# A COMPARISON OF THE QUALITIES OF DACRON AND COTTON BLENDS USED IN SHIRTINGS WITH ALL-COTTON FABRICS OF SIMILAR CONSTRUCTION

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# CHAPTER I

## INTRODUCTION

One of the trends apparent in fabric manufacturing today is toward the blending of natural and synthetic fibers. Research is being done to produce blended yarns and fabrics which will display to the utmost advantage the favorable characteristics of each of the constituent fibers and minimize their detrimental characteristics. It has been predicted that the consumer can expect to see, not radically new kinds of fabrics, but fabrics that are easier to care for.[1]

The 65 per cent Dacron and 35 per cent cotton blended fabrics used in shirtings are some of the more recent of these products presented to the public. It is claimed that they combine the comfort and attractive appearance of cotton with the long-wearing strength and easy maintenance qualities of Dacron.[2]

Since shirts made of Dacron and cotton blended fabrics are comparatively recent additions in the shirting industry and are in the higher price bracket, few people have had experience with them. The consumer has no basis for the judging of values versus cost other than through advertising which tends to give only the advantageous points.

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[1] "Blended Synthetics Offer Any Cloth You Want," Business Week, (April 19, 1952) p. 34.

[2] Jerome Campbell, "Dacron and Cotton Form Happy Union," Modern Textiles Magazine, XXXIV (February, 1954), p. 31.

Several advertisers claim that this blended fabric does not wrinkle; the collar will not wrinkle after becoming damp; the shirt may be washed and hung to dry and requires no ironing or only slight "touching-up." Consumers need an impartial judgment regarding the qualities of the materials as to type, wearing qualities, and any additional advantages or disadvantages.

This study, part of a larger research project, was planned to make a comparison of the qualities of the 65 per cent Dacron and 35 per cent cotton blends used in shirtings with all-cotton fabrics of similar construction. Two types of fabric, oxford and batiste, were selected for the study to determine the relative merits of these types of Dacron and cotton blended fabrics. Any variations in value attributable to the use of the Dacron in the blend would be indicated through laboratory testing, which includes analysis of fabric construction, and evaluation of appearance, and measurements of dimensional change, breaking strength, bursting strength, and crease resistance after multiple laundering.

As this study is to be approached from the consumer's point of view and for the consumer, the Dacron and cotton fabrics are to be compared with all-cotton fabrics of similar construction rather than to fabrics of identical construction. Although there are many variables in construction which may alter the serviceability of a fabric, it appears these are seldom considered in advertising and marketing. It was felt the examiner would have more choice than the consumer in the selection of fabrics. Also, since this type of research is interested in differences and not absolutes, it was desirable to use fabrics with varying construction or more than one variable.

The remainder of the study includes Chapter II, The Review of Literature, which describes blending, the characteristics of cotton and of Dacron, the reasons for blending, and the results published at this time of testing of Dacron and cotton blended fabrics. Chapter III describes the procedure for the selection of the test fabrics, the procedures for the laboratory analysis of fabric construction, and the procedures for the laboratory analysis of fabric serviceability. The compilation and evaluation of the selection of the fabrics, and the data from laboratory testing including fabric construction and serviceability are presented in Chapter IV. Chapter V includes the summary, conclusions, and recommendations for further study.

CHAPTER II

REVIEW OF LITERATURE

Blending, the mixing of two or more fibers to produce one yarn, is not in itself a new development in the textile industry. Initially, the natural fibers were blended together. "Generations have blended wool of different grades and assortments to produce fabrics with the proper texture, hand, and price for a given use."[1] Blending has also been used to produce cross-dyeing effects by mixing various colored fibers together or in combination with white fibers. "With the advent of man made fibers - the rayons and acetate - we added further versatility through blending. In recent years the development of the synthetic fibers has added new working tools, new ingredients to open even wider vistas through blending."[2] Quig and Dennison have indicated these reasons for blending fibers:

> The principal task facing the industry today is to bring functionality and aesthetic properties together. Thus, there are evident advantages in choosing fibers that will best suit the use to which the final fabric will be put. By studying the ultimate usage of a fabric, the textile manufacturer can choose a single fiber or a blend of fibers from synthetic and natural materials that will render the most satisfactory service and have the desired aesthetic properties.[3]

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[1] M. K. Ryan, Jr., "Improved Fabrics Through Blending" (Speech presented at Fabric Styling Clinic, Sponsored by Textile Distributors Institute, Inc., Hotel Astor, New York City, September 23, 1954), p. 2. (Mimeographed.)

[2] Ibid., p. 2.

[3] J. B. Quig, and R. W. Dennison, "Complementary Nature of Fibers from Natural and from Synthetic Polymers," Textile Research Journal, XXIV, (April, 1954), p. 372.

This study deals with the blending of a natural fiber - cotton - and a synthetic fiber - Dacron - to produce a fabric with more satisfactory service and desired aesthetic properties. First, it is necessary to understand the characteristics of cotton and Dacron before considering the characteristics of a yarn wherein the two are blended into a fabric.

Cotton, one of the oldest fibers known to man, was used in India as early as the eighth century B. C., and it is quite possible that Egypt was familiar with this plant at that date or before.[4] "The name comes from the French 'coton' which was derived from the Arabian 'katan' or 'qutum' which really referred to flax."[5] It was originally thought to be a type of wool growing on a wild plant of a finer and better quality than that of sheep.[6]

Cotton is a vegetable seed fiber consisting mainly of cellulose, especially after purification. According to Mauersberger it is a "condensation product of glucose, and it is this natural polymer that gives cotton its important properties."[7] It is an elongated cell that is constructed from millions of cellulose molecules. Upon maturing, the fiber is a more or less flattened fiber which is twisted upon its axis. The thick cell wall and characteristic twist serve as a means of identification.[8]

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4 Ethel Lewis, The Romance of Textiles, (New York: The MacMillan Company, 1953), p. 3.

5 Ibid., p. 335.

6 Ibid., p. 60.

7 Herbert R. Mauersberger (ed.), Matthews' Textile Fibers, (New York: John Wiley & Sons, Inc., 1954) p. 106-107.

8 Katharine Paddock Hess, Textile Fibers and Their Use, (New York: J. B. Lippincott Company, 1954), pp. 268, 270.

The cotton fiber ranges in length from approximately 3/8 of an inch to 2½ inches, depending upon the quality. It is generally classified into three groups which include: (1) Egyptian and Sea Island cotton, the long, fine strong fibers of good luster, and a staple length of 1 to 2½ inches; (2) American Upland, the intermediate cottons of somewhat coarser texture and shorter length with a staple length of from ½ to 1 5/16 inches; and (3) Indian or Asiatic cottons, the short, coarse fibers of no luster and a staple length of from 3/8 to 1 inch.[9]

Cotton has been called "King" of the textile fibers because it is the most universally used fiber. Part of this universal acceptance is due to its comparatively low cost and versatility in use. There is practically no cloth or article made of textile fibers for which cotton cannot be used.[10] Another reason for the wide acceptance is its serviceability in use. This is summarized by Hess as follows:

> Although cotton soils and crushes easily, it can be washed and ironed without injury, as the use of boiling water, weak alkali and soap do not materially affect it. Cotton will withstand much rough handling, high temperatures, and thus is considered by some to be the most hygenic fiber.[11]

Its main characteristics include (1) white to cream color, (2) low luster, (3) tensile strength between silk and wool or approximately 2.6 grams per denier, (4) low elasticity, (5) good conductor of heat, (6) highly resistant to effect of heat, (7) moderately high water absorbency, (8) moisture increases its strength and reduces elasticity, (9) sunlight slowly

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[9] Mauersberger, op. cit., p. 111.

[10] Hess, op. cit., p. 249.

[11] Ibid., p. 270.

deteriorates the fiber, (10) affected by mildew, (11) not attacked by moths, (12) not injured by weak acids and alkalies, (13) lack of crease resistance, (14) limpness when wet, and (15) strength and luster are increased by mercerization.[12, 13]

"Dacron," the registered trade-mark for DuPont's polyester fiber, was first known in England under the trade-mark of "Terylene." The development of this fiber was undertaken by the English chemists after studying the works of Dr. W. H. Carothers, DuPont research chemist. In 1946 the DuPont Company bought the United States rights to this fiber.[14] At that time it was known under the provisional title of "Fiber V" and then later given the name "Amilar." "The 'Dacron' trade-mark was substituted for the 'Amilar' mark when the company received advice of its possible confusion with an unrecorded commercial name."[15] The synthesis of this fiber is described by the manufacturer as follows:

> This polymer is a condensation product of ethylene glycol and dimethyl terephthalate. In producing the fiber, the raw materials dimethyl terephthalate and ethylene glycol are added to the reactor, and the polymerization is carried out at a high temperature using a vacuum. The glycol and ester reaction first releases methanol and then with the elimination of part of the glycol, the polymer chain is formed. The material, like nylon, is spun from the melt, and the filaments are stretched several times their original length to give them strength.[16]

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12 Ibid., p. 273.

13 Mauersberger, op. cit., p. 216.

14 Herbert R. Mauersberger, American Handbook of Synthetic Textiles New York: Textile Book Publishers, Inc., 1952, p. 336.

15 "Dacron New Name for Fiber V," Rayon and Synthetic Textiles, XXXII (April, 1951), p. 41.

16 "Fibers by DuPont," (Delaware: Product information Section Textile Fibers Department, E. I. duPont de Nemours and Co., Inc.), p. 10. (Mimeographed).

Dacron has been termed the "work-horse" fiber because it is truly outstanding in those areas relating to retention of appearance, ease of care, durability and generally good performance.[17]

Its main characteristics include: (1) wet and dry wrinkle resistance, (2) recovery from wrinkles both wet and dry, (3) wet and dry shape retention, (4) high wet and dry strength, (5) moderately high abrasion resistance, (6) high flex life, (7) chemical resistance, (8) heat resistance, (9) resistance to degradation by microorganisms and insects, (10) moderate elasticity, (11) moderate flame resistance, (12) crease retention, (13) dimensional stability, (14) quick drying, (15) low water sensitivity, (16) susceptible to static electricity.[18, 19]

Dacron has low water sensitivity which is responsible for its high ratio of wet-to-dry strength, retention of press, stability of dimension in laundering and changing relative humidity, high crease recovery and quick-drying properties. However, this low water sensitivity also causes the development of static electricity and more difficulty in dyeing.[20] It also makes the fabric feel clammy and warm in hot weather.

Another characteristic of Dacron is its ability through heat treatment at suitable temperatures to be rendered unchangeable in form and

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17 Ryan, op. cit., p. 5.

18 "Physical-Chemical Properties of Dacron Polyester Fiber," (Delaware: Customer Service Section Sales Service Division, Textile Fibers Department, E. I. duPont de Nemours & Co., Inc.), p. 1.

19 Samuel B. McFarlane, Technology of Synthetic Fibers, (New York: Fairchild Publications, Inc., 1953), p. 399.

20 J. B. Quig and R. W. Dennison, "Functional Properties of Synthetics," Industrial and Engineering Chemistry, XXXXIV, (September, 1952), p. 2177.

position in the fabrics at lower temperatures, so that a woven material may permanently retain its area and shape. In some instances the heat setting may also improve its resistance to wrinkling. On the negative side, this thermal behavior is responsible for glazing under improper heat and pressure and for the formation of minute holes in fabrics caused by ashes and embers.[21]

In blending fibers it is necessary to study the characteristics of each and then combine them to compliment each other for the purpose to which they will be put. One manufacturer has found "that the best blend, to get the performance characteristics they were after, was 65 per cent Dacron and 35 per cent cotton."[22]

In blending Dacron with other fibers, it has been found to impart outstanding contributions in respect to strength, abrasion resistance, crease recovery, dimensional stability, resistance to moisture, launderability, and press retention.[23] The more absorbent cotton "neutralizes Dacron's propensity to accumulate static electricity" and acts as a vehicle through which the fabric can breathe. This overcomes the cold or clammy feel in hot weather.[24] The cotton also contributes its aesthetic appearance to the blend.

Several articles which have been written have mentioned the fact that a blend is being produced of Dacron and cotton but give no results

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[21] *Ibid.*, p. 2177.

[22] Jerome Campbell, "Dacron and Cotton Form Happy Union," *Modern Textiles Magazine*, XXXIV (February, 1954), p. 31.

[23] J. F. Sayre and A. J. Weldon, "A Study in 3 - Fiber Blends," *Modern Textiles Magazine*, XXXV (July, 1954), p. 68.

[24] Campbell, *op. cit.*, p. 31, 52.

of serviceability or effectiveness in use. Although considerable research done on the performance of fabrics produced by blending natural and synthetic fibers has been published, at the present time little has been published concerning Dacron and cotton. Only one article was found related to the specific 65 per cent Dacron and 35 per cent cotton fabrics used in this study.

In this article written by Jerome Campbell, he states that the following conclusions were obtained through laboratory and wear tests conducted by Wauregan Mills on their 65 per cent Dacron and 35 per cent cotton blend in a batiste construction.

> Abrasion Resistance - The Dacron-cotton cloth is 273 per cent more abrasion resistant in the warp and 415 per cent more abrasion resistant in the filling than a 100 per cent all-cotton batiste used as a control.
>
> Crease Recovery - The Dacron-cotton cloth has about 75 per cent better crease recovery than the all-cotton batiste.
>
> Pill Resistance - The cloth is reasonably pill free as a result of the special twist and special finishing treatment.
>
> Resistance to Static - The Dacron-cotton blend is as resistant to static as the 100 per cent cotton batiste. The blending with Egyptian long-staple cotton retards the susceptibility of the Dacron.
>
> Dimensional Stability - This is rated as better than a Sanforized 100 per cent cotton fabric.
>
> Color and Light Fastness - As dyed and finished for Wauregan by Bradford Dye Works, color and light fastness of Dacron-cotton are rated as excellent.
>
> Wear properties of the Dacron-cotton blend -
>
> 1. The Dacron-cotton garments have a comfortable feel and are not clammy or cold, or excessively warm in hot weather.
>
> 2. Collars of shirts do not wilt easily in hot weather. The collar can be soaking wet with perspiration, but will dry quickly and be as fresh as before.
>
> 3. No odors are set up in the fabric.

4. The fabric does not soil as easily as an all-cotton cloth.

5. Garments, if washed and hung to dry wringing wet, will dry overnight at the longest and sometimes within three hours.

6. The shirts need little or no ironing.[25]

[25] *Ibid.*, p. 52.

# CHAPTER III

## METHOD OF PROCEDURE

### I. PROCEDURE FOR THE SELECTION OF FABRICS

The fabrics to be included in this study were blended fabrics of Dacron and cotton and similar all-cotton fabrics of the oxford and batiste types used in shirtings.

The blended fabrics to be studied were approximately 65 per cent Dacron and 35 per cent cotton. These were obtained by correspondence with retail stores, wholesale houses, fabric manufacturers, and shirt manufacturers.

The all-cotton fabrics of similar construction selected for comparison of serviceability features were purchased from retail stores. Because of the variations in the construction of all-cotton fabrics as compared to the blended fabrics, thread count was selected as the basis of comparison for this study. Three qualities of oxford and three qualities of batiste type all-cotton fabrics were selected to be compared with the similar types of blended fabrics. One quality of each type of all-cotton fabric was selected with a thread count similar to the average thread count of the Dacron and cotton blends of the same type. One quality was below the average; and one above the average thread count.

### II. PROCEDURES FOR LABORATORY ANALYSIS OF FABRIC CONSTRUCTION

Thread Count. The fabric was spread smoothly on a flat surface. The number of warp yarns in a linear inch was counted by using the Suter counter. Five counts were taken in the warp direction with no two threads being counted more than once and no count taken nearer the selvages than one-tenth the width of the fabric. The average of the five counts was reported as the number of warp yarns per linear inch.

The same procedure was used in determining the thread count in the filling direction.

This procedure is the test method recommended by the American Society for Testing Materials.[1]

Weave. The weaves were determined by observation using the pick counter.

Weight per Square Yard. The procedure used was that recommended by Skinkle.[2]

Five samples, two inches square, were cut from each of the fabrics. The oven-dried samples were weighed in an analytical balance. The weight per square yard was calculated by the formula: $S = \frac{36 \times 36}{A} \times \frac{G}{28.35}$ for each sample. In the formula, S is the ounces per square yard, A is the area of the sample in square inches, and G is the weight of the sample at standard regain in grams. The five determinations were averaged and recorded as the weight per square yard.

Fiber Content. The fiber content was stated by the fabric supplier and verified in the laboratory according to the method recommended by the

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[1] American Society for Testing Material Committee D-13 on Textile Materials, American Society for Testing Materials Standards on Textile Materials (Philadelphia: American Society for Testing Materials, 1954), p. 147.

[2] Skinkle, John, Textile Testing (New York: Chemical Publishing Company, 1949), pp. 76-79.

American Association for Textile Chemists and Colorists.[3]

The oven-dry clean weight of the fabrics was obtained after removal of fabric finishes. The samples were then treated with 70 per cent sulfuric acid to remove the cotton from the blend. After thorough washing and neutralization, the samples were again oven-dried and weighed.

The per cent of Dacron in the fabric was calculated using the formula $\frac{B}{A} \times 100$, where B in the formula is the oven-dry weight of the Dacron after the cotton was removed, and A is the oven-dry clean weight of the sample. The per cent cotton content was determined by subtracting the per cent of Dacron from 100. Five samples were tested in this manner and averaged to give the mean fiber content.

Twist. The test procedure used to determine the twist was that recommended by Skinkle.[4]

The gage length was set at five inches, and the indicator set at zero. A single warp yarn was unravelled from the fabric to allow enough thread to be clamped in the two jaws. The rotating jaw was revolved until enough twist was added to break the yarn. The dial and indicator were read and the direction of twist recorded. The next parallel warp yarn was drawn from the fabric and clamped in the jaws in the same manner. The rotating jaw was then revolved in the opposite direction so that the thread was first untwisted and then twisted to the breaking point. The dial reading for twist and direction was again recorded.

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[3] American Association of Textile Chemists and Colorists, *1954 Technical Manual and Yearbook of the American Association of Textile Chemists and Colorists* (New York: Howe Publishing Company, 1954), Volume XXX, p. 110.

[4] Skinkle, *op. cit.*, p. 58, 64-65.

This procedure was followed for ten warp threads in each direction. The turns per inch were calculated using the following formula: $T. P. I. = \frac{N_2}{2L_2} - \frac{N_1}{2L_1}$. The $N_2$ is the number of turns necessary to break a yarn that is first untwisted and then broken by adding twist, $N_1$ is the number of turns necessary to break a thread by adding twist, $L_2$ is the gage length for $N_2$, and $L_1$ is the gage length for $N_1$. The total warp turns per inch were added and the sum divided by five to give the average turns per inch.

The same procedure was used for determining the twist of the filling yarn.

To determine the amount of twist in a ply yarn, a thread was placed in the twist counter in the same manner used for singles yarns. The rotating jaw was revolved until all the ply twist was removed. This was reached when the strands were parallel and a needle could be passed from one jaw to the other. The direction and amount of twist was recorded. Ten recordings of twist in one inch were averaged to give the mean amount of twist in the ply yarn. All the strands but one were broken off at the jaws and the twist in a single strand determined by the procedure used for singles yarns.

Fabric Thickness. The compressometer-type thickness gage was used, and the tests were those specified as standard by the American Society for Testing Materials Committee D-13.[5]

The fabric was placed upon the anvil of the gage and the fabric smoothed to remove any wrinkles. No tension was placed on the fabric. The presser foot was lowered onto the fabric without impact and allowed to

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[5] American Society for Testing Material Committee D-13 on Textile Materials, op. cit., p. 147.

remain ten seconds before a reading was taken. The dial reading indicated to a thousandth of an inch between the anvil and the presser foot. Ten measurements were taken in this manner over the surface of the fabric with none closer than one-tenth of the width of the fabric to the selvages. The ten readings were averaged to obtain fabric thickness.

Yarn Number. The yarn count or number, which represents the number of units of length in a unit of weight, was calculated using the Universal Yarn Numbering Balance according to the recommendations supplied with the instrument.[6]

The procedure was based on the cotton system with 840 yards per number per pound. A one-yard length was used and the yarn number read directly on the balance. Warp threads in thirty-six inch lengths were drawn from the material and weighed on the balance. The index pointer was then read to give the correct yarn number. The same procedure was carried out five times and the results averaged to give the mean warp yarn number.

The same procedure was used to determine the filling yarn number.

Staple Length. The procedure used for the determination of average staple length was adapted from the procedure for hand stapling recommended by Skinkle.[7]

A warp yarn was removed from the material and untwisted. Several fibers were removed from the yarn and placed upon a slightly oiled ruler. A single fiber was drawn out and laid on the scale of the ruler. The

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[6] Roller-Smith Precision Balance, Alfred Suter, Universal Yarn Numbering Balance, Instruction sheet.

[7] Skinkle, op. cit., p. 35.

length was measured and recorded to the nearest sixteenth of an inch. Five measurements were taken in this manner and averaged.

The same procedure was used to determine the average filling staple length.

## III. PROCEDURES FOR LABORATORY ANALYSIS OF FABRIC SERVICEABILITY

Preparation of Fabric for Testing. For each fabric tested five swatches eighteen inches in length by one half the width of the fabric were cut from each yardage of fabric so that tests for dimensional change, tearing strength, bursting strength, and crease resistance might be determined after the first, second, fifth, tenth, and twentieth launderings.

A ten-inch square following the warp and filling threads was marked with basting thread in the swatch to be laundered twenty times. In this way the same square might be measured periodically for dimensional change.

Laundering Procedure. A review of recommended laundering procedures for fabrics of this type indicated that the standard procedures recommended by the American Association of Textile Chemists and Colorists might be too rigorous for the blended fabric. Hand washing procedures suggested by some of the manufacturers could not be sufficiently standardized for use in multiple launderings. A mild laundering procedure was formulated for this particular study. It was adapted from washing instructions given with men's shirts made of Dacron and cotton and from a method recommended for home laundering of fabrics of this type.[8]

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[8] Ruud Manufacturing Company, "Automatic Washer Method Number 4," All About Modern Home Laundering (Pittsburgh: Ruud Manufacturing Company, 1953), p. 45.

A semi-automatic control commercial washer was used and the control set for mild agitation. A concentration of .15 per cent mild neutral soap was used with an eight pound load of all-white laundry. The washer was flushed with water before using the following washing procedure:

1. One minute rinse in cold water.
2. Five minute sudsing at 120°F $\pm$ 2° (.15 per cent soap concentration).
3. Three two minute rinses at 100°F $\pm$ 2°.

The test swatches were hung to drip dry before they were judged for appearance in respect to wrinkle resistance to laundering. The following criteria were set up to rate them for suitability in use with respect to the amount of ironing necessary:

Class 1 - No ironing necessary. (Surface of fabric free from wrinkles; suitable for use in present state.)

Class 2 - Small amount of ironing necessary. (Superficial wrinkles; wrinkles easily removable.)

Class 3 - Greater amount of ironing necessary. (Multiple wrinkles deeply set; requiring heat, moisture, and pressure for optimum appearance.)

After this rating the swatches were rolled between wet towels for one hour to dampen them. They were then pressed on a flat bed press for three seconds at low temperature.

<u>Dimensional Change</u>. The ten-inch square marked on the twentieth test swatch was measured after the first, second, fifth, tenth, and twentieth launderings to determine dimensional changes. The pressed fabric was laid on a flat surface without tension. Five measurements were taken uniformly over the square in both the warp and filling directions. The five warp measurements were recorded to the nearest hundredth of an inch.

The warp measurements were averaged and the percentage of dimensional change determined using the following formula: $\frac{A - B}{A} \times 100 = C$. In which A is the original warp measurement, B is the warp measurement after laundering, and C is the percentage of dimensional change of the warp.

The same procedure was used to determine the percentage of dimensional change of the filling.

Tearing Strength. The raveled-strip method and the pendulum type testing machine specified by the American Society for Testing Materials[9] were used in determining tearing strength.

The tests were performed on five specimens in both the warp and filling direction wet and dry. These tests were run on the original fabric and after the first, second, fifth, tenth, and twentieth launderings. All tests for dry strength were performed on specimens conditioned at 65 $\pm$ 2 per cent relative humidity and 70° $\pm$ 2°F. for at least four hours. Test specimens to determine wet tearing strength were immersed in tap water for two hours before testing.

Five specimens in the warp and filling directions were cut one and one-fourth inches wide by twelve inches long. The strip was then raveled to one inch in width by removing approximately the same number of threads from each side. Each specimen was cut in half, one six-inch strip for dry tearing strength, and the other strip for wet tearing strength. In this manner each wet and dry tear was performed on test specimens containing the same yarns. The longer dimension was parallel to the direction of the tear.

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[9] American Society for Testing Materials, op. cit., pp. 148-149.

Tests were performed according to the procedure for the ravelled strip method and readings taken on the dial scale for light weight fabrics. The five dry warp readings were averaged for the dry warp tearing strength.

The same procedure was used to determine the average wet warp tearing strength, and dry and wet filling tearing strength.

Bursting Strength. The diaphragm bursting tester and procedure used were those specified by the American Association for Testing Materials[10] for knit goods. This test was felt to be of value in indicating the bursting strength of woven goods.

The tests were performed on wet and dry test specimens in the original fabric and following the first, second, fifth, tenth, and twentieth launderings. All specimens were conditioned at 65 $\pm$ 2 per cent relative humidity and 70° $\pm$ 2°F. for at least four hours. The fabrics for wet testing were immersed in tap water for two hours before testing.

The test specimen were cut approximately five inches square. The specimen was clamped over the diaphragm of the machine and the indicator set at zero. The gear was pushed to set the machine in motion. When the fabric ruptured, the gear was moved back to stop the machine and the dial was read. Five readings were taken in this manner for the dry specimen and averaged to give the dry bursting strength.

The same procedure was used to determine the average wet bursting strength.

Crease Resistance. The Monsanto Wrinkle Recovery Tester was used

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[10] American Society for Testing Materials, op. cit., p. 158.

to determine crease resistance in each fabric in the original state and following the first, second, fifth, tenth, and twentieth launderings. The standards established by the American Association of Textile Chemists and Colorists were used.[11]

All tests were determined on flat and wrinkle free fabrics conditioned at 65 $\pm$ 2 per cent relative humidity and 70° $\pm$ 2°F. for at least four hours.

Five warp test specimens were cut and placed in the wrinkle recovery tester according to the detailed instructions given in the standard procedure.

The recordings were taken with the degree scale in the "A" position or 0° - 180° line horizontal. The dangling edge of the fabric specimen was kept in line with the vertical line on the dial face. The degree scale on the dial face was read at the end of a five-minute recovery period.

The percentage of crease resistance was calculated by dividing the crease recovery angle by 180 and multiplying by 100. The five warp measurements of percentage of crease resistance were averaged and stated as the percentage crease resistance.

The same procedure was used for the filling direction.

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[11] American Association of Textile Chemists and Colorists, *op. cit.*, p. 154-155.

CHAPTER IV

PRESENTATION OF DATA

I. SELECTION OF FABRICS

When the study was first planned, the Dacron and cotton blended fabrics were to be purchased at retail stores selling yard goods. Investigation made in various stores revealed that they were not available at this source.

Letters of inquiry were sent to two additional stores, two mail order houses, thirteen textile mills, six shirt manufacturers, one selling agent, and the manufacturer of Dacron fiber. Four of these replied that they were willing to supply sufficient yardage for testing purposes.

The Dacron and cotton yardage for the study was obtained from one textile mill, two shirt manufacturers, and one selling agent. These fabrics, including four oxford type shirting fabrics and four batiste type shirting fabrics, were manufacturered by four textile mills. One broadcloth type shirting fabric was also obtained but was not included in this study.

The all-cotton fabrics used for comparison were purchased from retail stores.

Of the three qualities of all-cotton batiste type fabrics one had a thread count similar to the average thread count of the Dacron and cotton batiste type blends. One quality was below the average thread count and one above the average.

It was extremely difficult to obtain all-cotton oxford type fabrics on the retail market. For this reason it was not possible to find all-cotton fabrics with thread counts as high as two of the Dacron and cotton blended fabrics or as low as Fabric 3 in Group I. The three fabrics in Group II, however, represented oxford cloth of three qualities and were similar to the fabrics in Group I in appearance and general construction of the warp yarns.

The fourteen fabrics used in the study have been assembled as follows:

| | |
|---|---|
| Group I | Oxford Type - Dacron and cotton blended fabrics |
| Group II | Oxford Type - All-cotton fabrics |
| Group III | Batiste Type - Dacron and Cotton blended fabrics |
| Group IV | Batiste Type - All-cotton fabrics |

These fabrics are shown in Illustration I.

## II. SPECIFICATIONS GIVEN BY FABRIC MANUFACTURERS OR FABRIC SUPPLIERS

The Dacron and cotton blended fabrics selected for this study were all specified to be sixty-five per cent Dacron and thirty-five per cent cotton. The fabrics used for comparison were all specified one hundred per cent cotton.

Since eight of the fabrics were purchased at wholesale price and five of the fabrics at retail price, no comparison can be made in relation to cost versus serviceability. The fabrics purchased at wholesale price ranged from \$.45 to \$1.57½ and those purchased at retail price from \$.79 to \$1.29.

The specifications given by the fabric manufacturers or fabric suppliers are presented in Table I.

# ILLUSTRATION I

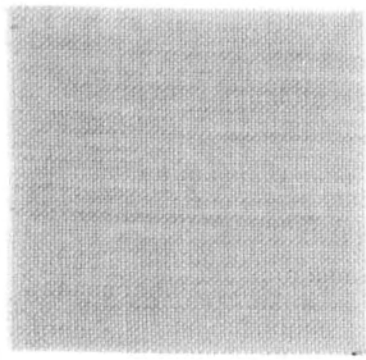
## FABRICS USED IN THE STUDY

### GROUP I

### OXFORD TYPE - DACRON AND COTTON BLENDED FABRICS



Fabric 1



Fabric 2



Fabric 3



Fabric 4

## ILLUSTRATION I (Continued)

## FABRICS USED IN THE STUDY

### GROUP II

### OXFORD TYPE - ALL-COTTON FABRICS

Fabric 1

Fabric 2

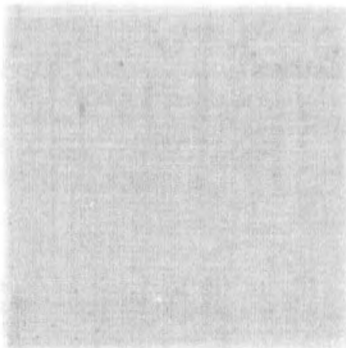
Fabric 3

ILLUSTRATION I (Continued)

FABRICS USED IN THE STUDY

GROUP III

BATISTE TYPE - DACRON AND COTTON BLENDED FABRICS



Fabric 1

Fabric 2



Fabric 3



Fabric 4

ILLUSTRATION I (Continued)

FABRICS USED IN THE STUDY

GROUP IV

BATISTE TYPE - ALL-COTTON FABRICS



Fabric 1



Fabric 2

Fabric 3

TABLE I

SPECIFICATIONS GIVEN BY FABRIC MANUFACTURERS

OR FABRIC SUPPLIERS

| Fabric Number | Fiber | Content (Per Cent) | Cost per Yard Retail | Cost per Yard Wholesale | Miscellaneous Information |
|---|---|---|---|---|---|
| GROUP I - Oxford type - Dacron and Cotton blended fabrics | | | | | |
| 1 | Egyptian cotton<br>Dacron | 35<br>65 | ---- | $1.10 | 37/38" wide |
| 2 | Egyptian cotton<br>Dacron | 35<br>65 | ---- | 1.10 | 37/38" wide |
| 3 | Egyptian cotton<br>Dacron | 35<br>65 | ---- | 1.57½ | 41/42" wide |
| 4 | Egyptian cotton<br>Dacron | 35<br>65 | ---- | 1.25 | Name, Dacford |
| GROUP II - Oxford type - All-cotton fabrics | | | | | |
| 1 | Cotton | 100 | $1.19 | ---- | ---- |
| 2 | Cotton | 100 | ---- | .45 | ---- |
| 3 | Cotton | 100 | 1.19 | ---- | ---- |
| GROUP III - Batiste type - Dacron and Cotton blended fabrics | | | | | |
| 1 | Egyptian cotton<br>Dacron | 35<br>65 | ---- | 1.10 | 37/38" wide<br>Batiste |
| 2 | Egyptian cotton<br>Dacron | 35<br>65 | ---- | 1.10 | 37/38" wide<br>Batiste |
| 3 | Cotton<br>Dacron | 35<br>65 | ---- | ---- | Yarn No. 50/1<br>Twist: 26<br>Greige Yarn Count: 90 x 72 |
| 4 | Cotton<br>Dacron | 35<br>65 | ---- | 1.25 | Name, Dacoma |
| GROUP IV - Batiste type - All-cotton fabrics | | | | | |
| 1 | Cotton | 100 | 1.29 | ---- | ---- |
| 2 | Cotton | 100 | .98 | ---- | 40" wide |
| 3 | Cotton | 100 | .79 | ---- | 40" wide |

## III. RESULTS OF LABORATORY ANALYSIS OF FABRIC CONSTRUCTION

The data pertaining to the laboratory analysis of fabric construction are given in Table II.

Weave. All the fabrics in Groups I and II were two warp threads, one filling thread oxford weave with the exception of Fabrics 1 and 2 in Group I which were two warp threads, two filling thread basket weave.

All the batiste type fabrics in Groups III and IV were plain weave.

Thread Count. The warp thread counts in Group I ranged from 94 to 100 and the filling thread count from 46 to 93. There was a greater range in the filling thread count because two of the fabrics were oxford weave and two fabrics basket weave.

In Group II the warp thread count also ranged from 94 to 100. The filling thread count ranged from 45 to 50.

In Group III the warp thread count ranged from 96 to 102 and the filling thread count from 80 to 89.

In Group IV the warp thread count ranged from 90 to 114 and filling thread count from 78 to 108.

Fiber Content. Groups II and IV were all 100 per cent cotton fabrics.

The fiber content of the oxford type blended fabrics (Group I) ranged from 62.7 per cent Dacron and 37.3 per cent cotton to 68.9 per cent Dacron and 31.1 per cent cotton. The average fiber content of the four fabrics was 67.2 per cent Dacron and 32.8 per cent cotton.

The fiber content of the batiste type blended fabrics (Group III) ranged from 64.5 per cent Dacron and 35.5 per cent cotton to 69.4 per cent

TABLE II

LABORATORY ANALYSIS OF FABRIC CONSTRUCTION

| Fabric Number | Fiber | Content (Per Cent) | Weave | Width (Inches) | Thickness (Inches) | Weight (oz./sq.yd.) | Thread Count | | Yarn Number | | Staple Length (Inches) | | Twist Count | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Warp | Filling | Warp | Filling | Warp | Filling | Warp | Filling |
| GROUP I - Oxford type - Dacron and Cotton Blended Fabrics | | | | | | | | | | | | | | |
| 1 | Cotton<br>Dacron | 31.6<br>68.4 | Basket | 38 | .016 | 3.5 | 100 | 93 | 40.4 | 40.7 | 1.7 | 1.5 | 29 Z | 31 Z |
| 2 | Cotton<br>Dacron | 31.3<br>68.7 | Basket | 38 | .016 | 3.4 | 100 | 90 | 41.4 | 40.4 | 1.7 | 1.5 | 29 Z | 34 Z |
| 3 | Cotton<br>Dacron | 37.3<br>62.7 | Oxford | 42 | .026 | 4.8 | 76 | 46 | 25.4 | 14.8 | 1.6 | 1.5 | 21 Z | 14 Z<br>ply 17 S |
| 4 | Cotton<br>Dacron | 31.1<br>68.9 | Oxford | 45 | .021 | 4.4 | 94 | 46 | 39.9 | 12.1 | 1.5 | 1.7 | 26 Z | 14 Z |
| GROUP II - Oxford type - All-cotton Fabrics | | | | | | | | | | | | | | |
| 1 | Cotton | 100.0 | Oxford | 36 | .019 | 4.1 | 100 | 50 | 54.8 | 13.2 | 1.3 | 1.3 | 26 Z | 10 Z |
| 2 | Cotton | 100.0 | Oxford | 35 | .025 | 3.9 | 98 | 44 | 44.8 | 13.6 | 1.3 | 1.3 | 22 Z | 11 Z |
| 3 | Cotton | 100.0 | Oxford | 38 | .023 | 4.0 | 94 | 45 | 42.2 | 13.5 | 1.3 | 1.1 | 20 Z | 11 Z |
| GROUP III - Batiste type - Dacron and Cotton Fabrics | | | | | | | | | | | | | | |
| 1 | Cotton<br>Dacron | 31.8<br>68.2 | Plain | 38 | .014 | 2.7 | 101 | 86 | 48.8 | 53.0 | 1.6 | 1.5 | 34 Z | 37 Z |
| 2 | Cotton<br>Dacron | 30.6<br>69.4 | Plain | 38 | .016 | 2.5 | 101 | 89 | 50.2 | 61.8 | 1.5 | 1.5 | 30 Z | 37 Z |
| 3 | Cotton<br>Dacron | 33.5<br>66.5 | Plain | 45 | .016 | 2.6 | 102 | 76 | 49.6 | 49.0 | 1.5 | 1.6 | 25 Z | 27 Z |
| 4 | Cotton<br>Dacron | 35.5<br>64.5 | Plain | 44 | .019 | 3.1 | 96 | 80 | 41.5 | 45.3 | 1.5 | 1.5 | 22 Z | 21 Z |
| GROUP IV - Batiste type - All-cotton Fabrics | | | | | | | | | | | | | | |
| 1 | Cotton | 100.0 | Plain | 38 | .009 | 1.4 | 114 | 108 | 93.8 | 135.8 | 1.6 | 1.5 | 32 Z | 32 Z |
| 2 | Cotton | 100.0 | Plain | 40 | .011 | 1.9 | 96 | 98 | 62.6 | 80.8 | 1.2 | 1.3 | 26 Z | 32 Z |
| 3 | Cotton | 100.0 | Plain | 39 | .013 | 1.8 | 90 | 78 | 67.6 | 67.4 | 1.3 | 1.3 | 26 Z | 26 Z |

Dacron and 30.6 per cent cotton. The average fiber content of these four fabrics was the same as the average of the four oxford type fabrics, 67.2 per cent Dacron and 32.8 per cent cotton.

Width. The fabrics ranged in width from 35 inches to 45 inches. There appeared to be no relationship to type, fiber, content, quality, or price in respect to width.

Thickness. The oxford type Dacron and cotton fabrics (Group I) ranged in thickness from .016 to .026 inch with an average for the four of .020 inch. The oxford type all-cotton fabrics (Group II) ranged from .019 to .025 inch with an average of .022 inch.

The batiste type Dacron and cotton fabrics (Group III) ranged in thickness from .014 to .019 inch with an average of .016 inch. The all-cotton fabrics (Group IV) ranged from .009 to .013 inch with an average of .011 inch.

This indicated that the all-cotton oxford type fabrics were thicker than those of Dacron and cotton. However, the Dacron and cotton batiste type fabrics were thicker than the all-cotton batiste type.

Weight. The weight of the Dacron and cotton oxford type fabrics ranged from 3.4 to 4.8 ounces per square yard and averaged 4.0 ounces per square yard. The all-cotton fabrics (Group II) ranged from 3.9 to 4.1 ounces per square yard and averaged 4.0 ounces. Thus the Dacron and cotton fabrics and the all-cotton fabrics were similar in weight in ounces per square yard.

In the batiste type fabrics the Dacron and cotton fabrics (Group III) ranged in weight from 2.5 to 3.1 ounces per square yard and averaged

2.7 ounces per square yard. The all-cotton fabrics (Group IV) ranged from 1.4 to 1.9 ounces and averaged 1.7 ounces per square yard. All fabrics in Group IV were lighter than the fabrics in Group III.

Yarn Number. There was a greater variation in yarn number between the Dacron and cotton and all-cotton fabrics than in the other construction characteristics.

The yarn number in the oxford type fabrics of Group I varied from 25.4 to 41.4 in the warp and from 12.1 to 40.7 in the filling. In Group II the yarn number ranged from 42.2 to 54.8 in the warp and from 13.2 to 13.6 in the filling.

In the Batiste type fabrics (Group III) the yarn number ranged from 41.5 to 50.2 in the warp and 45.3 to 61.8 in the filling. In Group IV there was a range of 62.6 to 93.8 in the warp and 67.4 to 135.8 in the filling.

In both types of all-cotton fabrics the yarn number for both the warp and filling were higher in the fabrics with the higher thread count and lower in the fabrics with lower thread count. However, this did not hold true in the Dacron and cotton blended fabrics.

Staple Length. The staple length for the oxford type fabrics in Group I ranged from 1.53 inches to 1.66 inches in the warp and 1.45 to 1.68 inches in the filling. The fibers were so fine that it was not possible to measure the Dacron staple and the cotton staple separately. Thus the staple length quoted represents both fibers. In Group II there was a range of 1.28 inches to 1.33 inches in the warp and 1.09 inches to 1.28 inches in the filling.

The staple length of the Batiste type fabrics in Group III ranged from 1.51 to 1.64 inches in the warp and 1.50 to 1.55 in the filling. In Group IV there was a range of 1.23 inches to 1.59 inches in the warp and 1.29 inches to 1.45 inches in the filling.

The staple length for the two types of Dacron and cotton blended fabrics were similar. They were also of longer length than the fibers in the all-cotton fabrics. The staple length of the batiste type all-cotton fabric was slightly higher than the oxford type all-cotton fabric, but lower than that of the Dacron and cotton blended fabrics.

<u>Twist Count</u>. The only fabric using a ply yarn was Number 3 in Group I. This was an S twist ply with 17 turns per inch.

All other fabrics had Z twist in both the warp and filling threads.

In the oxford type fabrics (Group I) the amount of twist ranged from 21 to 29 turns per inch in the warp yarn and from 14 to 34 turns per inch in the filling yarn. In Group II there was a range of 20 to 26 turns per inch in the warp yarn and 10 to 11 turns per inch in the filling yarn. The average of the four fabrics in Group I was 26 turns per inch in the warp and 24 turns per inch in the filling yarns. The average for Group II was 23 turns per inch in the warp and 11 turns per inch in the filling. This indicated that the Dacron and cotton fabrics had a greater amount of twist.

In the batiste type fabrics (Group III), there was a range of 22 to 34 turns per inch in the warp yarns and 21 to 37 turns per inch in the filling yarns. The all-cotton fabrics in Group IV ranged from 26 to 32 turns per inch in the warp and from 26 to 32 turns per inch in the filling. The average of the Dacron and cotton fabrics was the same as the average of the all-cotton fabrics or 28 turns per inch in the warp and 30 turns per inch in the filling.

## IV. APPEARANCE OF FABRICS AFTER LAUNDERING

The fabrics were judged for appearance with respect to wrinkle resistance in laundering after being hung to drip dry. They were rated according to the following criteria set up for the study:

Class 1 - No ironing necessary. (Surface of fabric free from wrinkles; suitable for use in present state.)

Class 2 - Small amount of ironing necessary. (Superficial wrinkles; wrinkles easily removable.)

Class 3 - Greater amount of ironing necessary. (Multiple wrinkles deeply set; required heat, moisture, and pressure for optimum appearance.)

The classifications of the fabric appearance after laundering are presented in Table III.

The Dacron and cotton fabrics of both types were found to have greater resistance to wrinkling after laundering when allowed to drip dry than the all-cotton fabrics.

Fabrics 1, 2, and 4 in Group I, oxford type fabrics, were all in Class 1 after the first laundering but dropped to Class 2 after the second laundering. Fabrics 1 and 2 remained in Class 2 throughout the fifth, tenth, and twentieth launderings. Fabric 4 dropped to Class 3 after the fifth laundering but returned to Class 2 after the tenth and twentieth launderings. Fabric 3 was rated in Class 2 throughout the twenty launderings.

Fabrics 1, 2, and 3 of Batiste type in Group III were rated in Class 2 after the first and second launderings but dropped to Class 3

TABLE III

APPEARANCE OF FABRICS AFTER LAUNDERING ACCORDING TO CLASS

Class 1 - No ironing necessary
Class 2 - Small amount of ironing necessary
Class 3 - Greater amount of ironing necessary

| Fabric Number | Number of Times Laundered | | | | |
|---|---|---|---|---|---|
| | One | Two | Five | Ten | Twenty |
| GROUP I - Oxford type - Dacron and Cotton Fabrics | | | | | |
| 1 | 1 | 2 | 2 | 2 | 2 |
| 2 | 1 | 2 | 2 | 2 | 2 |
| 3 | 2 | 2 | 2 | 2 | 2 |
| 4 | 1 | 2 | 3 | 2 | 2 |
| GROUP II - Oxford type - All-cotton Fabrics | | | | | |
| 1 | 3 | 3 | 3 | 3 | 3 |
| 2 | 3 | 3 | 3 | 3 | 3 |
| 3 | 3 | 3 | 3 | 3 | 3 |
| GROUP III - Batiste type - Dacron and Cotton Fabrics | | | | | |
| 1 | 2 | 2 | 3 | 2 | 2 |
| 2 | 2 | 2 | 3 | 2 | 2 |
| 3 | 2 | 2 | 3 | 2 | 2 |
| 4 | 2 | 3 | 3 | 2 | 2 |
| GROUP IV - Batiste type - All-cotton Fabrics | | | | | |
| 1 | 3 | 3 | 3 | 3 | 3 |
| 2 | 3 | 3 | 3 | 3 | 3 |
| 3 | 3 | 3 | 3 | 3 | 3 |

after the fifth laundering. They returned to Class 2 after the tenth and twentieth launderings. Fabric 4 was rated in Class 2 after the first laundering and then dropped to Class 3 after the second and fifth launderings. They returned again to Class 2 after the tenth and twentieth launderings.

All the fabrics in Group II and Group IV were rated in Class 3 after each judging throughout the twenty launderings.

It was apparent throughout the twenty launderings that the Dacron and cotton fabrics needed only a small amount of ironing or "touch-up ironing," whereas the all-cotton fabrics would require moisture, heat, and pressure in order to remove the wrinkles.

It was found that the Dacron and cotton fabrics dried rapidly. When all the fabrics were removed from the water at the same time, wrinkles had dried into the last fabrics to be hung.

## V. DIMENSIONAL CHANGES AFTER LAUNDERING

The importance of dimensional changes in fabrics has long been recognized by both manufacturer and consumer. John F. Skinkle, an authority on textile testing, makes the following statement: "In general, we may say that, even without any label or claim, a shrinkage of more than five per cent in either direction is excessive. . . ."[1] In her text, Isabel Wingate states that "The American Home Economics Association advises consumers to insist on cotton goods that are guaranteed not to shrink more than two per cent."[2] This amount of shrinkage is generally accepted as

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[1] Skinkle, John, Textile Testing, New York: Chemical Publishing Company, Inc., 1949, p. 118.

[2] Wingate, Isabel, Textile Fabrics, New York: Prentice-Hall, Inc., 1949, p. 317.

being the maximum amount of change that would not be noticed in the fit of a garment. However, the textile manufacturer is striving to meet the one per cent residual shrinkage or gain tolerance set for Sanforized products. This amount of dimensional change is highly desirable in consumer goods.

The percentage dimensional change after laundering is given in Table IV and the graphic representation of percentage dimensional change in Illustration II.

The oxford type fabrics (Group I and Group II) were within the two per cent shrinkage or gain tolerance. Fabrics 2 in Group I and Fabrics 1 and 2 in Group II were within the recommended one per cent tolerance in both the warp and filling direction. The fabric with the greatest amount of change was number 3 in Group I. This fabric had 1.3 per cent shrinkage in the warp and 1.5 per cent stretch in the filling. However, this was not sufficient shrinkage or stretch to make any noticeable amount of change in the fit of a garment.

The oxford fabrics in both Group I and Group II were very satisfactory in respect to dimensional change. There was no noticeable advantage in the Dacron and cotton blends over the all-cotton fabrics.

The batiste type fabrics in Group III were within the one per cent shrinkage or stretch tolerance as set for Sanforized products. However, in Group IV none of the fabrics were within the two per cent range even after the first laundering. Fabric 1 in both the warp and filling and Fabrics 2 and 3 in the warp direction had less than five per cent shrinkage throughout the twenty launderings. In the filling direction Fabrics 2 and 3 had greater than five per cent shrinkage after the first laundering and increased to 7.8 per cent shrinkage in Fabric 2 and 7.4 per cent in Fabric 3.

TABLE IV

PERCENTAGE DIMENSIONAL CHANGE AFTER LAUNDERING

| Fabric Number | Number of Times Laundered | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | One | | Two | | Five | | Ten | | Twenty | |
| | warp | filling | warp | filling | warp | filling | warp | filling | warp | filling |
| GROUP I - Oxford type - Dacron and Cotton Blended Fabrics | | | | | | | | | | |
| 1 | +0.4 | -0.2 | +0.7 | -0.2 | +0.9 | -0.7 | +0.7 | -0.7 | +1.1 | -1.1 |
| 2 | +0.4 | -0.2 | +0.5 | -0.3 | +0.4 | -0.6 | +0.3 | -1.0 | +0.2 | -0.4 |
| 3 | -0.5 | +0.4 | -0.8 | +0.7 | -0.9 | +1.1 | -1.3 | +1.5 | -1.0 | +0.6 |
| 4 | +0.4 | +0.6 | +0.1 | +0.8 | +0.4 | +1.1 | -0.1 | +1.4 | -0.3 | +1.1 |
| GROUP II - Oxford type - All-cotton Fabrics | | | | | | | | | | |
| 1 | +0.3 | -0.4 | +0.3 | -0.7 | +0.1 | -0.5 | -0.3 | -0.6 | -0.5 | -0.2 |
| 2 | +0.2 | +0.7 | -0.1 | +0.9 | -0.5 | -0.1 | -0.2 | +0.2 | -0.6 | +0.1 |
| 3 | +0.6 | 0.0 | -0.2 | -0.2 | -1.2 | -0.1 | -1.3 | +1.0 | -1.1 | +0.2 |
| GROUP III - Batiste type - Dacron and Cotton Blended Fabrics | | | | | | | | | | |
| 1 | +0.1 | +0.2 | +0.2 | 0.0 | 0.0 | +0.2 | -0.4 | 0.0 | -0.5 | -0.2 |
| 2 | +0.1 | -0.2 | +0.2 | -0.2 | -0.1 | 0.0 | -0.2 | +0.3 | -0.5 | -0.3 |
| 3 | -0.7 | -0.1 | -0.9 | -0.2 | -0.8 | +0.1 | -1.0 | -0.1 | -0.9 | -0.2 |
| 4 | +0.4 | +0.1 | +0.5 | +0.6 | +0.2 | +0.9 | +0.2 | +0.7 | +0.2 | +0.6 |
| GROUP IV - Batiste type - All-cotton Fabrics | | | | | | | | | | |
| 1 | -2.2 | -3.5 | -1.9 | -4.1 | -2.4 | -4.1 | -1.9 | -4.0 | -2.3 | -4.2 |
| 2 | -2.2 | -6.5 | -2.5 | -7.1 | -2.5 | -7.6 | -3.1 | -7.8 | -3.0 | -7.4 |
| 3 | -2.1 | -6.0 | -2.4 | -6.5 | -2.9 | -7.4 | -3.0 | -6.2 | -3.4 | -6.4 |

ILLUSTRATION II

PERCENTAGE DIMENSIONAL CHANGE AFTER LAUNDERING

OXFORD TYPE FABRICS - WARP

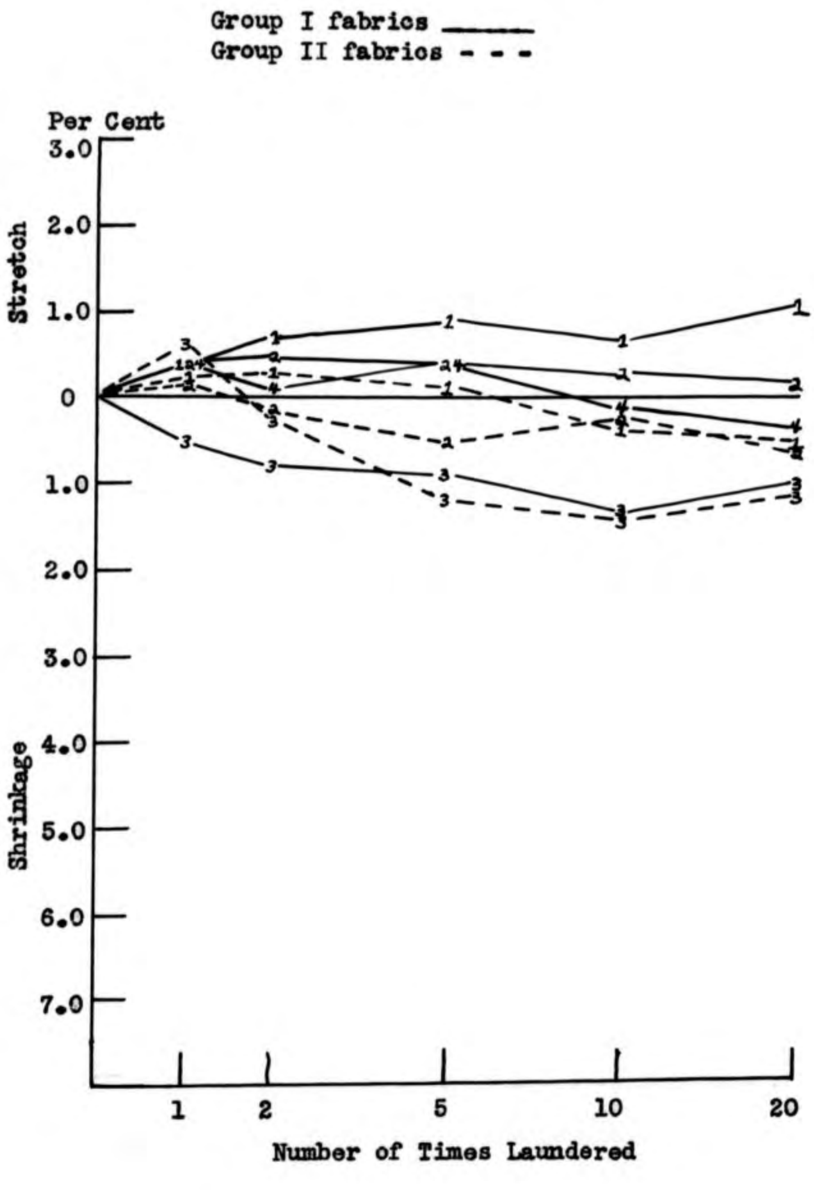


ILLUSTRATION II (Continued)

PERCENTAGE DIMENSIONAL CHANGE AFTER LAUNDERING

OXFORD TYPE FABRICS - FILLING

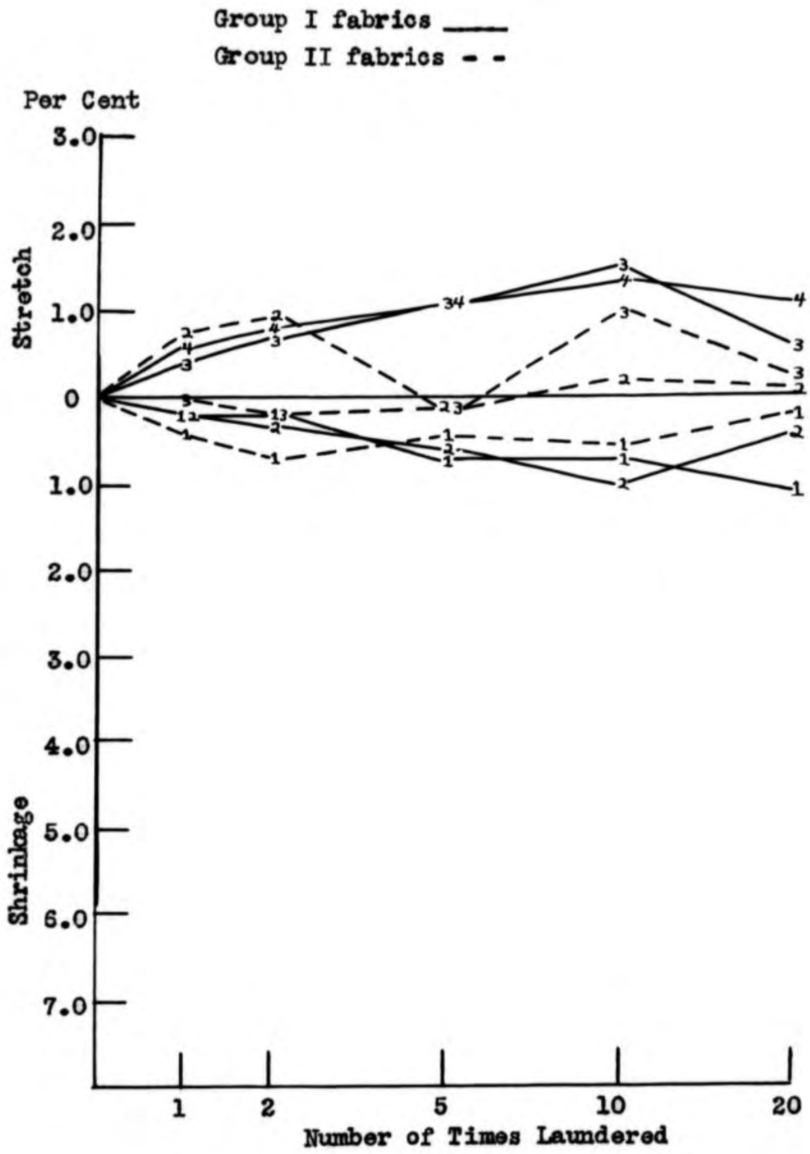


ILLUSTRATION II (Continued)

PERCENTAGE DIMENSIONAL CHANGE AFTER LAUNDERING

BATISTE TYPE FABRIC - WARP

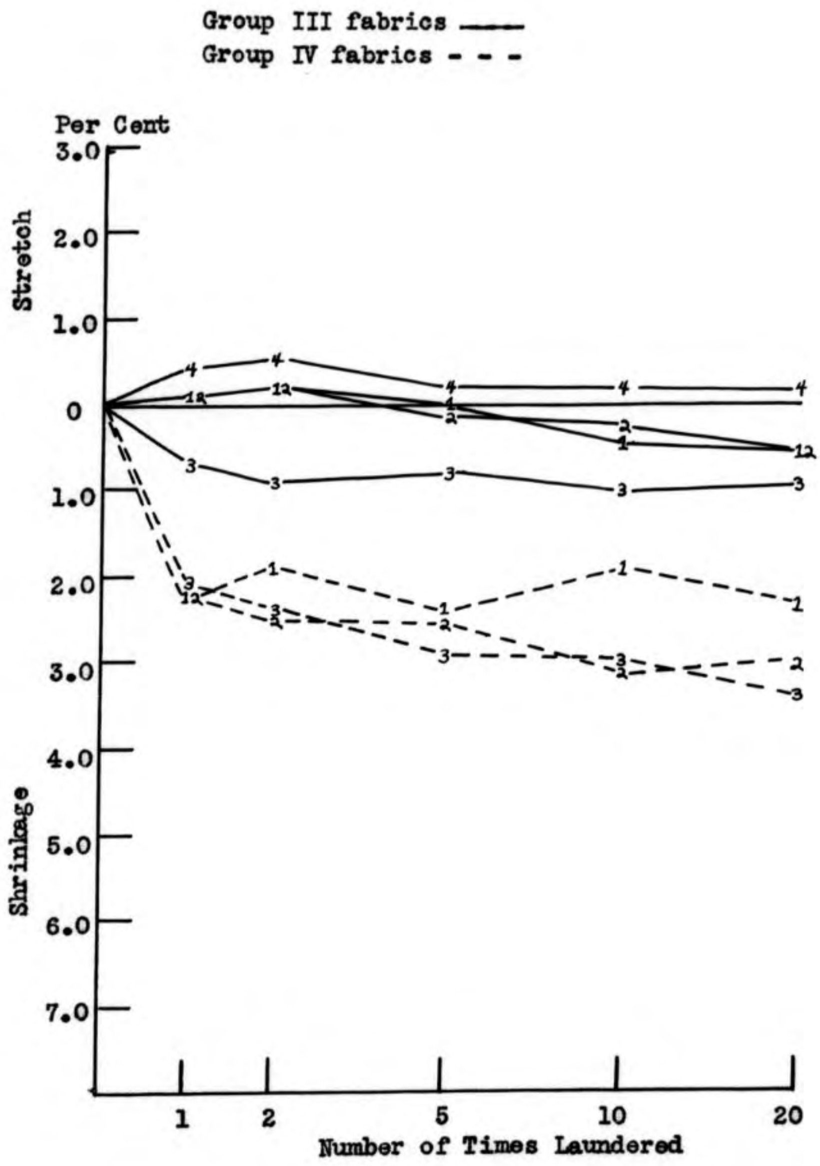
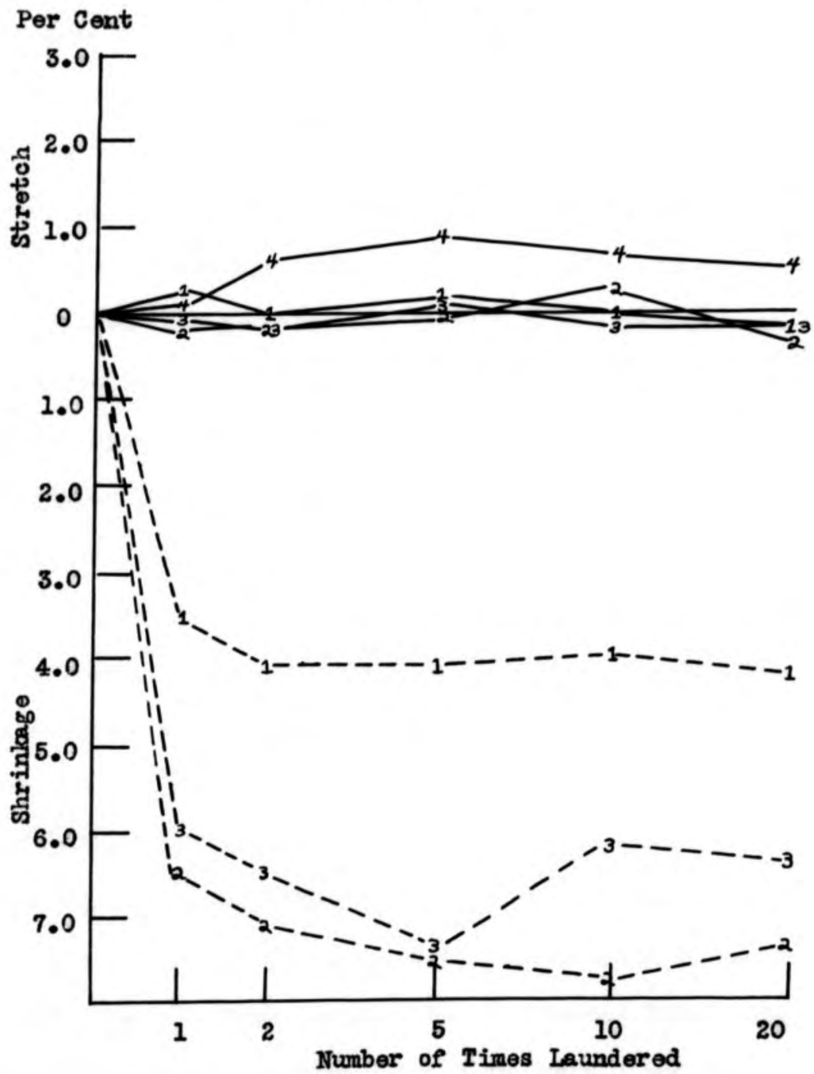


ILLUSTRATION II (Continued)

PERCENTAGE DIMENSIONAL CHANGE AFTER LAUNDERING

BATISTE TYPE FABRICS - FILLING

Group III fabrics _____
Group IV fabrics - - - -



In batiste type fabrics, there was a noticeable advantage to the Dacron and cotton blended fabrics in respect to dimensional change. The Dacron and cotton fabrics did not shrink or stretch more than one per cent through the twenty launderings while all the all-cotton fabrics shrank more than two per cent after the first laundering. Two of the three fabrics shrank more than five per cent in the filling direction.

## VI. BREAKING STRENGTH

The breaking strength in pounds before and after laundering is given in Table V, the percentage change in breaking strength after laundering in Table VI, and the graphic representation of percentage change in breaking strength in Illustration III.

The oxford type fabrics (Group I and II) generally increased in the dry warp breaking strength after the first and second launderings. After the second laundering there was a general loss in strength continuing through the twentieth laundering. By the twentieth laundering only Fabric 3 in Group II had lost less than five per cent strength. Three fabrics, Fabrics 1 and 2 in Group I and Fabric 1 in Group II, lost between five and ten per cent strength. Fabrics 3 and 4 in Group I lost between ten and fifteen per cent strength. Fabric 2 of Group II was the only fabric with a loss slightly over fifteen per cent. Two of the all-cotton fabrics, Fabric 1 and 3, Group II, were consistently stronger than the other fabrics at each testing period after the second laundering.

Four of these fabrics (Fabrics 1 and 2 in Group I and Fabrics 1 and 2 in Group II) gained in the filling dry strength after the first laundering and three fabrics (Fabrics 3 and 4 in Group I and Fabric 3 in

TABLE V

BREAKING STRENGTH IN POUNDS BEFORE AND AFTER LAUNDERING

| Fabric Number | NUMBER OF TIMES LAUNDERED | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Original | | | | One | | | | Two | | | | Five | | | | Ten | | | | Twenty | | | |
| | Dry | | Wet | | Dry | | Wet | | Dry | | Wet | | Dry | | Wet | | Dry | | Wet | | Dry | | Wet | |
| | warp | filling | warp | filling | warp | filling | warp | filling | warp | filling | warp | filling | warp | filling | warp | filling | warp | filling | warp | filling | warp | filling | warp | filling |
| GROUP I - Oxford type - Dacron and Cotton Blended Fabrics | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 39.4 | 27.6 | 44.3 | 25.5 | 39.5 | 28.2 | 43.7 | 27.1 | 39.0 | 26.0 | 45.0 | 27.4 | 37.0 | 25.9 | 43.3 | 23.8 | 35.9 | 25.1 | 42.2 | 27.4 | 35.5 | 24.5 | 41.3 | 27.1 |
| 2 | 39.5 | 25.1 | 42.4 | 26.3 | 41.1 | 27.5 | 45.5 | 27.2 | 39.8 | 24.9 | 44.1 | 25.7 | 37.1 | 24.4 | 43.4 | 22.5 | 36.7 | 21.9 | 40.9 | 23.1 | 35.1 | 23.5 | 41.5 | 24.1 |
| 3 | 44.6 | 49.2 | 46.8 | 46.2 | 44.9 | 44.1 | 47.1 | 41.2 | 44.1 | 50.8 | 46.6 | 51.3 | 43.4 | 46.8 | 45.0 | 49.1 | 41.6 | 41.3 | 44.9 | 42.7 | 39.3 | 40.2 | 44.8 | 43.0 |
| 4 | 37.2 | 42.5 | 38.6 | 44.7 | 36.4 | 42.0 | 40.6 | 42.2 | 38.0 | 42.3 | 38.5 | 45.7 | 35.8 | 39.8 | 38.4 | 39.5 | 34.5 | 39.3 | 38.3 | 40.6 | 33.2 | 36.4 | 37.6 | 40.0 |
| GROUP II - Oxford type - All-cotton Fabrics | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 45.3 | 94.2 | 49.3 | 101.8 | 46.5 | 95.5 | 47.0 | 101.4 | 47.2 | 90.7 | 48.3 | 94.3 | 44.7 | 87.8 | 44.2 | 94.4 | 43.8 | 88.6 | 42.4 | 87.8 | 42.1 | 79.2 | 43.2 | 92.2 |
| 2 | 49.6 | 69.6 | 51.5 | 64.6 | 53.1 | 74.2 | 50.3 | 66.3 | 50.2 | 67.0 | 49.9 | 75.7 | 46.6 | 66.4 | 45.4 | 72.1 | 44.4 | 66.1 | 43.9 | 63.2 | 41.9 | 67.0 | 48.0 | 70.4 |
| 3 | 46.0 | 75.0 | 49.5 | 76.5 | 46.8 | 74.6 | 51.8 | 76.2 | 49.5 | 75.8 | 48.2 | 76.2 | 48.4 | 71.9 | 42.1 | 74.4 | 45.8 | 69.1 | 41.6 | 69.0 | 44.4 | 68.4 | 42.0 | 75.1 |
| GROUP III - Batiste type - Dacron and Cotton Blended Fabrics | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 33.8 | 22.7 | 38.9 | 24.7 | 33.0 | 30.1 | 37.9 | 25.2 | 32.4 | 21.7 | 37.0 | 25.0 | 31.6 | 19.9 | 36.4 | 23.3 | 30.0 | 19.4 | 35.0 | 22.8 | 29.9 | 20.0 | 35.4 | 23.6 |
| 2 | 33.7 | 22.7 | 38.3 | 24.5 | 30.6 | 20.8 | 36.1 | 23.4 | 32.2 | 22.2 | 36.2 | 27.4 | 30.1 | 21.3 | 34.3 | 23.0 | 28.9 | 18.8 | 33.8 | 21.9 | 27.2 | 20.2 | 31.7 | 22.9 |
| 3 | 33.3 | 22.4 | 34.2 | 23.3 | 33.7 | 24.2 | 34.7 | 22.5 | 33.1 | 21.5 | 34.9 | 22.7 | 31.1 | 20.8 | 33.9 | 21.1 | 32.7 | 17.8 | 33.4 | 20.5 | 29.8 | 18.3 | 32.5 | 22.0 |
| 4 | 41.7 | 30.7 | 48.4 | 36.0 | 42.0 | 34.6 | 47.6 | 39.1 | 41.0 | 34.8 | 46.8 | 40.9 | 39.4 | 31.3 | 45.5 | 36.8 | 34.2 | 30.7 | 44.6 | 36.4 | 36.4 | 32.9 | 43.8 | 39.1 |
| GROUP IV - Batiste type - All-cotton Fabrics | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 32.8 | 17.2 | 34.0 | 18.4 | 32.6 | 17.0 | 28.2 | 18.8 | 27.8 | 16.7 | 32.6 | 15.6 | 30.9 | 16.7 | 31.4 | 15.1 | 29.1 | 15.9 | 34.2 | 16.0 | 26.9 | 16.2 | 32.1 | 14.9 |
| 2 | 30.5 | 21.6 | 37.0 | 23.6 | 33.9 | 22.9 | 34.1 | 22.6 | 32.1 | 22.6 | 37.9 | 18.4 | 31.9 | 19.7 | 31.6 | 18.2 | 31.5 | 15.5 | 34.5 | 19.5 | 28.8 | 19.7 | 32.3 | 19.1 |
| 3 | 23.1 | 18.9 | 26.7 | 19.2 | 27.7 | 21.3 | 28.7 | 22.5 | 27.6 | 19.7 | 28.1 | 16.5 | 25.2 | 17.9 | 24.8 | 19.4 | 23.7 | 20.0 | 24.5 | 18.8 | 22.4 | 18.6 | 24.9 | 20.7 |

TABLE VI

PERCENTAGE CHANGE IN BREAKING STRENGTH AFTER LAUNDERING

| Fabric Number | NUMBER OF TIMES LAUNDERED | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | One | | | | Two | | | | Five | | | | Ten | | | | Twenty | | | |
| | Dry | | Wet | | Dry | | Wet | | Dry | | Wet | | Dry | | Wet | | Dry | | Wet | |
| | warp | filling | warp | filling | warp | filling | warp | filling | warp | filling | warp | filling | warp | filling | warp | filling | warp | filling | warp | filling |
| GROUP I - Oxford type - Dacron and Cotton Blended Fabrics | | | | | | | | | | | | | | | | | | | | |
| 1 | +0.3 | +2.2 | -1.4 | +6.3 | -1.0 | -5.8 | +1.5 | +7.5 | -6.1 | -6.2 | -2.3 | -6.7 | -8.9 | -9.1 | -4.7 | +7.5 | -9.9 | -11.2 | -6.8 | +6.3 |
| 2 | +4.1 | +9.6 | +7.3 | +3.4 | +0.8 | -0.8 | +4.0 | -2.3 | -6.1 | -2.8 | +2.4 | -14.4 | -7.1 | -12.7 | -3.5 | -11.7 | -8.6 | -6.4 | -2.1 | -8.4 |
| 3 | +0.7 | -10.4 | +0.6 | -10.8 | -1.1 | +3.3 | -0.4 | +11.0 | -2.7 | -4.9 | -3.8 | +6.3 | -6.7 | -16.1 | -4.1 | -7.6 | -11.9 | -18.3 | -4.3 | -6.9 |
| 4 | -2.2 | -1.2 | +5.2 | -5.6 | +2.2 | -0.5 | -0.3 | +2.2 | -3.8 | -6.4 | -0.5 | -11.6 | -7.3 | -7.5 | -7.8 | -9.2 | -10.8 | -14.4 | -2.6 | -10.5 |
| GROUP II - Oxford type - All-cotton Fabrics | | | | | | | | | | | | | | | | | | | | |
| 1 | +2.7 | +1.4 | -4.7 | -0.4 | +4.2 | -3.7 | -2.0 | -7.4 | -1.3 | -6.8 | -10.4 | -7.3 | -3.3 | -5.9 | -14.0 | -13.8 | -7.1 | -15.9 | -12.4 | -9.4 |
| 2 | +7.1 | +6.6 | -2.3 | +2.6 | +1.2 | -3.7 | -3.1 | +17.2 | -6.0 | -4.6 | -11.9 | +11.6 | -10.5 | -5.0 | -14.8 | -2.2 | -15.5 | -3.7 | -6.8 | +9.0 |
| 3 | +1.7 | -0.5 | +4.6 | -0.4 | +7.6 | +1.1 | -2.6 | -0.4 | +5.2 | -4.1 | -14.9 | -2.7 | -4.4 | -7.9 | -15.9 | -9.8 | -3.5 | -8.8 | -15.2 | -1.8 |
| GROUP III - Batiste type - Dacron and Cotton Blended Fabrics | | | | | | | | | | | | | | | | | | | | |
| 1 | -2.4 | [illegible] | -2.5 | +2.1 | -4.1 | -4.4 | -4.9 | +1.2 | -6.5 | -12.3 | -6.4 | -5.7 | -11.2 | -14.5 | -10.0 | -7.7 | -11.5 | -11.9 | -9.0 | -4.5 |
| 2 | -9.2 | -8.4 | -5.7 | -4.5 | -4.5 | -2.2 | -5.5 | +11.8 | -10.7 | -6.2 | -10.4 | -6.1 | -14.3 | -17.4 | -11.7 | -10.6 | -19.3 | -11.0 | -17.2 | -6.5 |
| 3 | +1.2 | +8.0 | +1.5 | -3.4 | -0.6 | -4.0 | +2.0 | -2.6 | -6.6 | -7.1 | -0.9 | -9.4 | -1.8 | -20.6 | -2.3 | -12.0 | -10.5 | -18.6 | -5.0 | -5.6 |
| 4 | +7.2 | +12.7 | -1.7 | +8.6 | -1.7 | +13.4 | -3.3 | +13.6 | -5.5 | +2.0 | -6.0 | +2.2 | -18.0 | 0.0 | -7.9 | +1.1 | -12.7 | +7.2 | -9.5 | +8.6 |
| GROUP IV - Batiste type - All-cotton Fabrics | | | | | | | | | | | | | | | | | | | | |
| 1 | -0.6 | -1.2 | -17.1 | +2.1 | -15.3 | -2.9 | -4.1 | -15.2 | -5.8 | -2.9 | -7.6 | -18.0 | -11.3 | -7.6 | +0.6 | -13.0 | -18.0 | -5.8 | -5.6 | -19.0 |
| 2 | +11.1 | +6.0 | -7.8 | -4.2 | +5.2 | +4.6 | +2.4 | -22.0 | +4.6 | -8.8 | -14.6 | -22.9 | +3.3 | -28.2 | -6.8 | -17.4 | -5.6 | -8.8 | -12.7 | -19.1 |
| 3 | +19.9 | +12.7 | +7.5 | +17.2 | +19.5 | +4.2 | +5.2 | -14.1 | +9.1 | -5.3 | -7.1 | +1.0 | +2.6 | +5.8 | -8.2 | -2.1 | -3.0 | -1.6 | -6.7 | +7.8 |

ILLUSTRATION III

PERCENTAGE CHANGE IN BREAKING STRENGTH AFTER LAUNDERING

OXFORD TYPE FABRICS - DRY-WARP

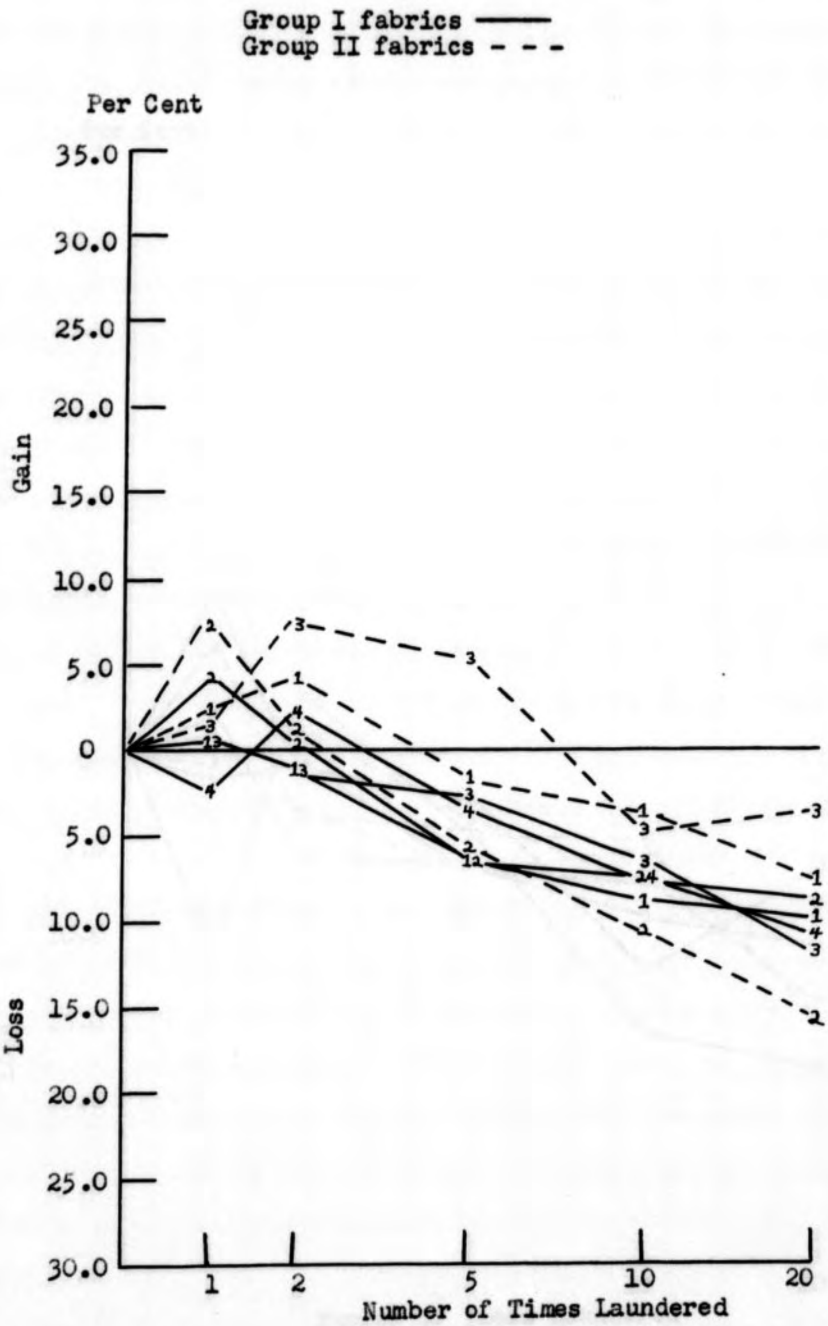


ILLUSTRATION III (Continued)

PERCENTAGE CHANGE IN BREAKING STRENGTH AFTER LAUNDERING

OXFORD TYPE FABRICS - DRY-FILLING

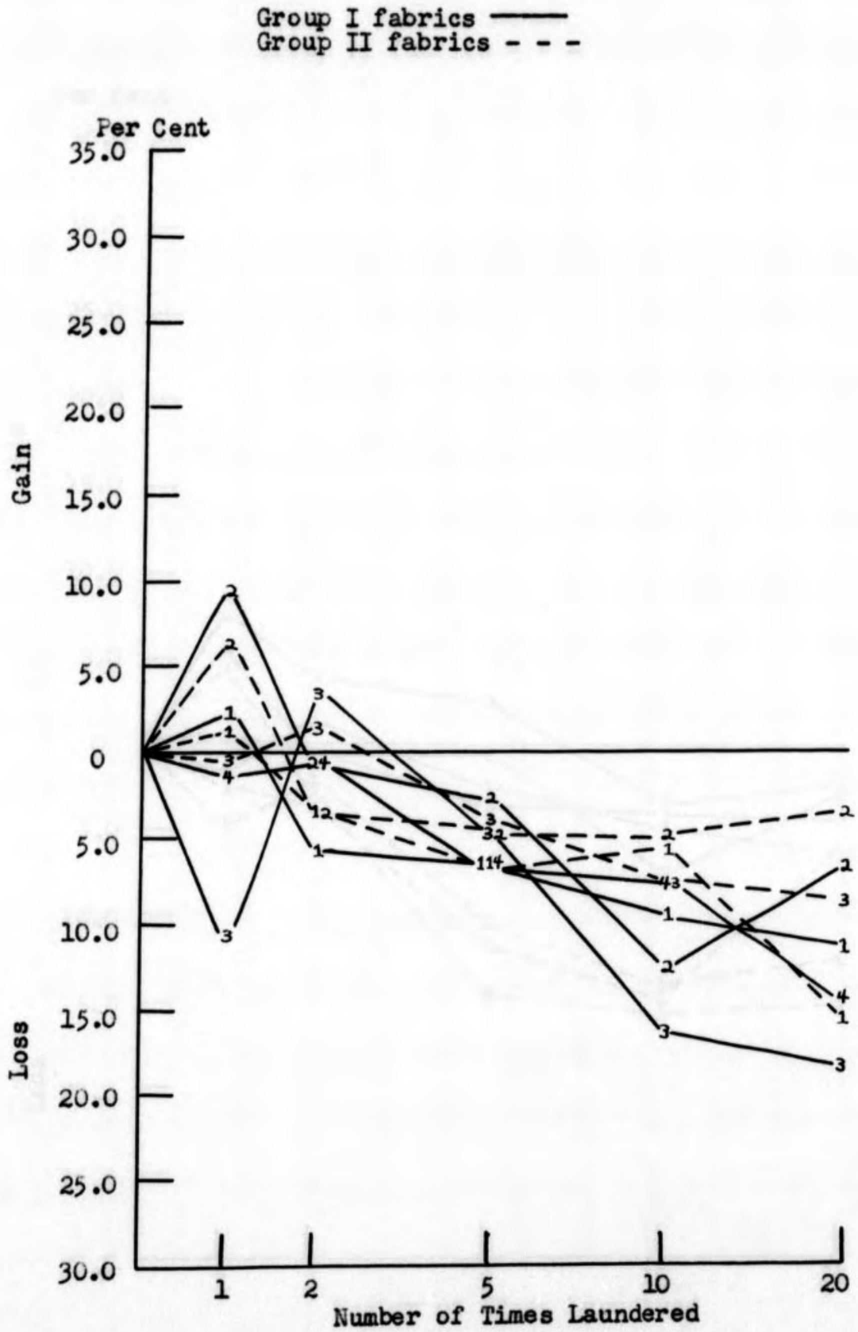


ILLUSTRATION III (Continued)

PERCENTAGE CHANGE IN BREAKING STRENGTH AFTER LAUNDERING

OXFORD TYPE FABRICS - WET-WARP

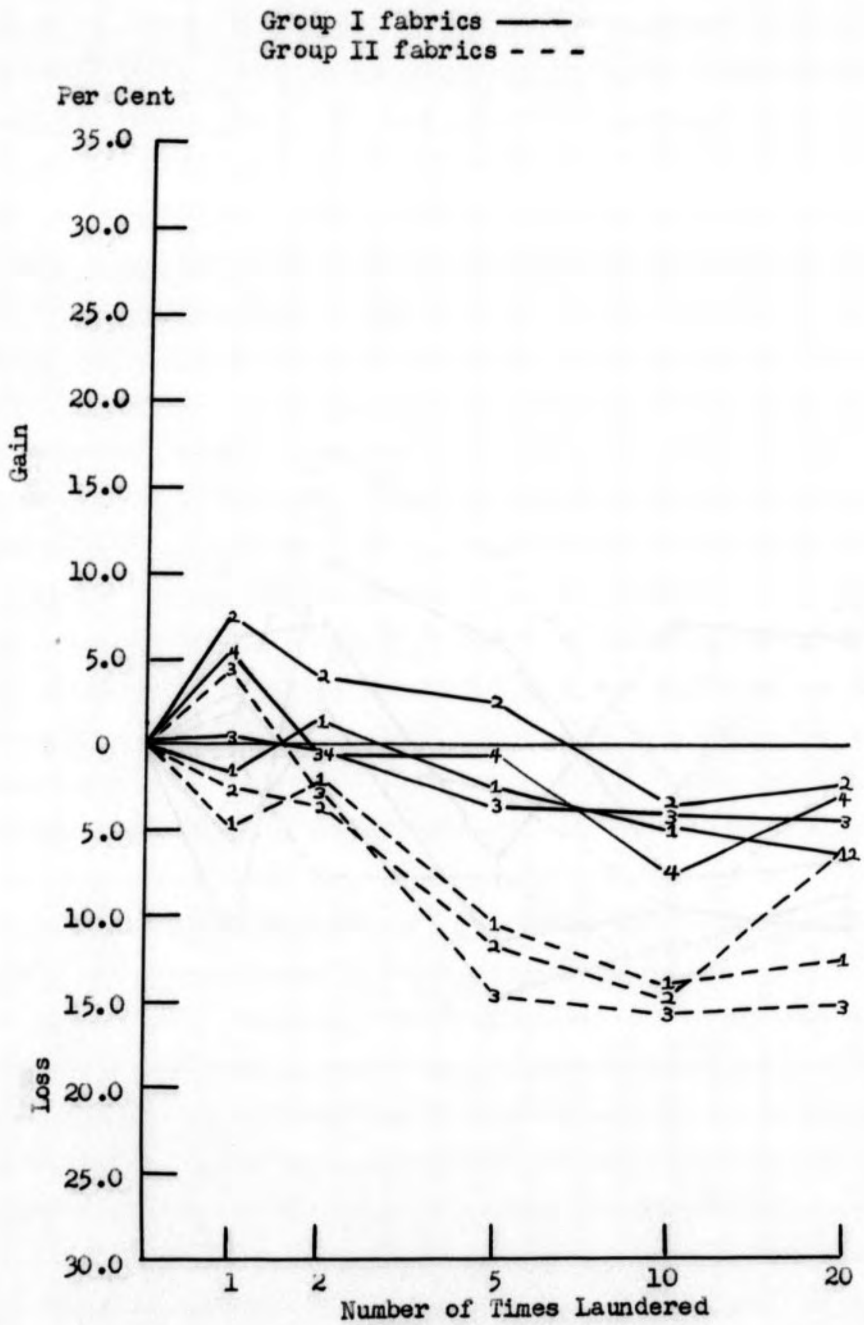


ILLUSTRATION III (Continued)

PERCENTAGE CHANGE IN BREAKING STRENGTH AFTER LAUNDERING

OXFORD TYPE FABRICS - WET-FILLING

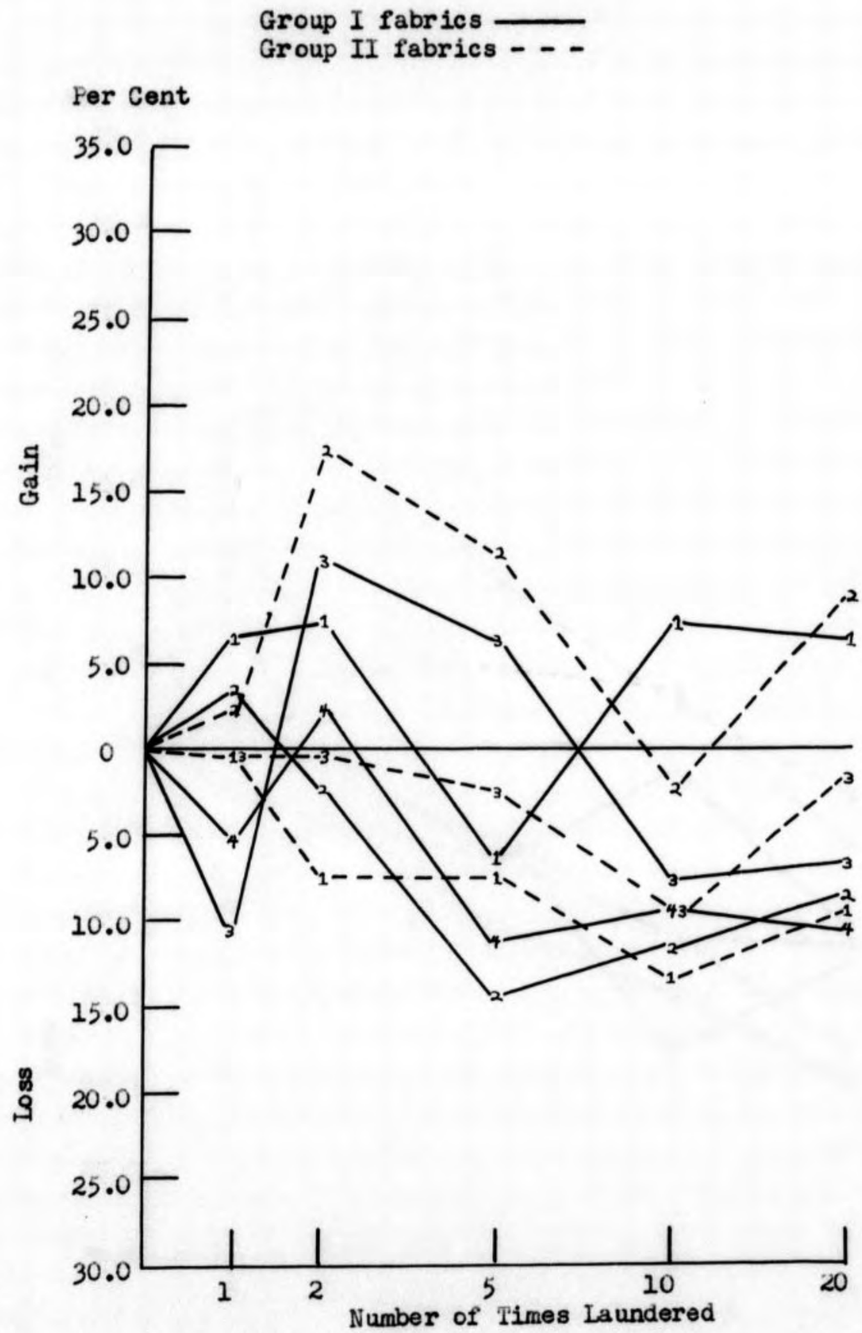


ILLUSTRATION III (Continued)

PERCENTAGE CHANGE IN BREAKING STRENGTH AFTER LAUNDERING

BATISTE TYPE FABRICS - DRY-WARP

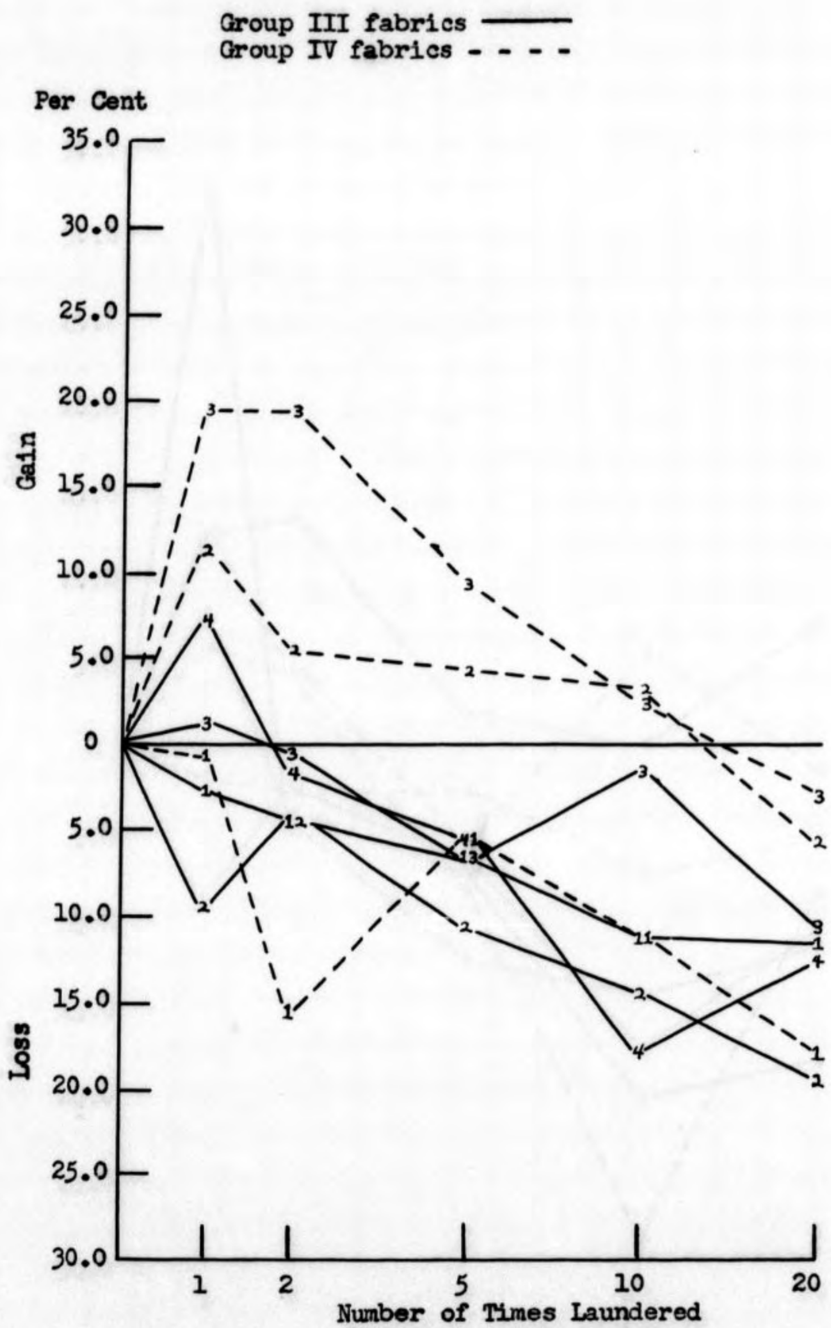


ILLUSTRATION III (Continued)

PERCENTAGE CHANGE IN BREAKING STRENGTH AFTER LAUNDERING

BATISTE TYPE FABRICS - DRY-FILLING

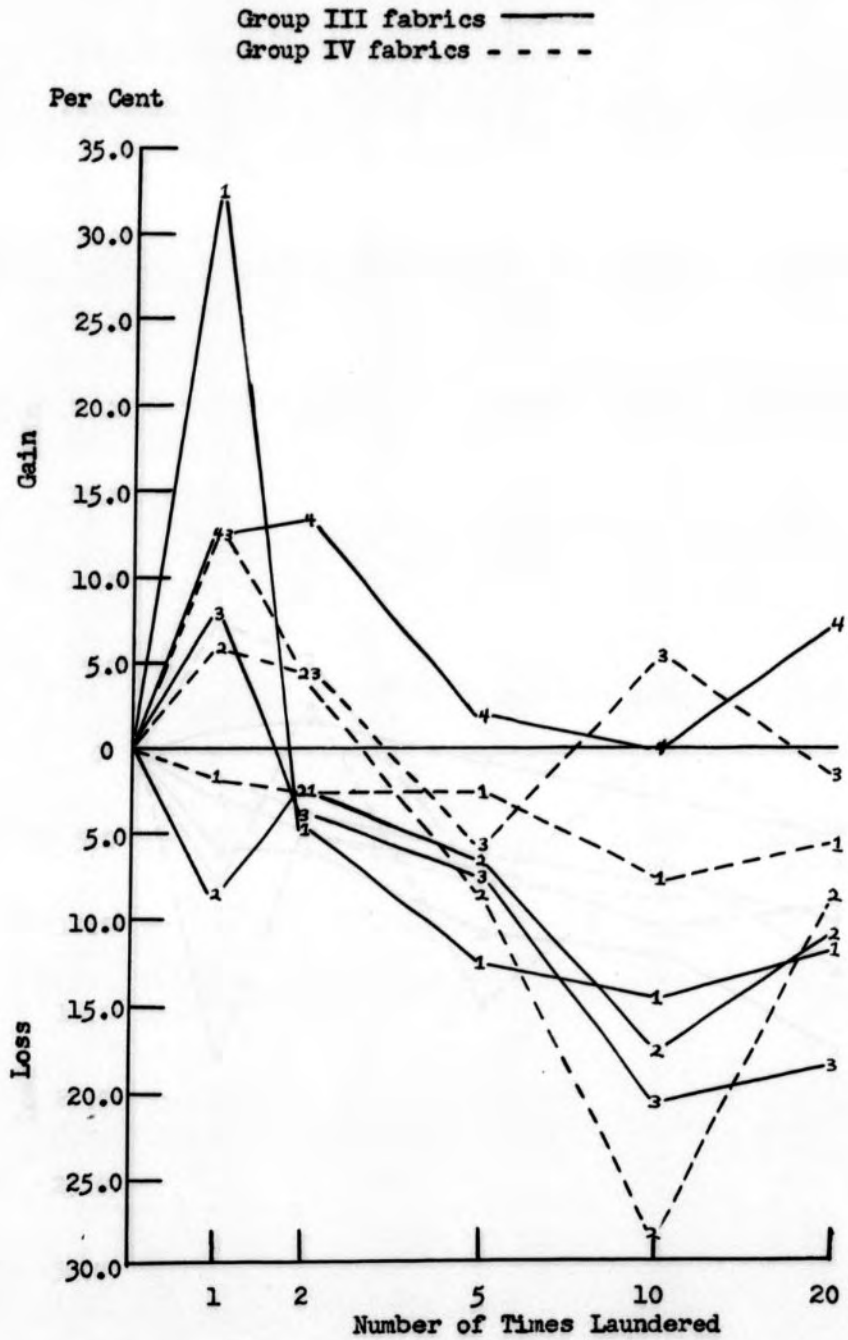


ILLUSTRATION III (Continued)

PERCENTAGE CHANGE IN BREAKING STRENGTH AFTER LAUNDERING

BATISTE TYPE FABRICS - WET-WARP

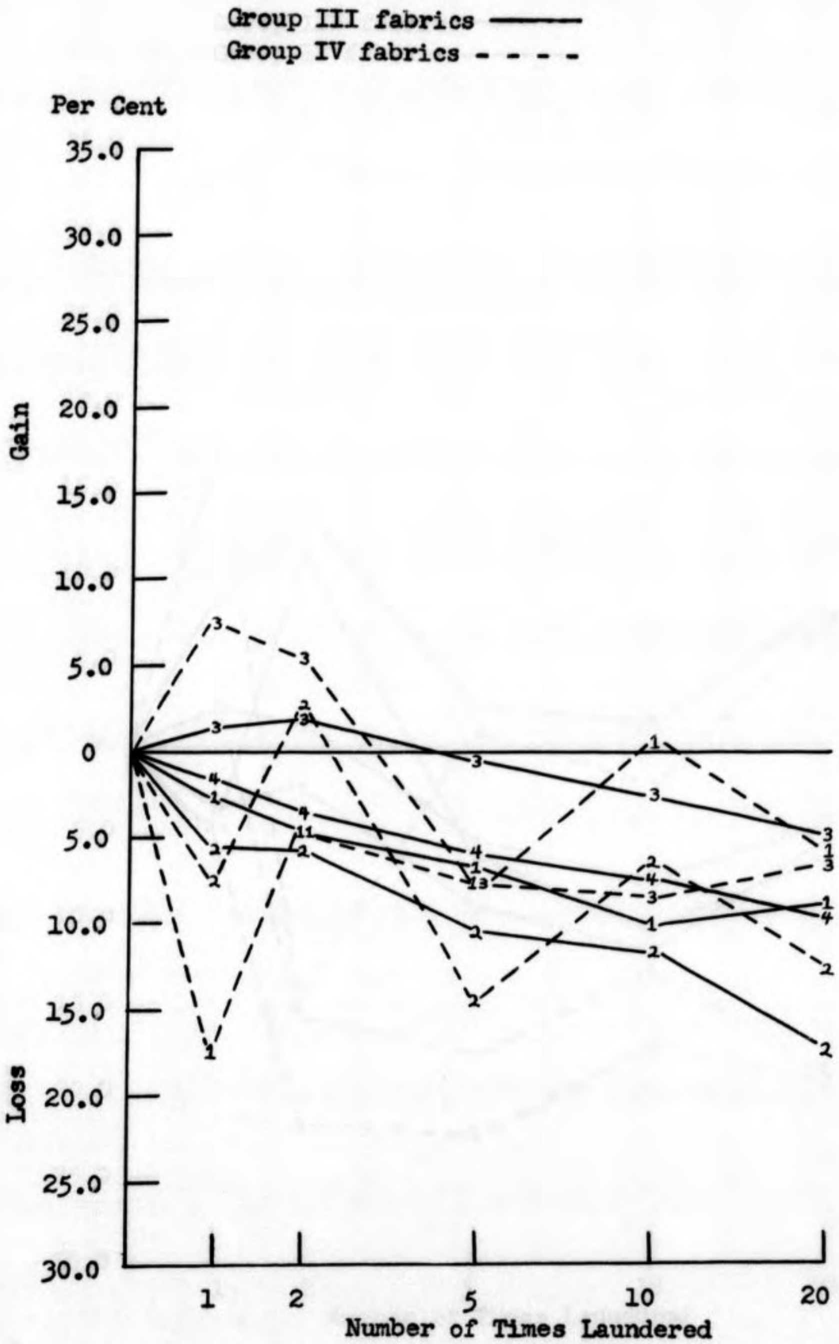
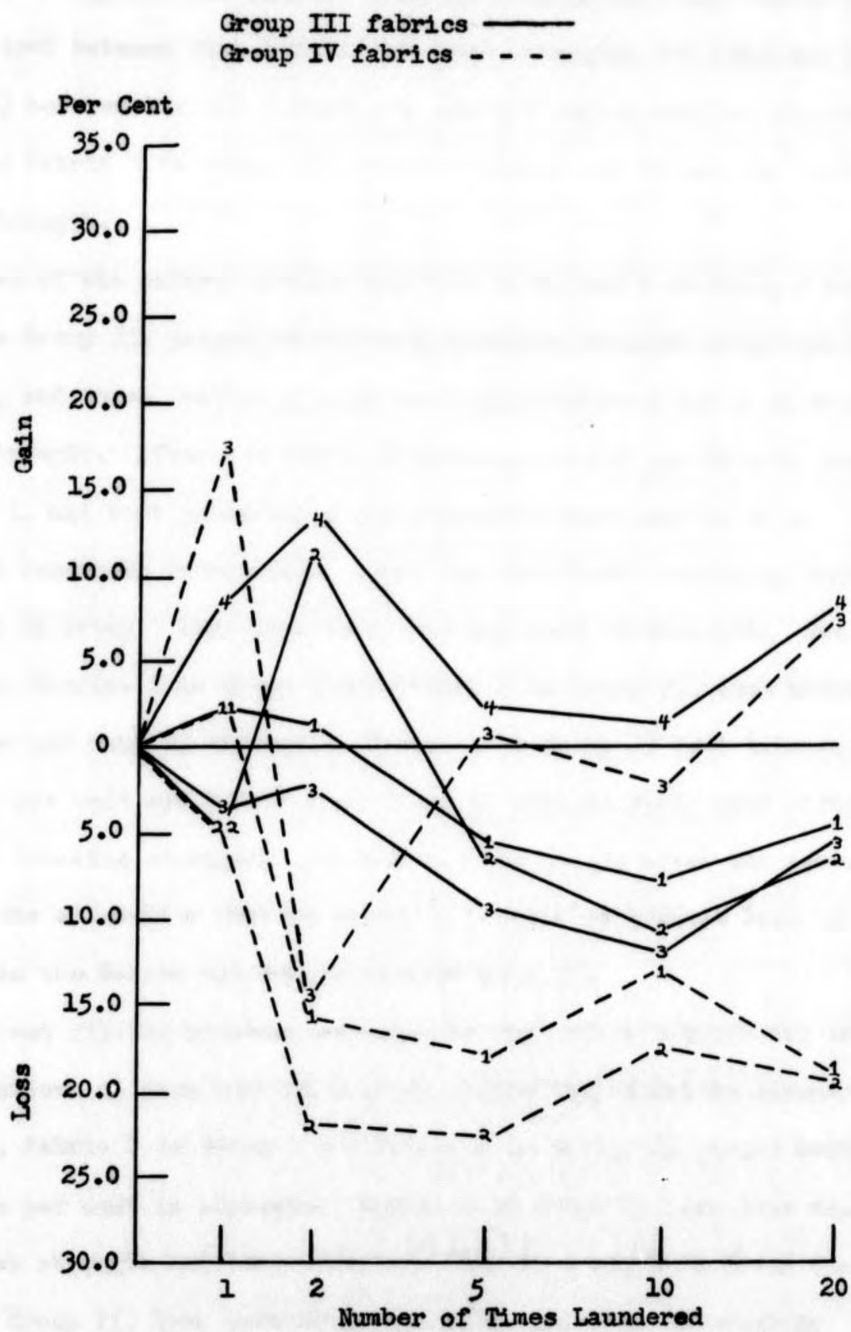


ILLUSTRATION III (Continued)

PERCENTAGE CHANGE IN BREAKING STRENGTH AFTER LAUNDERING

BATISTE TYPE FABRICS - WET-FILLING



Group II) lost strength. By the fifth laundering all the fabrics had lost strength and generally continued to do so through the twentieth laundering. After the twentieth laundering only Fabric 2 in Group II lost less than five per cent in strength. Two fabrics (Fabrics 2 in Group I and Fabric 3 in Group II) lost between five and ten per cent strength; two (Fabrics 1 and 4 in Group I) between ten and fifteen per cent strength; and two (Fabric 3 of Group I and Fabric 1 in Group II) between fifteen and twenty per cent breaking strength.

Four of the oxford fabrics (Fabrics 2, 3, and 4 in Group I and Fabric 3 in Group II) gained in wet warp breaking strength after the first laundering, and three (Fabric 1 in Group I and Fabrics 1 and 2 in Group II) lost strength. After the fifth laundering all but one fabric, Fabric 2 of Group I, had lost in strength and generally continued to do so through the twentieth laundering. After the twentieth laundering Fabrics 2, 3, and 4 in Group I lost less than five per cent in strength. Two of the fabrics, Fabrics 1 in Group I and Fabric 2 in Group II, lost between five and ten per cent in strength. Fabric 1 in Group II lost between ten and fifteen per cent and Fabric 3 of Group II lost slightly over fifteen per cent in breaking strength. At each testing period after the second laundering the all-cotton fabrics showed a greater percentage loss in strength than the Dacron and cotton blended fabrics.

The wet filling breaking strength of the oxford fabrics was erratic with fluctuations at each testing period. After the twentieth laundering two fabrics, Fabric 1 in Group I and Fabric 2 in Group II, gained between five and ten per cent in strength. Fabric 3 in Group II lost less than five per cent strength and three fabrics (Fabrics 2 and 3 in Group I and Fabric 1 in Group II) lost between five and ten per cent in breaking strength. Fabric 4 in Group I lost slightly more than ten per cent in strength.

The dry warp breaking strength of batiste type fabrics (Groups III and IV) fluctuated at each testing period. However, after the twentieth laundering all fabrics had lost strength. One fabric, Fabric 3 in Group IV, lost less than five per cent and one, Fabric 2 in Group IV, lost between five and ten per cent strength. Three fabrics (Fabrics 1, 3, and 4 in Group III) lost between ten and fifteen per cent and two (Fabric 2 in Group III and Fabric 1 in Group IV) lost between fifteen and twenty per cent breaking strength. Two of the all-cotton fabrics were consistently stronger throughout the twenty launderings than the other fabrics.

The dry filling breaking strength of the batiste fabrics was extremely erratic with a fluctuation between a gain of 32.6 per cent and a loss of 28.2 per cent. After the twentieth laundering, Fabric 4 of Group III gained between five and ten per cent in strength. The remainder of the fabrics had lost strength with one, Fabric 3 in Group IV, losing less than five per cent. Two fabrics (Fabrics 1 and 2 in Group IV) lost between five and ten per cent and two (Fabrics 1 and 2 in Group III) lost between ten and fifteen per cent in strength. Fabric 3 in Group III lost almost twenty per cent strength.

The wet warp breaking strength of the batiste type Dacron and cotton fabrics generally tended to decrease at each test period. The all-cotton fabrics fluctuated considerably but had also lost strength by the twentieth laundering. After the twentieth laundering, Fabric 3 in Group III lost five per cent in strength. Four fabrics (Fabrics 1 and 4 in Group III and Fabrics 1 and 3 in Group IV) lost between five and ten per cent strength. One fabric, Fabric 2 in Group IV, lost between ten and fifteen per cent and one, Fabric 2 in Group III, lost between fifteen and twenty per cent breaking strength.

The wet filling strength of the batiste fabrics also tended to fluctuate throughout the testing periods. After the second laundering, two of the all-cotton fabrics, Fabrics 1 and 2, had a greater percentage loss in strength than the other fabrics. This tendency was maintained throughout subsequent testing periods. After the second laundering, the majority of the fabrics lost strength. After the twentieth laundering, two fabrics, Fabric 4 in Group III and Fabric 3 in Group IV, gained between five and ten per cent strength. Fabric 1 in Group III had lost less than five per cent strength. Fabrics 2 and 3 in Group III lost between five and ten per cent strength while Fabrics 1 and 2 in Group IV lost almost twenty per cent in breaking strength.

In the all-cotton oxford type fabrics, the filling was considerably higher in breaking strength than the warp. This was not true in the Dacron and cotton fabrics. In fact, the warp strength of the two basket weave fabrics (Fabrics 1 and 2 in Group I) was considerably higher than the filling. In general, both types of Dacron and cotton blended fabrics and all-cotton fabrics had greater wet breaking strength than dry strength.

There was no general difference in percentage breaking strength between the Dacron and cotton blended fabrics and all-cotton fabrics. Where there was a difference these exceptions have been noted.

In general, all the fabrics tended to have a loss in breaking strength after the second laundering which was continued through the twentieth laundering.

The majority of the fabrics were within a fifteen per cent increase or decrease change in breaking strength after the twentieth laundering.

## VII. BURSTING STRENGTH

The bursting strength in pounds before and after laundering is given in Table VII, the percentage change in bursting strength after laundering in Table VIII, and the graphic representation of percentage change in bursting strength in Illustration IV.

There was considerable fluctuation in the percentage increases and decreases in bursting strength of the fabrics at the various testing periods.

The majority of the oxford type fabrics (Group I and Group II) had lost dry strength by the twentieth laundering. Fabric 2 in Group II had gained between ten and fifteen per cent in strength and Fabric 4 in Group I had gained less than one per cent. Two fabrics, Fabric 3 in Group I and Fabric 1 in Group II, lost less than one per cent. Three fabrics, Fabrics 1 and 2 in Group I and Fabric 3 in Group II, lost between five and ten per cent in strength.

The oxford type fabrics (Groups I and II) except Fabric 4 in Group I had lost in wet strength after the twentieth laundering. This fabric gained less than one per cent in strength. Fabric 3 in Group I and Fabric 3 in Group II lost less than five per cent in strength. One fabric, Fabric 1 in Group II, lost between five and ten per cent; two, Fabrics 1 and 2 in Group I, between ten and fifteen per cent; and one, Fabric 2 in Group II, between fifteen and twenty per cent strength.

TABLE VII

BURSTING STRENGTH IN POUNDS BEFORE AND AFTER LAUNDERING

| Fabric Number | Number of Times Laundered | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Original | | One | | Two | | Five | | Ten | | Twenty | |
| | Dry | Wet | Dry | Wet | Dry | Wet | Dry | Wet | Dry | Wet | Dry | Wet |
| GROUP I - Oxford type - Dacron and Cotton Blended Fabrics | | | | | | | | | | | | |
| 1 | 101.6 | 115.6 | 105.4 | 114.4 | 103.8 | 112.0 | 95.8 | 108.4 | 98.0 | 110.8 | 95.0 | 102.2 |
| 2 | 102.8 | 115.2 | 105.6 | 114.2 | 104.0 | 114.0 | 98.2 | 113.8 | 98.2 | 102.0 | 95.4 | 103.0 |
| 3 | 152.2 | 165.8 | 142.2 | 153.0 | 163.0 | 169.4 | 164.8 | 164.0 | 136.0 | 157.2 | 150.8 | 161.6 |
| 4 | 107.8 | 116.6 | 113.4 | 120.0 | 109.4 | 127.6 | 107.6 | 122.6 | 109.8 | 118.0 | 108.0 | 117.4 |
| GROUP II - Oxford type - All-cotton Fabrics | | | | | | | | | | | | |
| 1 | 121.8 | 136.0 | 115.6 | 141.2 | 115.6 | 138.6 | 112.6 | 129.2 | 111.4 | 131.2 | 120.8 | 127.6 |
| 2 | 100.4 | 148.2 | 113.0 | 121.4 | 106.6 | 130.6 | 102.4 | 136.6 | 112.4 | 136.0 | 113.2 | 122.8 |
| 3 | 134.2 | 140.0 | 131.2 | 126.0 | 119.2 | 170.4 | 130.8 | 158.4 | 134.6 | 156.2 | 126.6 | 135.2 |
| GROUP III - Batiste type - Dacron and Cotton Blended Fabrics | | | | | | | | | | | | |
| 1 | 98.2 | 98.2 | 98.0 | 99.2 | 94.8 | 97.0 | 93.2 | 97.6 | 92.2 | 97.2 | 92.4 | 97.8 |
| 2 | 87.4 | 93.4 | 87.0 | 94.0 | 87.6 | 93.8 | 91.2 | 91.8 | 87.4 | 94.8 | 87.2 | 91.8 |
| 3 | 95.2 | 95.0 | 97.2 | 95.4 | 93.4 | 92.2 | 93.4 | 93.0 | 89.6 | 90.0 | 89.4 | 90.2 |
| 4 | 114.0 | 112.0 | 111.4 | 116.2 | 105.2 | 118.0 | 111.2 | 116.4 | 104.8 | 117.6 | 109.2 | 117.8 |
| GROUP IV - Batiste type - All-cotton Fabrics | | | | | | | | | | | | |
| 1 | 64.6 | 84.0 | 71.0 | 81.2 | 71.0 | 83.0 | 67.4 | 81.6 | 58.6 | 82.4 | 67.3 | 80.4 |
| 2 | 78.6 | 95.0 | 77.6 | 89.2 | 72.6 | 93.6 | 71.6 | 87.4 | 75.4 | 87.4 | 72.4 | 87.0 |
| 3 | 59.5 | 71.2 | 60.4 | 74.4 | 65.4 | 85.4 | 62.2 | 76.8 | 61.6 | 72.8 | 60.6 | 69.8 |

TABLE VIII

PERCENTAGE CHANGE IN BURSTING STRENGTH AFTER LAUNDERING

| Fabric Number | Number of Times Laundered: One | | Two | | Five | | Ten | | Twenty | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Dry | Wet | Dry | Wet | Dry | Wet | Dry | Wet | Dry | Wet |
| GROUP I - Oxford type - Dacron and Cotton Blended Fabrics | | | | | | | | | | |
| 1 | +3.7 | -1.0 | +2.2 | -3.1 | -5.7 | -6.4 | -3.5 | -4.2 | -6.5 | -11.6 |
| 2 | +2.7 | -0.9 | +1.2 | -1.0 | -4.4 | -1.2 | -4.4 | -11.5 | -7.2 | -10.6 |
| 3 | -6.6 | -7.7 | +7.1 | +2.2 | +8.3 | -1.1 | -10.6 | -5.2 | -0.9 | -2.5 |
| 4 | +5.6 | +2.9 | +1.6 | +9.4 | -0.2 | +5.1 | +1.9 | +1.2 | +0.2 | + 0.7 |
| GROUP II - Oxford type - All-cotton Fabrics | | | | | | | | | | |
| 1 | -5.1 | +3.8 | -5.1 | +1.9 | -7.6 | -5.0 | -8.5 | -3.5 | -0.8 | -6.2 |
| 2 | +12.6 | -18.1 | +6.2 | -11.9 | +2.0 | -7.8 | +11.9 | -8.2 | +12.7 | -17.4 |
| 3 | -2.2 | -10.0 | -11.2 | +22.0 | -2.5 | +13.1 | +0.3 | +11.5 | -5.7 | -3.4 |
| GROUP III - Batiste type - Dacron and Cotton Blended Fabrics | | | | | | | | | | |
| 1 | -0.2 | +1.0 | -3.5 | -1.2 | -5.1 | -0.6 | -6.1 | -1.0 | -5.9 | -0.4 |
| 2 | -0.5 | +0.6 | +0.2 | +0.4 | +4.3 | -1.7 | 0.0 | +1.5 | -0.2 | -1.7 |
| 3 | +2.1 | +0.4 | -1.9 | -2.9 | -1.9 | -2.1 | -5.9 | -5.3 | -6.1 | -5.1 |
| 4 | -2.3 | +3.8 | -7.7 | +5.4 | -2.5 | +3.9 | -8.1 | +5.0 | -13.0 | +5.2 |
| GROUP IV - Batiste type - All-cotton Fabrics | | | | | | | | | | |
| 1 | +9.9 | -3.3 | +9.9 | -1.2 | +4.3 | -2.9 | -9.3 | -1.9 | +4.2 | -4.3 |
| 2 | -1.3 | -6.1 | -7.6 | -1.5 | -8.9 | -8.0 | -4.1 | -8.0 | -7.9 | -8.4 |
| 3 | +1.5 | +4.5 | +9.9 | +19.9 | +4.5 | +7.9 | +3.5 | +2.2 | +1.8 | -1.9 |

ILLUSTRATION IV

PERCENTAGE CHANGE IN BURSTING STRENGTH AFTER LAUNDERING

OXFORD TYPE FABRICS - DRY

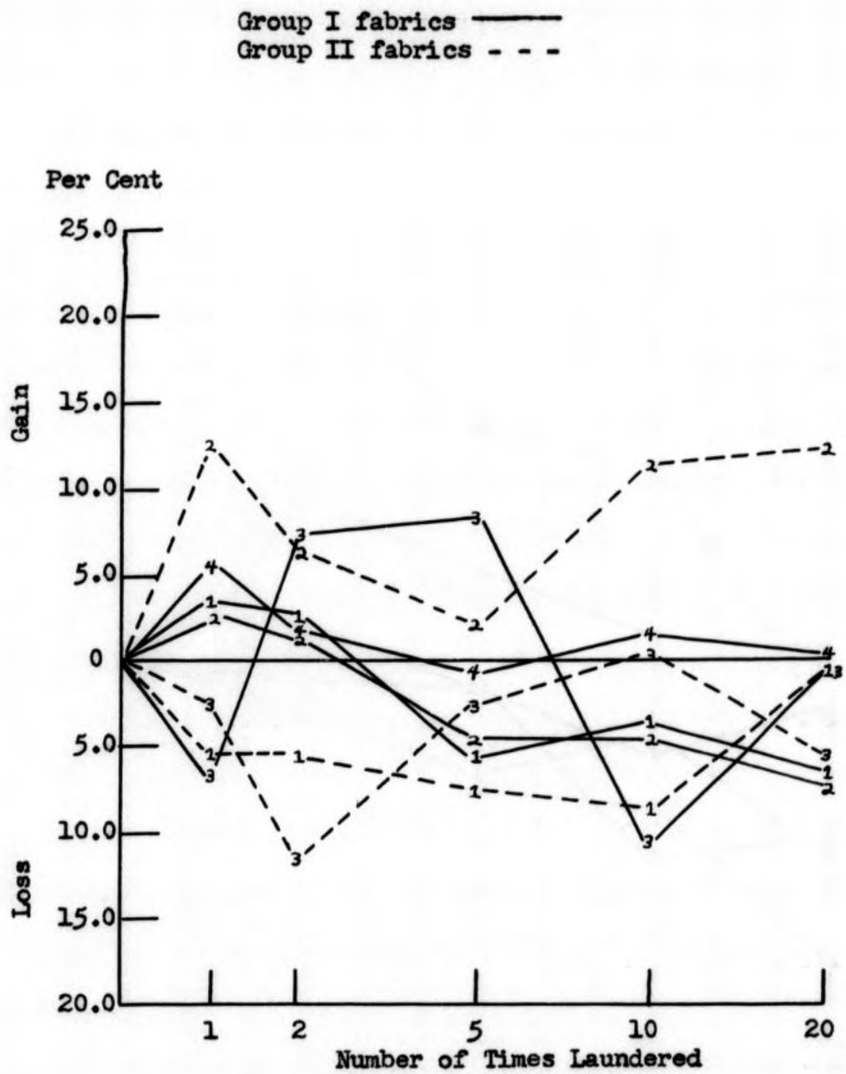


ILLUSTRATION IV (Continued)

PERCENTAGE CHANGE IN BURSTING STRENGTH AFTER LAUNDERING

OXFORD TYPE FABRICS - WET

GROUP I Fabrics ———
GROUP II Fabrics - - -

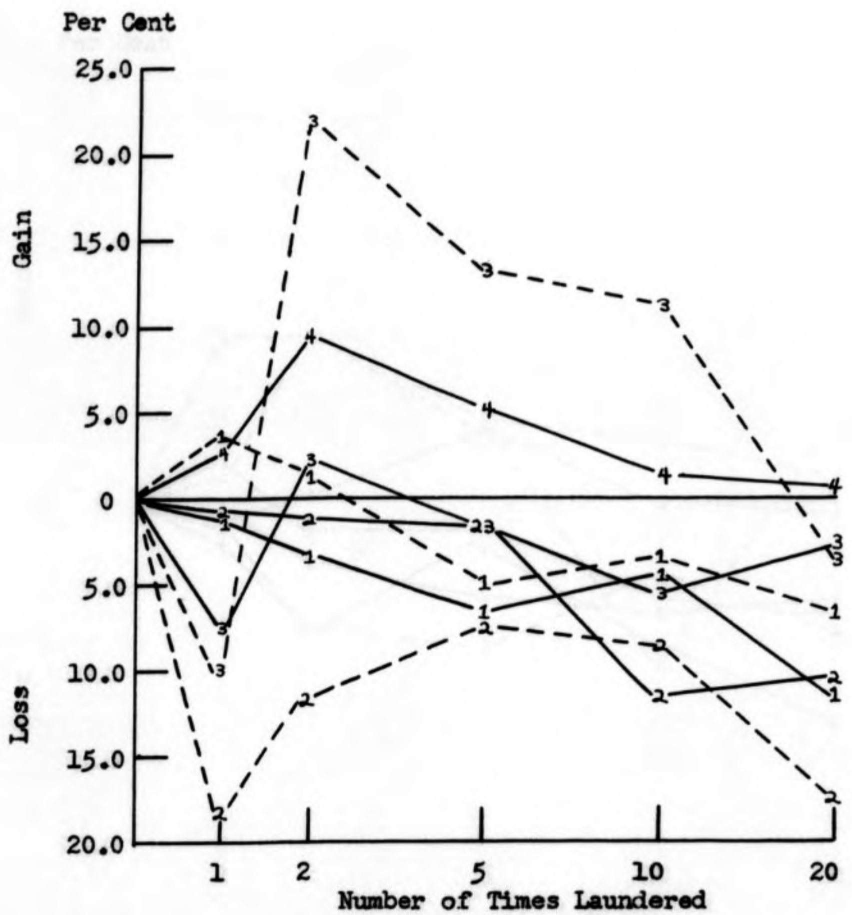


ILLUSTRATION IV (Continued)

PERCENTAGE CHANGE IN BURSTING STRENGTH AFTER LAUNDERING

BATISTE TYPE FABRICS - DRY

Group III fabrics ———
Group IV fabrics - - - -

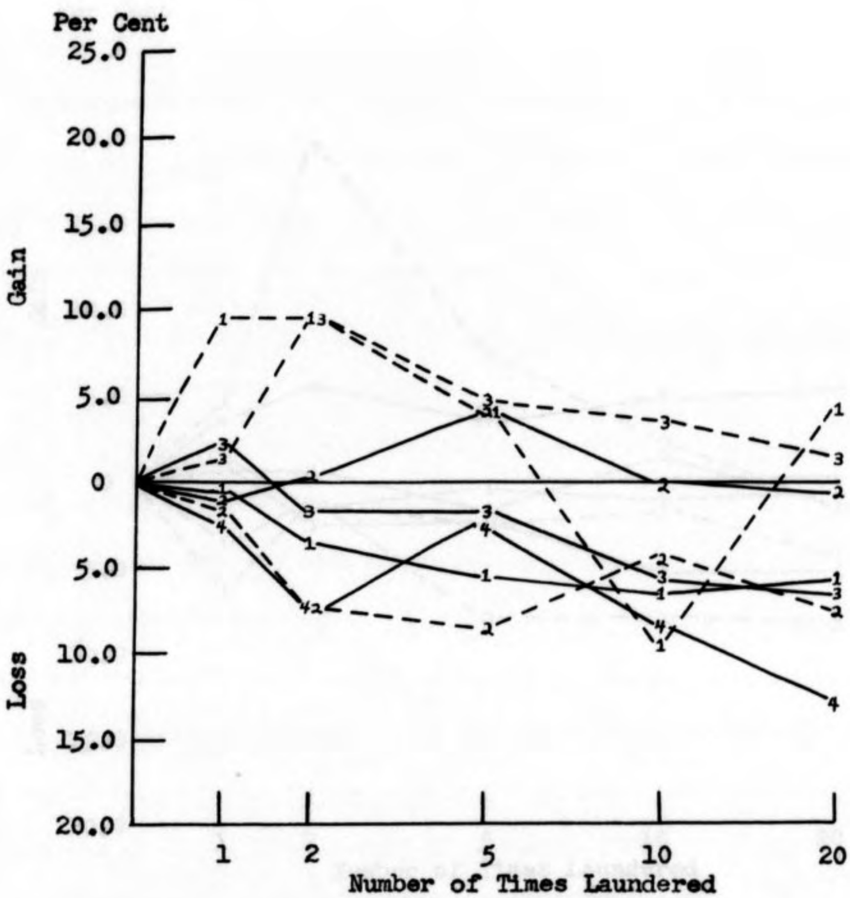
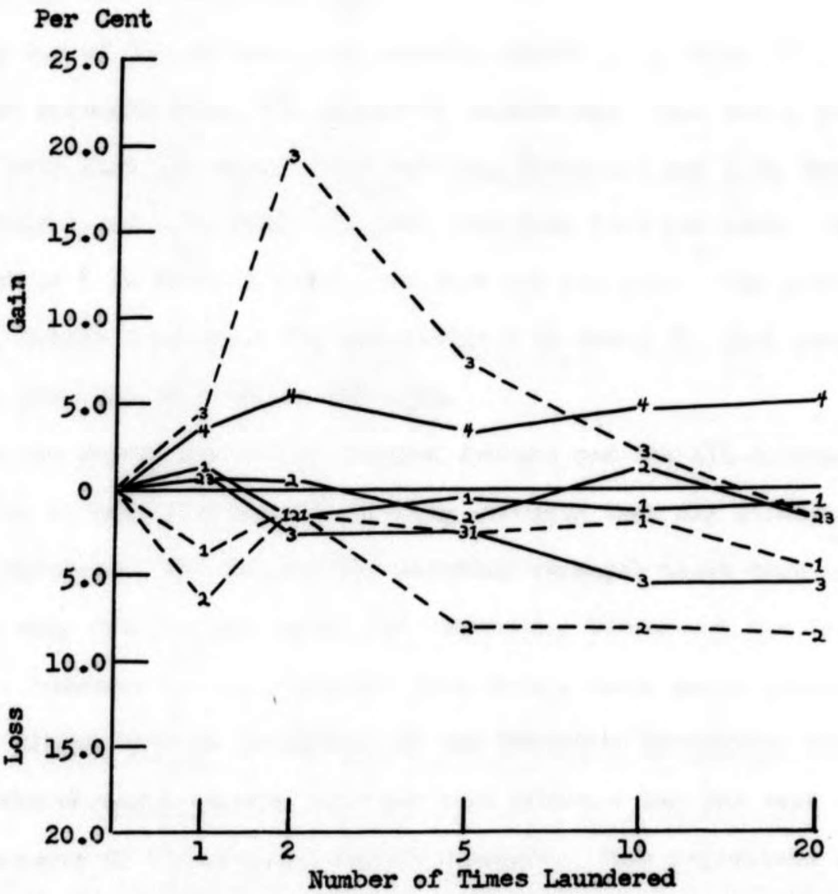


ILLUSTRATION IV (Continued)

PERCENTAGE CHANGE IN BURSTING STRENGTH AFTER LAUNDERING

BATISTE TYPE FABRICS - WET

Group III fabrics ——
Group IV fabrics - - -



The batiste type fabrics (Groups III and IV) generally decreased in dry strength by the twentieth laundering. Fabrics 1 and 3 in Group IV had gained less than five per cent in strength after the twentieth laundering. Fabric 2 in Group III lost less than one per cent in strength. Three fabrics, Fabrics 1 and 3 in Group III and Fabric 2 in Group IV, lost between five and ten per cent in strength. Only Fabric 4 in Group III lost between ten and fifteen per cent.

Only one of the batiste type fabrics, Fabric 4 in Group III, had gained in wet strength after the twentieth laundering. This was a gain of slightly over five per cent. Four fabrics, Fabrics 1 and 2 in Group III and Fabrics 1 and 3 in Group IV, lost less than five per cent. One of these, Fabric 1 in Group III was less than one per cent. The remaining two fabrics, Fabric 3 in Group III and Fabric 2 in Group IV, lost between five and ten per cent in bursting strength.

Both the Dacron and cotton blended fabrics and the all-cotton fabrics tended to have greater wet bursting strength than dry strength.

The results of the dry and wet bursting strength tests were quite erratic with many fabrics increasing and decreasing throughout the twenty launderings. However, by the twentieth laundering, there was a general tendency for slight loss in strength. By the twentieth laundering the majority of the strength changes recorded were within a ten per cent increase or decrease of the original fabric strength. This represents a relatively small amount of strength change during the period.

In general, there was greater fluctuation in the percentage changes of the all-cotton fabrics than of the Dacron and cotton blended fabrics at each testing period. However, there was no marked difference in the percentage strength after the twentieth laundering in either group.

## VIII. CREASE RESISTANCE

"Buck and McCord, in an extremely thorough review of the entire subject, define crease resistance (. . .) as follows: 'Crease resistance may be thought of as that property of a fabric which causes it to recover from folding deformations that normally occur during its use. The recovery may be almost instantaneous in which case there will be an apparent resistance to the formation of a crease. Recovery may be slower in other cases with the crease mark disappearing gradually. The speed and completeness of a fabric's recovery from creases is the measure of its crease resistance.'"[3]

In Textile Fibers, Yarns, and Fabrics, Kaswell states that "There appears to be a general opinion that a crease recovery angle of at least 125° is necessary in order for a fabric to exhibit acceptable performance."[4] This "standard is based upon the general experience of textile technologists who know that when applying standard types of resin finishes to cellulosic fibers, if the recovery angle is above 125° at 65 per cent R. H., an acceptable fabric will result, regardless of a depression in recovery angle at a higher humidity."[5] This degree angle interpreted in percentage crease recovery gives a 69.4 per cent standard which has been accepted for this study.

The percentage crease resistance before and after laundering is given in Table IX and the graphic representation of percentage crease resistance in Illustration V.

In the oxford fabrics in Group I, there was a rapid initial recovery with slow recovery during the remaining five-minute recovery period. Only

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[3] Ernest R. Kaswell, Textile Fibers, Yarns, and Fabrics, New York: Reinhold Publishing Corporation, 1953, page 256, (Buck, G. S., Jr. and McCord, F. A., "Crease Resistance and Cotton," Textile Research Journal, 19:216 (1949).

[4] Ibid., p. 277.

[5] Ibid., p. 277.

TABLE IX

PERCENTAGE CREASE RESISTANCE BEFORE AND AFTER LAUNDERING

| Fabric Number | NUMBER OF TIMES LAUNDERED | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Original | | One | | Two | | Five | | Ten | | Twenty | |
| | warp | filling | warp | filling | warp | filling | warp | filling | warp | filling | warp | filling |
| Group I - Oxford type - Dacron and Cotton Blended Fabrics | | | | | | | | | | | | |
| 1 | 83.0 | 79.2 | 72.0 | 70.1 | 73.1 | 80.2 | 74.8 | 77.0 | 75.8 | 81.6 | 79.3 | 81.3 |
| 2 | 78.7 | 83.9 | 74.7 | 73.3 | 73.9 | 80.4 | 75.6 | 78.6 | 76.4 | 80.4 | 78.9 | 79.3 |
| 3 | 80.4 | 75.1 | 79.4 | 74.7 | 80.4 | 68.6 | 80.4 | 71.6 | 81.3 | 74.3 | 82.8 | 75.0 |
| 4 | 69.1 | 73.4 | 74.6 | 74.0 | 75.6 | 75.7 | 73.3 | 74.4 | 76.1 | 78.8 | 78.4 | 75.3 |
| Group II - Oxford type - All-Cotton Fabrics | | | | | | | | | | | | |
| 1 | 46.2 | 40.9 | 44.8 | 40.0 | 46.9 | 42.3 | 47.8 | 42.3 | 45.7 | 43.3 | 50.1 | 47.2 |
| 2 | 50.2 | 45.0 | 46.4 | 38.0 | 43.4 | 45.0 | 47.4 | 45.6 | 43.0 | 42.6 | 45.2 | 44.9 |
| 3 | 44.3 | 43.7 | 45.9 | 45.2 | 48.8 | 45.7 | 44.1 | 42.7 | 45.8 | 43.6 | 48.3 | 47.3 |
| Group III - Batiste type - Dacron and Cotton Blended Fabrics | | | | | | | | | | | | |
| 1 | 71.4 | 75.4 | 71.7 | 72.3 | 70.7 | 73.4 | 70.9 | 73.7 | 75.8 | 74.3 | 75.1 | 74.4 |
| 2 | 68.2 | 74.9 | 77.3 | 69.3 | 75.3 | 73.9 | 73.3 | 75.4 | 74.6 | 76.3 | 73.2 | 79.0 |
| 3 | 81.3 | 79.9 | 79.1 | 77.0 | 77.2 | 80.3 | 77.3 | 77.6 | 78.2 | 79.1 | 77.6 | 80.9 |
| 4 | 71.4 | 73.8 | 66.1 | 69.3 | 69.6 | 71.6 | 72.2 | 75.4 | 69.8 | 74.9 | 71.3 | 74.7 |
| Group IV - Batiste type - All-Cotton Fabrics | | | | | | | | | | | | |
| 1 | 38.3 | 41.9 | 36.6 | 44.6 | 37.3 | 47.6 | 37.4 | 51.3 | 41.6 | 52.6 | 41.0 | 49.8 |
| 2 | 40.4 | 39.3 | 38.4 | 43.7 | 31.9 | 44.6 | 41.7 | 43.3 | 43.2 | 46.6 | 45.2 | 45.2 |
| 3 | 35.3 | 41.6 | 35.6 | 44.4 | 42.0 | 44.0 | 41.7 | 45.4 | 46.7 | 47.3 | 47.6 | 44.2 |

ILLUSTRATION V

PERCENTAGE CREASE RESISTANCE BEFORE AND AFTER LAUNDERING

OXFORD TYPE FABRICS - WARP

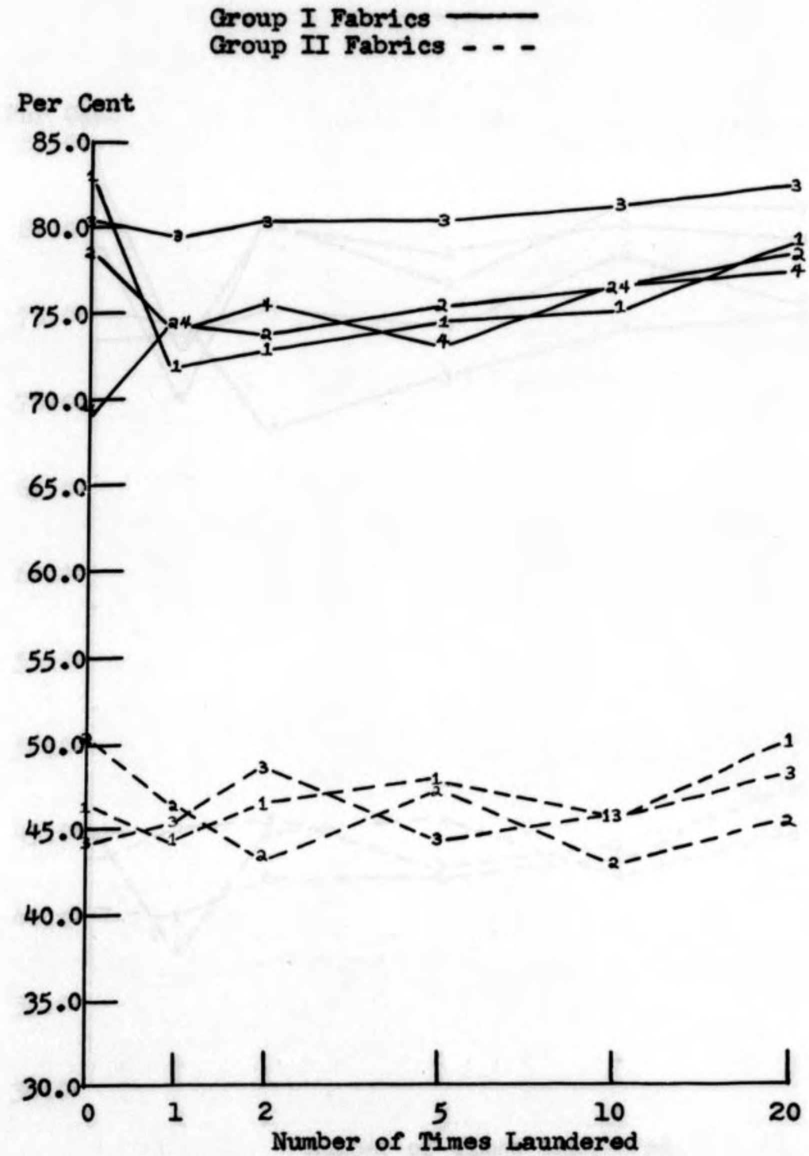


ILLUSTRATION V (Continued)

PERCENTAGE CREASE RESISTANCE BEFORE AND AFTER LAUNDERING

OXFORD TYPE FABRICS - FILLING

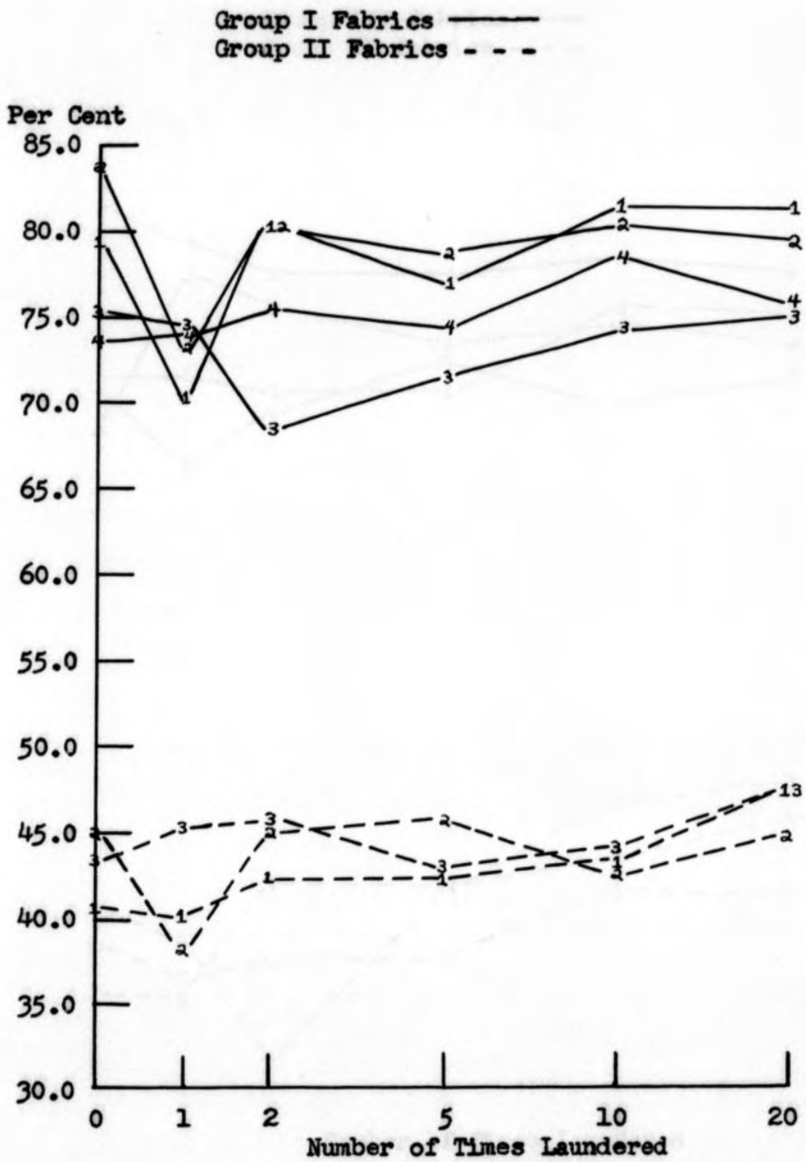


ILLUSTRATION V (Continued)

PERCENTAGE CREASE RESISTANCE BEFORE AND AFTER LAUNDERING

BATISTE TYPE FABRICS - WARP

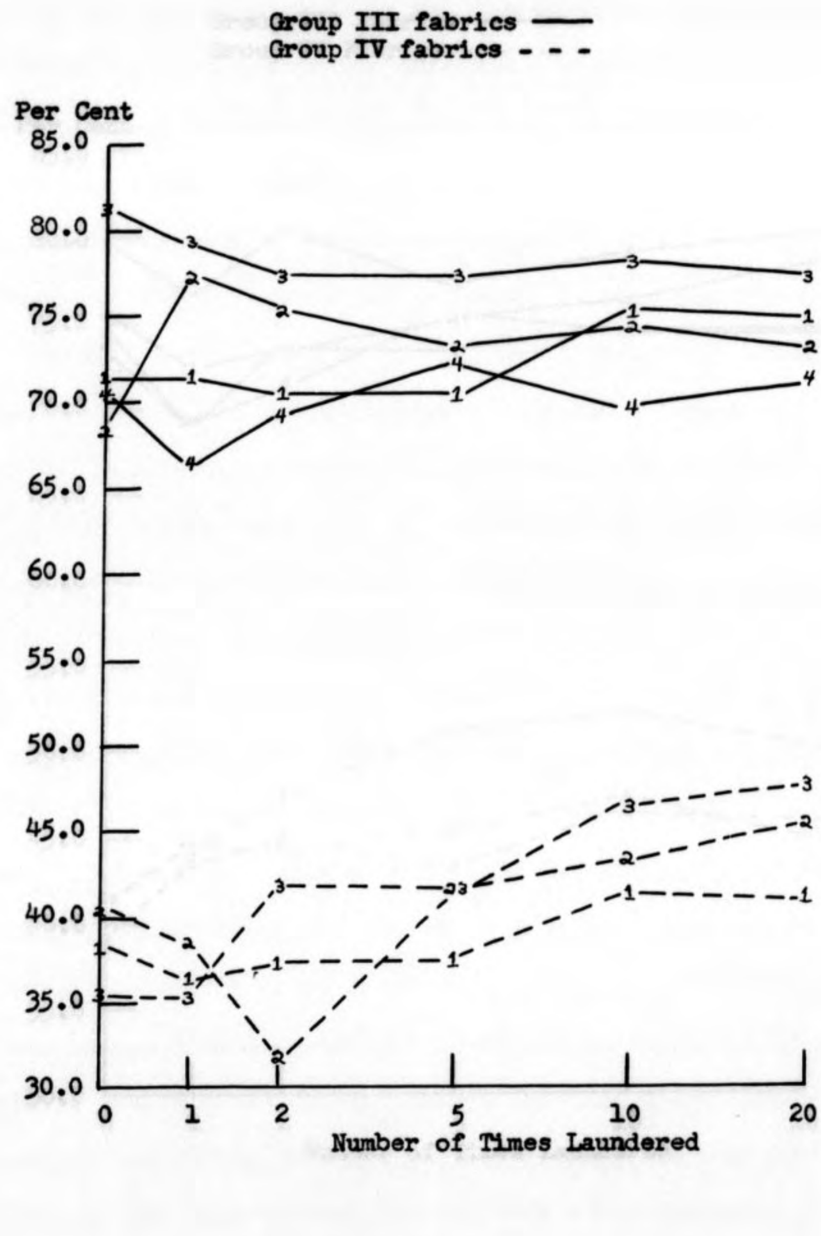
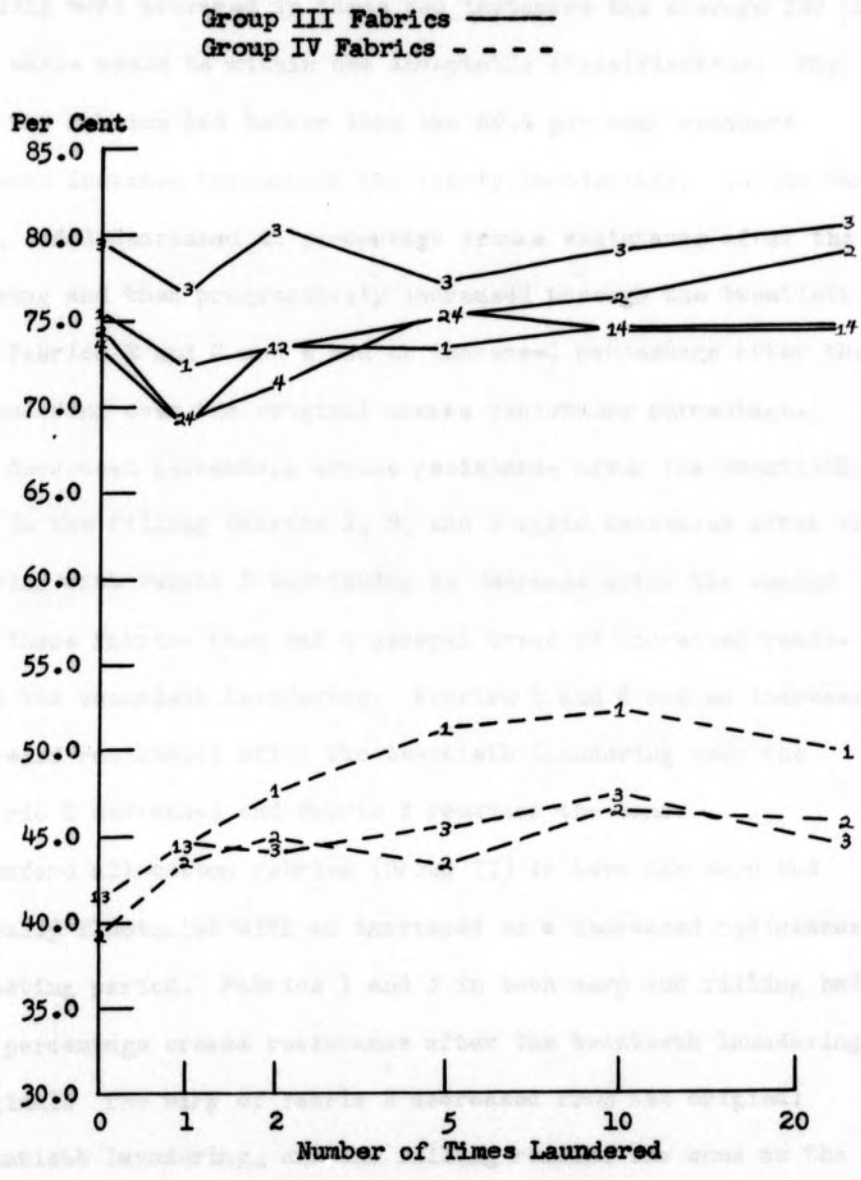


ILLUSTRATION V (Continued)

PERCENTAGE CREASE RESISTANCE BEFORE AND AFTER LAUNDERING

BATISTE TYPE FABRICS - FILLING



the warp of Fabric 4 in the original and the filling of Fabric 3 after the second laundering were slightly below the 69.4 per cent standard with a 69.1 per cent and a 68.6 per cent recovery respectively. However, if the warp and filling were averaged in these two instances the average for the fabrics as a whole would be within the acceptable classification. The remainder of the fabrics had better than the 69.4 per cent standard recovery in each instance throughout the twenty launderings. In the warp, Fabrics 1, 2, and 3 decreased in percentage crease resistance after the first laundering and then progressively increased through the twentieth laundering. Fabrics 2 and 3 and 4 had an increased percentage after the twentieth laundering over the original crease resistance percentage. Fabric 4 had decreased percentage crease resistance after the twentieth laundering. In the filling Fabrics 1, 2, and 3 again decreased after the first laundering with Fabric 3 continuing to decrease after the second laundering. These fabrics then had a general trend of increased resistance through the twentieth laundering. Fabrics 1 and 4 had an increased percentage crease resistance after the twentieth laundering over the original; Fabric 2 decreased and Fabric 3 remained the same.

The oxford all-cotton fabrics (Group II) in both the warp and filling generally fluctuated with an increased or a decreased resistance after each testing period. Fabrics 1 and 3 in both warp and filling had an increased percentage crease resistance after the twentieth laundering over the original. The warp of Fabric 2 decreased from the original after the twentieth laundering, and the filling remaind the same as the original. These fabrics were all considerably below the recommended 69.4 per cent crease recovery standard.

In the Dacron and cotton batiste type fabrics (Group III) there was a rapid initial recovery and slow delayed recovery like that of the Dacron and cotton oxford type fabrics. Fabric 2 was below the 69.4 per cent standard in the warp of the original and in the filling after the first laundering, but if the warp and filling in these two instances were averaged the fabric as a whole was above this standard. Fabric 4 was below this standard after the first laundering in both the warp and filling and thus the fabric as a whole was below the standard in this one instance. All the other fabrics in this group were above the standard for acceptable performance. Fabric 3 generally decreased in warp resistance at each testing period with a decreased percentage crease resistance after the twentieth laundering. Fabrics 1, 2, and 4 fluctuated with an increased and decreased resistance through the twenty launderings. However, Fabrics 1 and 2 had an increased percentage crease resistance after the twentieth laundering. Fabric 4 had approximately the same percentage crease resistance in the original fabric and after the twentieth laundering. In the filling, Fabric 3 fluctuated through the fifth laundering and then increased through the twentieth laundering. Fabrics 1, 2, and 4 decreased after the first laundering and then generally increased through the twentieth laundering. Fabric 1 had a decreased percentage crease resistance after the twentieth laundering. The percentage crease resistance of Fabrics 2, 3, and 4 had increased after the twentieth laundering.

As in the all-cotton oxford type fabrics (Group II), the all-cotton batiste type fabrics (Group IV) were considerably below the 69.4 per cent standard for acceptable performance. Although the fabrics tended to fluctuate between increase and decrease in percentage crease resistance in both the warp and filling, the general trend was toward an increase. By the twentieth laundering all the fabrics had increased considerably in both the warp and filling over the original percentage crease resistance.

There was a marked improvement shown in the amount of crease resistance in both types of Dacron and cotton blended fabrics over the all-cotton fabrics. The Dacron and cotton fabrics with the exception of Fabric 4 in Group III after the first laundering were within the standard for acceptable performance in crease recovery. None of the all-cotton fabrics approached this standard. The Dacron and cotton blended fabrics also exhibited a much more rapid immediate recovery than the all-cotton fabrics. In general, the majority of the Dacron and cotton blended fabrics and all-cotton fabrics had an increased percentage crease recovery after the twentieth laundering in both the warp and filling.

## CHAPTER V

## SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS FOR FURTHER STUDY

Shirts made of 65 per cent Dacron and 35 per cent cotton blended fabrics are currently being placed on the retail market, but are in a higher price bracket than comparable all-cotton shirts. The consumer has no basis for judging the merits of the Dacron and cotton blended shirts over the all-cotton shirts other than advertisements which tend to give only advantageous points.

This study, part of a larger research project, was planned to make a comparison of oxford and batiste type 65 per cent Dacron and 35 per cent cotton blended fabrics with similar all-cotton fabrics used in shirtings. It was expected that any variation in value attributable to the use of Dacron in the blend would be indicated through laboratory testing. These tests included fabric construction, and evaluation of appearance, dimensional change, breaking strength, bursting strength, and crease resistance after one, two, five, ten, and twenty launderings.

Investigations made in various retail stores revealed that Dacron and cotton blended fabrics were not being sold as yard goods. Therefore, the fabrics for the study were limited to those which could be obtained from textile mills, selling agents, and shirt manufacturers. Four oxford type and four batiste type Dacron and cotton blended fabrics were selected and purchased at wholesale prices.

The three qualities of oxford type and of batiste type all-cotton fabrics selected for comparison were obtained from retail stores. However, it was found very few stores stocked oxford type fabrics.

According to laboratory analysis, the majority of the Dacron and cotton blended fabrics had slightly more than the specified 65 per cent Dacron and slightly less than 35 per cent cotton. The average fiber content of the four oxford type fabrics was the same as the average of the four batiste type fabrics, 67.2 per cent Dacron and 32.8 per cent cotton.

The following similarities and differences in the two groups of oxford type fabrics were noted as the result of laboratory analysis of fabric construction. Two of the Dacron and cotton fabrics had a two warp thread, two filling thread basket weave and all the other fabrics had a two warp thread, one filling thread oxford weave. The average warp thread count of the Dacron and cotton fabrics was 93 threads per inch and of the all-cotton fabrics 97 threads per inch. While in the filling the Dacron and cotton fabrics had 69 threads per inch and the all-cotton fabrics 46 threads per inch. The two groups were similar in thickness. The Dacron and cotton had an average thickness of .020 inches and the all-cotton fabrics .022 inches. The two groups were also similar in weight with each group having an average weight of 4.0 ounces per square yard. There was greater variation in yarn number between the Dacron and cotton and all-cotton fabrics than in other construction characteristics. The Dacron and cotton fabrics had a higher yarn number in the filling and the all-cotton had a higher yarn number in the warp. The staple length of the Dacron and cotton fabrics was higher than the all-cotton fabrics in both the warp and filling. One Dacron and cotton fabric was constructed with a ply yarn. This had an S twist with 17 turns per inch. All the fabrics had a Z twist in both the warp and filling yarns. The Dacron and cotton fabrics had a higher twist count in both the warp and filling than the all-cotton fabrics. The average twist count of the Dacron and cotton fabrics was 26 turns per inch in the warp and 24 in the filling. The all-cotton fabrics had 23 turns per inch in the warp and 11 in the filling.

The following similarities and differences in the two groups of batiste type fabrics were noted as the result of laboratory analysis of fabric construction. Both Dacron and cotton blended fabrics and all-cotton fabrics were plain weave. The average warp thread count of each group was 100 threads per inch. The average filling thread count was 83 threads per inch for the Dacron and cotton fabrics and 95 for the all-cotton fabrics. The Dacron and cotton fabrics were slightly thicker than the all-cotton fabrics with a .016 inch and .011 inch thickness respectively. All the Dacron and cotton fabrics were heavier than the all-cotton fabrics. The Dacron and cotton fabrics had an average weight of 2.7 ounces per square yard and the all-cotton had an average weight of 1.7 ounces per square yard. The yarn number of the all-cotton fabrics was higher in both the warp and filling than the Dacron and cotton fabrics. The staple lengths of the Dacron and cotton fabrics were higher than the all-cotton fabrics in both warp and filling. All the warp and filling yarns in both groups were single ply and had a Z twist. The average twist count of the Dacron and cotton fabrics was the same as the average of the all-cotton fabrics with 28 turns per inch in the warp and 30 turns per inch in the filling.

The appearance in respect to wrinkle resistance in laundering of the Dacron and cotton fabrics was consistently better than the all-cotton fabrics. Throughout the twenty launderings the majority of both types of Dacron and cotton fabrics were rated in Class 2. Whereas the all-cotton fabrics were rated in Class 3 after each laundering. This indicated that the Dacron and cotton fabrics would need only a small amount of ironing or "touch-up ironing," and the all-cotton fabrics would require moisture, heat, and pressure for removal of the wrinkles.

The Dacron and cotton fabrics dried very rapidly. When all the fabrics were removed from the water at the same time, wrinkles had dried into the last fabrics to be hung. Thus it would be important for the consumer to hang garments to drip dry immediately following removal from the water for maximum satisfaction in fabric appearance.

There was no noticeable advantage in the oxford type Dacron and cotton fabrics over the oxford type all-cotton fabrics in respect to dimensional change. All the fabrics were within a two per cent shrinkage or gain tolerance throughout the twenty launderings. This amount of dimensional change would be very satisfactory in garments.

In the batiste type fabrics, there was a noticeable advantage to the Dacron and cotton blended fabrics in dimensional change. The Dacron and cotton fabrics did not shrink or stretch more than one per cent throughout the twenty launderings. The all-cotton fabrics shrank more than two per cent after the first launderings and two of the three fabrics shrank over five per cent in the filling direction. This is considered an excessive amount of shrinkage.

In the all-cotton oxford type fabrics, the filling was considerably higher in breaking strength than the warp. This was not true in the Dacron and cotton fabrics. In fact, the warp breaking strength of the two basket weave fabrics (Fabrics 1 and 2 in Group I) was considerably higher than the filling. In general, both types of Dacron and cotton fabrics and all-cotton fabrics had greater wet strength than dry strength.

There was no appreciable difference in percentage breaking strength between the Dacron and cotton blended fabrics and all-cotton fabrics after twenty launderings. The majority of the fabrics were within a fifteen per cent increase or decrease in breaking strength after the twentieth laundering.

In general, all the fabrics tended to have a loss in breaking strength after the second laundering which was continued through the twentieth laundering.

Both the Dacron and cotton blended fabrics and the all-cotton fabrics tended to have greater wet bursting strength than dry strength.

The results of the dry and wet bursting strength tests were quite erratic with many fabrics increasing and decreasing throughout the twenty launderings. However, by the twentieth laundering there was a general tendency for slight loss in strength. After the twentieth laundering, the majority of the strength changes were within a ten per cent increase or decrease of the original fabric strength.

In general, there was a greater fluctuation in the percentage changes in bursting strength of the all-cotton fabrics than of the Dacron and cotton fabrics at each testing period. However, there was no marked difference in the percentage strength after the twentieth laundering in either group.

There was a marked improvement shown in the amount of crease resistance in both types of Dacron and cotton blended fabrics over the all-cotton fabrics. The Dacron and cotton fabrics consistently met the 69.4 per cent standard set for fabrics to exhibit acceptable performance. None of the all-cotton fabrics approached this standard. The Dacron and cotton fabrics also exhibited a much more rapid immediate crease recovery than the all-cotton fabrics.

After the twentieth laundering the majority of all the fabrics had an increased percentage crease resistance in both the warp and filling.

## CONCLUSIONS

The following conclusions were drawn from the study:

1. It was apparent throughout the twenty launderings that the Dacron and cotton blended fabrics were superior to the all-cotton fabrics in appearance with respect to wrinkle resistance in laundering.

2. For maximum satisfaction in the appearance of the Dacron and cotton fabrics it would be important that the fabrics be hung to drip dry immediately following removal from the water.

3. There were no noticeable advantages in the oxford type Dacron and cotton blends over the all-cotton fabrics in dimensional change after twenty launderings.

4. There was a noticeable advantage in the batiste type Dacron and cotton fabrics over the all-cotton fabrics in dimensional change which was apparent after the first laundering and all subsequent testing periods.

5. In the majority of cases both types of Dacron and cotton fabrics and all-cotton fabrics had greater wet breaking strength than dry strength.

6. There was no appreciable difference in percentage breaking strength between the Dacron and cotton blended fabrics and the all-cotton fabrics after the twentieth laundering.

7. Both the Dacron and cotton fabrics and the all-cotton fabrics tended to have greater wet bursting strength than dry strength.

8. There was no marked difference between the Dacron and cotton fabrics and all-cotton fabrics in the percentage bursting strength after the twentieth laundering.

9. There was a marked difference shown in the amount of crease resistance in both types of Dacron and cotton fabrics over the all-cotton fabrics.

10. The Dacron and cotton blended fabrics exhibited a much more rapid immediate crease recovery than the all-cotton fabrics.

11. The majority of the Dacron and cotton fabrics and all-cotton fabrics had an increased percentage crease recovery after the twentieth laundering.

## RECOMMENDATIONS FOR FURTHER STUDY

The following recommendations are suggested for further study:

1. To continue laundering the fabrics used in the study with tests for evaluation of appearance, dimensional change, breaking strength, bursting strength, and crease resistance after the thirty-fifth and fiftieth launderings.

2. To determine the wearing quality of the Dacron and cotton blended fabrics in comparison to the all-cotton fabrics in relation to abrasion resistance in the original fabrics and after one, two, five, ten, twenty, thirty-five, and fifty launderings.

3. To determine the serviceability in use by wear studies of shirts made from Dacron and cotton blended fabrics as compared with the serviceability of similar shirts of all-cotton construction.

4. To determine the effect of various home washing machines upon the serviceability of the fabrics selected.

5. To determine the effect of soaps and detergents used in home laundering upon the soil removal efficiency and whiteness retention of the fabrics.

6. To indicate problems that may occur in the home laundering and finishing of these fabrics.

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