cent sizing and 2.1 per cent resin; after the 20th laundering with Vel, F retained 5.6 per cent sizing and 4.7 per cent resin, G retained 4.5 per cent sizing and 4.8 per cent resin. The

Table 6. Percentage of sizing and resin in fabrics E, F, G, and H after 1, 5, 10, and 20 launderings with Ivory and with Vel.[1]

De-ter-gent	No. wash-ings	E Sizing	E Resin	F Sizing	F Resin	G Sizing	G Resin	H Sizing	H Resin
					Warp				
Vel	1	4.1	1.6	5.4	6.4	5.5	5.2	0.6	0.4
Vel	5	4.0	1.1	5.4	6.3	5.0	5.5	0.8	0.0
Vel	10	2.8	0.9	5.5	5.4	5.7	4.5	0.3	0.0
Vel	20	2.3	0.4	5.6	4.7	4.5	4.8	0.4	0.3
					Filling				
Ivory	1	4.0	1.0	5.6	5.2	5.4	4.9	0.6	0.0
Ivory	5	5.6	1.0	5.7	5.7	5.6	4.2	0.7	0.1
Ivory	10	6.4	1.3	4.7	7.4	3.8	6.1	0.9	0.4
Ivory	20	7.1	0.5	8.7	3.3	7.3	2.1	1.4	0.2

[1]Original:

	Sizing	Resin
E	7.3	1.1
F	5.2	6.6
G	4.3	6.5
H	6.6	4.5

untreated chambray had, as purchased and after 20 launderings with both detergents, a greater percentage of finish. With both chambrays, as with both voiles, it appeared that after each series of launderings with Ivory there was a build up of soap. The differences in the amount of resin remaining in the chambrays after 20 launderings with Vel was significantly greater than after 20 launderings with Ivory.

Crease Resistance

Results of tests for crease resistance as measured by the angle method indicated that the treated voile, as purchased and after each series of launderings was acceptable, it had a recovery angle of 100 degrees (76.6 per cent) or more. When tested by the chord method, fillingwise recovery of E, as purchased, and after each series of launderings was too low to be acceptable, 2.8 cm. (75 per cent) or more; the warpwise recovery was acceptable as purchased, but after laundering only after the first and the tenth launderings with Vel. According to the angle test, H as purchased was satisfactory fillingwise but the warpwise recovery was insufficient to be acceptable. Laundering seemed to improve the fabric's ability to recover from creasing enough to make it acceptable warpwise also when tested, using the angle method. Results of tests by the chord method indicate that crease recovery of H both as purchased and after each series of launderings was less than the acceptable percentage. Results of tests for crease resistance as measured by both the chord and angle methods indicated that the chambrays were acceptable both as purchased and after each series of launderings (Table 7).

It is noted that when the chord method was used, crease recovery was better warpwise than fillingwise with two exceptions: after the third laundering of fabric F with Ivory and after the

Table 7. Crease recovery, in percentage and centimeters by the chord test and in percentage and degrees by the angle test for each fabric after each series of launderings.[1]

Detergent	No. washings	E Chord %	E Chord cm.	E Chord S.E.[2]	E Angle %	E Angle deg.	E Angle S.E.	F Chord %	F Chord cm.	F Chord S.E.	F Angle %	F Angle deg.	F Angle S.E.
Warp													
Ivory	1	55.3	2.2	.09	89.3	126	3.6	67.3	2.7	.03	94.2	141	1.2
Ivory	3	56.5	2.3	.2	88.4	124	3.3	60.8	2.4	.2	90.2	129	1.4
Ivory	5	60.9	2.4	.02	90.6	130	0.5	70.5	2.8	.06	89.7	127	4.0
Ivory	10	61.8	2.5	.2	89.2	126	2.6	80.5	3.2	.08	89.1	126	2.6
Ivory	20	60.3	2.4	.01	87.7	123	3.2	76.8	3.1	.08	88.1	123	2.0
Vel	1	70.0	2.8	.30	90.1	129	2.5	81.4	3.3	.02	94.7	143	2.2
Vel	3	62.2	2.5	.08	87.5	122	2.3	75.3	3.0	.08	90.5	130	1.3
Vel	5	61.3	2.5	.03	90.4	129	3.5	79.5	3.2	.08	90.9	131	2.4
Vel	10	70.0	2.8	.02	90.6	130	4.9	78.3	3.1	.2	89.3	126	1.5
Vel	20	66.5	2.7	.2	91.5	132	3.7	78.5	3.1	.1	88.2	124	1.6
Filling													
Ivory	1	45.0	1.8	.4	84.7	116	1.6	67.3	2.7	.03	94.2	141	1.2
Ivory	3	49.8	2.0	.1	94.8	143	2.7	66.5	2.7	.07	94.8	143	1.4
Ivory	5	53.4	2.1	.06	94.6	142	2.2	66.6	2.8	.02	94.6	142	4.2
Ivory	10	53.3	2.1	.07	90.3	129	2.1	67.3	2.7	.06	94.1	140	3.3
Ivory	20	47.2	1.9	.05	90.5	130	0.5	66.5	2.7	.07	95.2	144	1.4
Vel	1	58.5	2.3	.09	91.6	133	4.0	68.8	2.8	.08	96.4	149	2.2
Vel	3	54.8	2.2	.1	91.5	132	2.3	73.5	2.9	.06	94.2	141	1.1
Vel	5	59.1	2.4	.06	93.6	139	3.6	75.8	3.0	.05	95.5	145	4.6
Vel	10	56.3	2.3	.2	91.6	133	3.1	75.9	3.0	.04	94.9	143	4.5
Vel	20	48.5	1.9	.1	93.5	138	3.2	66.5	2.7	.08	93.6	138	1.9

Detergent	No. washings	G Chord %	G Chord cm.	G Chord S.E.	G Angle %	G Angle deg.	G Angle S.E.	H Chord %	H Chord cm.	H Chord S.E.	H Angle %	H Angle deg.	H Angle S.E.
Warp													
Ivory	1	72.5	2.9	.2	86.4	119	3.0	48.8	2.0	.2	70.8	90	5.4
Ivory	3	72.8	2.9	.07	89.3	126	4.4	49.0	2.0	.1	75.6	98	5.9
Ivory	5	65.8	2.6	.1	86.6	120	1.9	57.5	2.3	.2	81.8	110	4.7
Ivory	10	68.8	2.8	.02	90.2	129	3.3	53.0	2.1	.01	76.5	100	1.7
Ivory	20	66.8	2.8	.07	89.0	126	0.7	58.3	2.3	.1	80.5	107	3.9
Vel	1	75.5	3.0	.09	92.8	136	2.7	60.6	2.4	.07	76.7	100	7.9
Vel	3	73.5	2.9	.1	91.6	133	1.3	54.5	2.2	.1	74.6	97	1.3
Vel	5	75.9	3.0	.04	89.0	126	1.8	54.3	2.2	.1	77.7	102	4.5
Vel	10	77.3	3.1	.07	91.3	132	1.7	54.8	2.2	.2	85.8	118	8.0
Vel	20	70.0	2.8	.05	91.9	134	2.1	61.3	2.5	.02	84.6	116	5.8
Filling													
Ivory	1	67.8	2.7	.09	90.9	131	3.6	47.8	1.9	.2	76.5	100	3.8
Ivory	3	66.9	2.7	.01	91.2	132	1.3	43.8	1.8	.1	85.0	116	3.0
Ivory	5	65.0	2.6	.1	90.4	129	2.3	50.0	2.0	.05	80.7	109	3.1
Ivory	10	63.3	2.5	.1	90.8	130	1.3	50.8	2.0	.1	83.1	112	3.1
Ivory	20	66.0	2.6	.05	88.9	125	2.4	51.6	2.1	.08	84.6	116	2.6
Vel	1	67.0	2.7	.1	94.8	143	2.7	46.8	1.9	.09	82.0	110	0.9
Vel	3	67.3	2.7	.08	92.5	135	3.3	55.3	2.2	.5	83.3	113	4.8
Vel	5	74.8	3.0	.05	93.1	137	.7	53.0	2.1	.05	82.4	111	0.9
Vel	10	75.3	3.0	.1	92.8	136	5.0	52.3	2.1	.2	78.9	104	2.4
Vel	20	66.5	2.7	.07	91.9	133	2.6	58.3	2.3	.1	81.0	108	1.9

[1]Original:

	Warp Chord %	Warp Chord cm.	Warp Chord S.E.	Warp Angle %	Warp Angle deg.	Warp Angle S.E.	Filling Chord %	Filling Chord cm.	Filling Chord S.E.	Filling Angle %	Filling Angle deg.	Filling Angle S.E.
E	71.8	2.9	.2	91.6	133	1.2	64.8	2.6	.1	93	137	0.9
F	81.8	3.3	.09	93.6	140	1.3	75.5	3.0	.1	97.7	156	2.8
G	73.3	2.9	.07	94.5	142	3.8	74.8	3.0	.2	98.0	157	1.6
H	56.3	2.3	.08	75.1	97	3.4	49	2.0	.1	77.6	102	3.7

[2]Standard error

third laundering of H with Vel. In contrast, when the angle method was used, crease recovery was higher in the filling direction than in the warp direction with the following exceptions: E, after the first laundering with Ivory; G, after 20 launderings with Ivory; and H after 5 launderings with Ivory and after 10 and 20 launderings with Vel.

After each series of launderings with Ivory and with Vel, E, when tested by the chord method, had a lower crease resistance than the fabric as purchased. The difference was significant after the following launderings with Vel: fillingwise; 3 both warpwise and fillingwise; 5, warpwise; and 20 fillingwise; and after the following Ivory launderings: 1, both warpwise and fillingwise; 3, fillingwise; 5, both warpwise and fillingwise; 10, fillingwise; and 20 both warpwise and fillingwise. When tested by the angle method recovery was lower for the laundered fabrics with the following exception, all fillingwise: after 3 and 5 Ivory launderings, where recovery was significantly greater than that of the fabric as purchased, and after 5 and 20 Vel launderings where recovery was about the same as for the fabric as purchased.

After the series of launderings with the two detergents the revovery of H when tested by the chord method tended to have less recovery warpwise and greater recovery fillingwise than the fabric as purchased. After 3 and 10 Ivory launderings the warpwise recovery of H when tested by the chord method was significantly less than that of the fabric as purchased. After 20 Vel launderings recovery both warpwise and fillingwise was greater than that of the fabric as purchased. When measured by the angle method the crease recovery of H tended to be greater than that of the fabric as purchased; the following recoveries were significantly greater: filling wise after 3, 10, and 20 Ivory launderings; 1, 3, and 5 Vel launderings; and warpwise after 5 and 20 Ivory launderings and the 10 and 20 Vel launderings when tested on the angle tester.

After being laundered with Ivory the crease recovery of the chambrays was less than that of the fabric as purchased, the differences were significant with the following exceptions: fabric F after launderings 10 and 20 warpwise and 5 fillingwise; and fabric G, after 1, 3, and 20 launderings in both warp and filling directions, all when tested by the chord method. After the Vel launderings the crease recovery of the chambrays was less than that of the fabric as purchased when tested by the angle method with one exception, the warpwise recovery of F after one laundering. The crease recovery of the chambrays after the Vel launderings when tested by the angle method was significantly less than that of the fabric as purchased with the following exceptions; the warpwise recovery of both fabrics after one laundering and the warpwise recovery of G after 5 launderings. The warpwise recovery of fabric G as measured by the chord method after 10 launderings with Vel was significantly greater than that of the fabric as purchased. The crease recovery of the chambrays after the Vel launderings when tested by the chord method was significantly less than the recovery of the fabric as purchased for the following: Fabric F, warpwise after 3 launderings, and fillingwise after 20 launderings. Both fabrics showed fewer differences in recovery on the fabric as purchased and after laundering when Vel was used than when Ivory was used.

In every case, as shown in Table 7, the angle method crease recovery readings were much higher than the corresponding chord method readings. The differences can be explained partly by the fact that the specimens measured by the chord method must recover against gravity, where the effect of gravity is eliminated by using the angle tester. The difference in the percentage of recovery of the fabrics as purchased and the fabrics after laundering was greater when tested by the chord method than when tested on the angle tester. As laundering softens the fabrics, gravity has a greater effect on the ends of the specimen and lowered crease recovery readings are obtained.

Little correlation was shown between the two instruments as results in Table 8 indicate; in only two of the 16 correlations computed was it large enough to be considered at the five per cent level, none were large enough to be considered at the one per cent level.

Table 8. Correlation between chord and angle wrinkle recovery testers when used to measure the crease resistance of fabrics E, F, G, and H.*

Detergent	E		F		G		H	
	warp	filling	warp	filling	warp	filling	warp	filling
Ivory	.162	-.818	-.645	-.904	.03	.06	.908	.709
Vel	.332	-.314	-.582	.19	-.301	.04	.267	.007

*Correlation (r) = .878 at 5% level
.959 at 1% level

SUMMARY AND CONCLUSIONS

This study was made to compare the crease resistance of fabrics purchased with a crease resistant finish and similar fabrics no so treated, to determine the effectiveness of the finish on fabrics as purchased and on fabrics after a series of launderings with a soap and with a synthetic detergent, and to compare the results of two types of instruments for measuring wrinkle recovery.

The treated fabrics had higher thread counts than the untreated fabrics. The yarns in the treated voile had more twist than the yarn in the untreated voile; there was little difference in the yarn twist of the two chambrays. The fabrics as purchased were quite similar in weight per square yard, and breaking strength. The untreated chambray, being the heaviest, withstood a greater load before breaking and before slipping. After 20 launderings, the Vel-laundered fabrics had a slightly higher breaking strength than the Ivory-laundered. Both voiles showed a greater percentage of shrinkage than the chambrays, the treated voile showed the greatest amount probably due to the high twist of the yarn. Both the chambrays were quite stable, shrinkage being one per cent or less than one per cent in both the warp and filling. In general, the percentage of shrinkage after using the two detergents was somewhat similar, however, those laundered with Vel were slightly more stable.

Upon analysis of the fabrics as purchased, the untreated fabrics contained more sizing and resin than the treated ones. The finish applied to the untreated voile was only temporary as most of it was removed in the first laundering. The finish of E was decreased greatly during the series of launderings. Both chambrays retained the sizing; the untreated chambray retained a greater percentage of resin finish than the treated one did. After the Ivory launderings there was a build up of soap; the Vel removed less of the resin finish than the Ivory did.

In general, fabrics washed with Vel showed less significant difference from the crease recovery of the fabrics as purchased than did those washed with Ivory.

Both chambrays, as purchased and after each series of launderings, had a crease resistance that was acceptable according to results of tests obtained on both crease recovery tester instruments. The treated voile was acceptable as purchased and after each series of launderings, according to results obtained from the angle test, and when tested on the chord method it was not acceptable as purchased and after each series of launderings fillingwise. The untreated voile as purchased had a recovery that was acceptable only fillingwise and only when tested by the angle method. However, after the series of launderings, H gained enough in recovery to be acceptable warpwise also when tested on the angle tester.

All angle method readings were higher than the corresponding readings as taken on the chord method partially due to the elimination of gravity from recovery by the angle method. Very little correlation was shown between the results as measured on the two instruments.

The results of this study indicate that 1) fabrics not finished with a crease resistant resin may be quite wrinkle resistant due to some other finish or to construction, 2) crease resistant finishes vary in effectiveness and permanency, consequently there is need of further research to make improvement possible, 3) the resin finishes are more stable when a mild detergent is used in laundering than when a mild soap is used, and 4) improved methods for measuring crease recovery are needed.

ACKNOWLEDGMENT

Appreciation is expressed to Miss Esther Cormany, Associate Professor of Clothing and Textiles, for her time and effort in directing this study.

BIBLIOGRAPHY

(1) Buck, George S., Jr. and Frank A. McCord.
Crease resistance and cotton. Textile Res. Jour. 19:216-243, April, 1949.

(2) Committee D-13.
A.S.T.M. standards on testile materials. Designation: D 629-46T American Society for Testing Materials, October, 1951.

(3) Daul, George C., Robert M. Remhardt, and J. David Reis.
Crease resistant cloth from partially carboxymethylated cotton. Textile Res. Jour., 22:792-796, December, 1952.

(4) Doing a job with cotton.
Textile Age, 17:78-80, May, 1953.

(5) Federal specifications for textiles, general specifications, test methods. CCC-T-191a. Supplement, Oct., 8,1945.

(6) Horigan, F. D., and C. R. Sage.
A literature and patent survey on creasing and crease resistance of textiles. U.S. Quartermaster Corps Research and Development Laboratories. Philadelphia Tech. Library Bibliog. Ser. No. 6. 1949.

(7) Hebeler, H. H., and H. J. Kolb.
The measurement of fabrics wrinkling. Textile Res. Jour. 20:650-653, September, 1950.

(8) Instruments for measuring crease resistance. Amer. Dyestuff Rptr. 41:419-423, July, 1952.

(9) Kaswell, Ernest R.
"Crease retention, wrinkle resistance, and dimensional stability." Textile fibers, yarns, and fabrics, Chap. XVI. New York: Reinhold Pub. Corp., 1953.

(10) Marsh, J. T.
"The internal application of synthetic resins." An introduction to textile finishing. 4th impression. Chap. XVI. New York: John Wiley and Sons, Inc.,1951.

(11) Modern methods of processing cotton.
Ciba Review, 95:3431, December, 1952.

(12) Monsanto wrinkle recovery tester bulletin.
No. T-7, December, 1947.

(13) New finishes for old fibers.
Fortune, 39:121-130, April, 1949.

(14) Nuessle, A. C.
Some variables in improving the crease recovery of cotton fabrics with synthetic resins. Amer. Dyestuff Rptr., 41:196-212, March 31, 1952.

(15) Recent developments in textile finishing.
Textile Recorder, 70:80-82, March, 1953.

(16) Stout, Evelyn E., Gloria Y. Wood, and Elizabeth C. Bryant.
The effect home-applied and factory-applied finishes on laboratory performance of cotton chambray.
Jour. of Home Economics, 44:634-637, October, 1952.

(17) What's cooking in new resin treatments.
Textile World, 100:129, 192, 194, June, 1950.

COMPARISON OF THE CREASE RESISTANT QUALITY OF FOUR SELECTED COTTON FABRICS BEFORE AND AFTER A SERIES LAUNDERINGS WITH TWO DETERGENTS WHEN MEASURED ON TWO TYPES OF INSTRUMENTS

by

CECILIA MAY ROACH

B. S., Mount St. Scholastica College, 1949

ABSTRACT OF THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Clothing and Textiles

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

1953

INTRODUCTION

Cottons finished with resins to impart crease resistance are found on the market in increasing numbers. The purpose of this study was to compare the crease resistance of fabrics purchased with a crease resistant finish and similar fabrics not so treated, to determine the effectiveness of the finish on fabrics as purchased and on fabrics after a series of launderings with a soap and with a synthetic detergent, and to compare the results of two types of instruments for measuring wrinkle recovery.

MATERIALS AND PROCEDURE

Four sheer cotton dress fabrics were used for this study, a voile to which a commercial crease resistant finish had been applied, a similar voile without a crease resistant finish, a chambray to which a commercial crease resistant finish had been applied, and a similar chambray without a crease resistant finish.

Fabrics were divided into two groups for laundering using 1) Ivory, a mild soap and 2) Vel, a mild synthetic detergent. After 1, 3, 5, 10, and 20 launderings, portions were withdrawn for testing. Data for weight per square yard, thread count, twist, dimensional stability, breaking strength, elongation, and slippage were obtained from the Purnell Project 161-6-B.

The fabrics as purchased and after each series of washings were analyzed for percentage of sizing and non fibrous materials according to procedures recommended by the American Society for Testing Materials.

Fabrics as purchased and after each series of launderings were tested for crease resistance on two types of apparatus. One, measuring the chord length of recovery is built by United States Testing Company to meet Federal Specification CCC-T-191-a, and the other, measuring the crease recovery angle, is sold by Monsanto Chemical Company, and is used extensively for measuring wrinkle recovery.

FINDINGS AND SUMMARY

The treated fabrics had higher thread counts than the untreated fabrics. The yarns in the treated voile had more twist than yarns in the untreated voile; there was little difference in the yarn twist of the two chambrays. The fabrics, as purchased, were quite similar in weight per square yard and breaking strength. The untreated chambray, being the heaviest, withstood a greater load before breaking and before slipping. After 20 launderings, the Vel-laundered fabrics has a slightly higher breaking strength than the Ivory-laundered and showed a slightly lower percentage of shrinkage. Both voiles showed a greater percentage of shrinkage than the chambrays. The treated voile showed the greatest amount probably due to the high twist of the yarn. Both the chambrays were quite stable, shrinkage being one per cent or less than one per cent in both the warp and the filling.

Contrary to what a crease resistant finish would seem to imply analysis of the fabrics as purchased showed that the fabrics purchased as untreated contained more of a resin finish than those purchased as treated with a resin finish. The untreated voild lost most of the resin finish and sizing in the first launderings while the untreated chambray after the 20th laundering still retained slightly more than the treated one. The Vel-laundered fabrics lost less finish than the Ivory-laundered fabrics. The treated fabrics, as purchased, showed greater recovery from creasing than the untreated fabrics. In general, the Vel-laundered fabrics showed better recovery from creasing than the Ivory-laundered fabrics.

Of the two types of instruments used to measure crease recovery, the United States Testing Company's device indicated less recovery than the Monsanto. This is probably due to the effect of gravity which prevents the recovery chord from being as great as it should be. When the United States Testing Company's recovery tester was used, as a rule, the crease recovery was better warpwise than fillingwise, while when using the Monsanto tester, the crease recovery was higher in the filling direction.

The results of the tests conducted indicated that: 1) the construction of the fabric made a greater difference in the crease resistance qualities than did the resin finish, 2) the percentage of crease recovery and amount of finish retained in the fabrics was slightly greater with the Vel launderings than with the Ivory launderings, and 3) the correlation shown between the two crease recovery instruments was very low.