# A COMPARISON OF THE SERVICE QUALITIES OF CERTAIN ALL LINEN, ALL RAYON, AND LINEN AND RAYON MIXTURE FABRICS BEFORE AND AFTER LAUNDERING

by

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# INTRODUCTION

Mixed linen and rayon fabrics are new on the market. Rayon, itself, has not been in use many years. Centuries past, the four natural fibers - wool, silk, cotton, and linen - were recognized by textile manufacturers as the basic textile fibers. The entire textile world has been revolutionized by the introduction of rayon.

Rayon was first produced as long filaments, next as short or staple fibers. Now, rayon yarns can be made from continuous filaments or spun from staple fibers by the cotton, woolen, or worsted system. The rayon yarns can be produced coarse or fine, bright or dull, regular or irregular in structure. These yarns are used in the manufacture of fabrics which are either woven or knitted.

Many of the early spun rayon fabrics resembled linen fabrics in weave, texture, and finish. Likewise, rayons have been made to resemble silk and wool fabrics. More recently some fabrics were made of spun rayon plus another fiber which may be wool, cotton, silk, or linen. These are known as the mixture fabrics.

Mixture fabrics were originally made because rayon

needed the re-enforcement of the natural fibers for strength and good spinning. Likewise, spun rayon is often used in a mixture because it has a tendency to soften fabrics in which one of the components may be harsh in texture; for instance, linen. In rayon-linen mixtures, the higher percentage of fiber is usually rayon. The percentage of linen, as a rule, does not exceed 30 percent.

Information on the effect of laundering upon the service qualities of linen and rayon mixture fabrics as compared with similar fabrics of all linen and all rayon is important to the consumer. Consumers wish to know whether these fabrics can be laundered or if they must be dry cleaned for best service.

Little is known of the extent to which these fabrics will resist creasing. Fabrics, including linen and linen mixtures, are often given a special treatment (13) to make them crease-resistant. In this treatment, fabrics are saturated with solutions of certain chemicals which, after being heated, produce synthetic resins.

This study was made to secure information upon the service qualities of linen and rayon mixture fabrics, all linen, and all rayon fabrics. A comparison of the fabrics was made before and after laundering with emphasis upon

crease resistance properties, abrasion, shrinkage, elongation, and breaking strength.

## PRESENT STATUS OF KNOWLEDGE

Few studies have been found that deal with linen and rayon mixture fabrics. Scheithauer (8) carried out washing tests on fabrics made from linen, cotton, cotton and staple fiber, cotton and cottonised bast fiber, and staple fiber and cottonised bast fiber mixture yarns. These fabrics were laundered fifty times by two different machine processes. Fabrics made from yarns of one part staple fiber to five parts cotton showed losses in dry breaking strength practically equal to the losses in fabrics made of all cotton. However, when one part staple fiber to one part cotton fiber was used the loss doubled. The wet strength of fabrics which were made from one part staple fiber to two parts cotton fiber was practically equal to the dry strength. After laundering the loss in strength of the linen fabrics was greater than that of the one part staple and the two parts cotton fabrics and about equal to that of the one part staple and one part cotton fabrics. After repeated launderings, the ratio of wet to

dry strength of linen fabrics, which had been high before washing, was lower. Fabrics which were made from one part cottonised bast fiber to one part cotton yarns were comparable with cotton fabrics, whereas those made from one part staple fiber to one part cottonised bast fiber were comparable with linen fabrics in their resistance to washing.

Searle and Mack (10) made a study of the incidence of shrinkage in 570 women's and children's wearing apparel fabrics. This study showed the desirability of extending the application of pre-shrinking treatments to a larger proportion of fabrics on the market since the percentage of shrinkage was high in these tests.

The crease resistance of linens, rayons, and cottons was tested by Furry (4). Twenty dress fabrics which had been commercially treated to develop a crease resistant finish were laundered and ironed five times according to standard methods. The flexometer developed by the National Bureau of Standards was used to determine the crease resistance. Of the fabrics tested, the rayons had the most flexural resilience, the linens as much, but the cottons were less resilient. All the fabrics lost resilience upon being laundered. With laundering, the linens increased in

strength but the cottons and rayons lost strength.

Auerbach (1) found that the resistance of fabrics to creasing varied with the type of yarn, the weave, thickness of fabric, and the treatment used in finishings. He found that knitted fabrics in general showed better resistance to creasing than fabrics which are woven.

## PROCEDURE

Nine dress fabrics which included five linen and rayon mixtures, two all linen, and two all rayon were purchased. Samples of these fabrics are shown in Plate I. Four yards of white or light colored fabric of about the same weight were bought of each of the nine types. All were of plain weave and ranged in price from $0.40 to $1.39 per yard.

### Identification

The fiber content of all the fabrics was ascertained microscopically by comparing longitudinal and cross sectional mounts with known mounts. Cross sections were prepared by the use of the Schwarz fiber microtome.

## EXPLANATION OF PLATE I

### Samples of Fabrics

Fig. 1. Viscose rayon and linen.

Fig. 2. Viscose rayon and linen.

Fig. 3. Viscose rayon and linen.

Fig. 4. Viscose rayon and linen.

Fig. 5. Viscose rayon and linen.

Fig. 6. Viscose rayon.

Fig. 7. Viscose rayon.

Fig. 8. Linen.

Fig. 9. Linen.

PLATE I

Fig. 1

Fig. 2

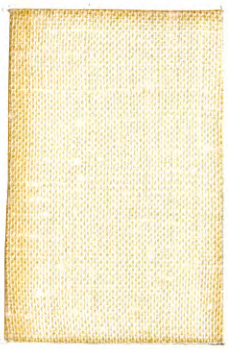

Fig. 3

Fig. 4

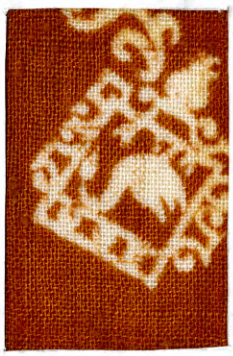

Fig. 5

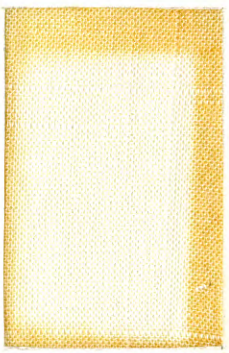

Fig. 6

Fig. 7

Fig. 8

Fig. 9

## Quantitative Microscopical Analysis

The percentage of fiber content of all mixed samples was determined by microscopic analysis which is a modified method of Hermann and Herzog (6, 3). Short longitudinal sections, one-sixteenth of an inch, were cut with scissors and mount[illegible] glycerin on a slide. Polarized light was used in the identification of the linen sections. The entire area under the cover glass was observed, and the fibers counted by the manipulation of a mechanical stage which had two graduated scales at right angles. A 16-mm. objective and a 10x ocular were used. Twenty slides, ten for warp and ten for filling, were prepared from yarns taken from various parts of the fabric, and the counts for each fiber were averaged. The average weight of camera lucida drawings of the cross sections of each fiber was determined. The percentage of fiber content was calculated by the following formula:

$$\text{Percent of fiber } A = \frac{100\, n_a\, w_a\, g_a}{n_a\, w_a\, g_a + n_b\, w_b\, g_b}$$

where n is the number of fibers

w is the average weight

g is the specific gravity of the fiber.

The values of the specific gravities were taken from Hermann and Herzog (6) and the International Critical Tables (7).

## Laundering

Each fabric was laundered and ironed at the Manhattan Laundry once, five, and ten times along with soiled garments of the same type of material. Palmolive soap beads and soft water were used. The fabrics were subjected to one suds and four rinses after which they were ironed, without stretching, in an ironer.

## Physical Tests

The following physical characteristics of the fabrics were determined: thickness, weight per square yard, crimp, twist, yarn counts, thread count, breaking strength (both wet and dry), elongation, shrinkage, abrasion, and crease resistance.

Thickness, weight per square yard, thread count, shrinkage, breaking strength and elongation were determined according to Committee D-13 (2).

Breaking strength and elongation were determined by the raveled-strip method using ten strips for both warp and filling. Strips for wet breaking strength were broken wet after they had been immersed in distilled water for two hours.

Crimp was determined by the Schwarz micro method (9) in which camera lucida drawings were made from cross sections of the fabric.

Yarn counts were made by cutting samples eight inches square from each fabric. After drying and weighing the warp and filling yarns were raveled, counted, put into groups, and reweighed. The combined weights of the raveled threads of both warp and filling were compared with the weight of the original piece of fabric. The slight difference in weight was divided equally between warp and filling. Each set of yarns was multiplied by the length of the specimen giving the total length of warp and filling yarns. The amount of crimp was computed and added to this length. Knowing the total length of the warp and filling yarns and the weight, yarn counts were calculated using the cotton system.

Tests for abrasion were made on the M. I. T. model of abrasion tester (5, 12). All fabrics tested were given

five hundred strokes. Crocus cloth was used as the abradant.

Crease resistance was tested by the creasing angle method developed by Schiefer (11). Ten test samples were cut from both warp and filling of each fabric before laundering and after the cloth had been laundered once, five and ten times. Each specimen was folded by bringing the two ends together forming a loop in the center. The ends were held together by tweezers while the loop was inserted between parallel glass plates under a load of one pound. The specimen was kept there for three minutes. It was removed and suspended on a horizontal wire 1 mm. in diameter. After three minutes, the angle between the two ends was measured. The ratio of the angle after the load was applied to the angle before the load was determined and is known as the resilience ratio. The percentage of resilience is this ratio times 100.

## FINDINGS AND DISCUSSION

The description of the fabrics tested is presented in Table 1. This includes data in relation to the purchase of the fabrics and their physical characteristics. The fab-

Table 1. Description of certain all rayon, all linen, and rayon and linen mixture fabrics including data in relation to the purchase of materials and their physical characteristics.

| Fabric | Composition | Purchased: where | Purchased: when | Price: per yard | Width: inches | Weave | Thickness: inches | Thread count (per inch): warp | Thread count (per inch): filling | Crimp (percent): warp | Crimp (percent): filling | Twist direction: warp | Twist direction: filling | Twist per inch: warp | Twist per inch: filling | Yarn count, cotton system, dry weight: warp | Yarn count, cotton system, dry weight: filling | Weight per square yard: ounces dry weight |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | 72% viscose 28% linen | Cole Brothers Junction City, Kansas | June, 1939 | $0.49 | 39 | plain | 0.0113 | 51±0.4 | 74±0.4 | 7.4±0.6 | 15.7±1.6 | Z | Z | 22.5±0.4 | 16.4±0.3 | 23.6 | 32.4 | 3.36 |
| II | 74% viscose 26% linen | Walker Brothers Wichita, Kansas | June, 1939 | 0.79 | 36 | plain | 0.0139 | 50±0.3 | 63±0.4 | 17.3±2.1 | 14.0±0.7 | Z | Z | 24.4±0.3 | 24.9±0.3 | 18.6 | 24.2 | 4.39 |
| III | 64% viscose 36% linen | Vandever's Tulsa, Oklahoma | June, 1939 | 1.39 | 39 | plain | 0.0233 | 33±0.4 | 36±0.1 | 8.9±0.8 | 13.4±0.8 | Z | Z | 12.3±0.3 | 15.2±0.3 | 11.1 | 9.8 | 3.86 |
| IV | 77% viscose 23% linen | Sears, Roebuck & Co. Kansas City, Mo. | July, 1939 | 0.40 | 36 | plain | 0.0172 | 56±0.3 | 60±0.2 | 8.2±0.9 | 24.1±1.5 | Z | Z | 17.8±0.2 | 19.9±0.5 | 21.1 | 21.4 | 5.33 |
| V | 75% viscose 25% linen | Ward M. Keller Manhattan, Kansas | June, 1939 | 0.89 | 36 | plain | 0.0175 | 44±0.3 | 52±0.3 | 9.5±0.9 | 12.3±1.0 | Z | Z | 21.6±0.5 | 19.7±0.3 | 15.6 | 21.9 | 4.28 |
| VI | 100% viscose | Cole Brothers Manhattan, Kansas | June, 1939 | 0.40 | 36 | plain | 0.0151 | 60±0.3 | 64±0.4 | 17.6±0.1 | 16.7±0.7 | Z | Z | 20.3±0.3 | 20.3±0.3 | 27.1 | 22.9 | 3.86 |
| VII | 100% viscose | Cole Brothers Manhattan, Kansas | July, 1939 | 0.79 | 36 | plain | 0.0218 | 64±0.4 | 59±0.1 | 15.5±0.9 | 13.9±0.5 | Z | Z | 24.1±0.3 | 18.3±0.4 | 19.6 | 18.3 | 4.23 |
| VIII | 100% linen | Cole Brothers Manhattan, Kansas | June, 1939 | 0.75 | 36 | plain | 0.0175 | 41±0.2 | 50±0.3 | 5.9±0.4 | 5.4±0.4 | Z | Z | 10.1±0.3 | 12.0±0.2 | 13.6 | 17.5 | 4.11 |
| IX | 100% linen | Wiley's Store Hutchinson, Kansas | June, 1939 | 1.00 | 36 | plain | 0.0105 | 36±0.3 | 40±0.6 | 18.4±0.8 | 22.7±1.5 | Z | Z | 11.6±2.2 | 5.7±0.4 | 12.6 | 11.9 | 5.31 |

rics which were of plain weave and similar in thickness were dress materials ranging in price from $0.40 to $1.39 per yard. Yarn twist was Z in direction for all fabrics tested and varied from 10.1 to 24.4 turns per inch for warp yarns and from 5.7 to 24.9 turns per inch for filling yarns. The two linens had the lowest twist. Mixture fabrics and the viscose rayon fabrics were higher than the linens and comparable in twist.

Weight per square yard, thickness, and shrinkage are included in Table 2. The weight per square yard on controls varied from 3.36 ounces for fabric I to 5.33 ounces for fabrics IV and IX. The two spun rayons weighed the same. All linen fabric VIII weighed 4.11 ounces and all linen fabric IX, 5.33 ounces. The thread count was higher in the filling than in the warp in all cases. Thickness was about the same for all fabrics increasing somewhat with laundering. This increase was probably due to shrinkage. Fabric III, which is a mixture of rayon and linen, shrank the most of all, 19.4 percent in warp and 11.3 percent in filling after the tenth laundering. Fabric I, which is also a mixture of rayon and linen, shrank 12.5 percent in warp but only 1.3 percent in filling after the tenth laundering. All linen fabric IX shrank the least of

Table 2. Weight per square yard, thickness, shrinkage, and resilience ratio on controls and after one, five, and ten launderings for all rayon, all linen, and rayon and linen mixture fabrics.

| Fabric | Number of launderings | Weight per square yard in ounces | Thickness before abrasion | Thickness after abrasion | Percent shrinkage warp | Percent shrinkage filling | Resilience Warp angle 1 | Resilience Warp angle 2 | Resilience Warp ratio* | Resilience Filling angle 1 | Resilience Filling angle 2 | Resilience Filling ratio* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | 0 | 3.36 | 0.0113 | 0.0127 | 0.0 | 0.0 | 131.0 | 63.0 | 48.2 | 133.8 | 69.4 | 51.8 |
| | 1 | 4.04 | 0.0136 | 0.0139 | 12.5 | 9.4 | 109.6 | 62.2 | 56.7 | 111.2 | 64.0 | 57.5 |
| | 5 | 3.94 | 0.0142 | 0.0144 | 6.3 | 0.0 | 94.0 | 72.0 | 76.5 | 135.5 | 69.0 | 50.9 |
| | 10 | 4.03 | 0.0147 | 0.0151 | 12.5 | 1.3 | 95.5 | 62.7 | 65.6 | 126.0 | 67.5 | 53.6 |
| II | 0 | 4.29 | 0.0139 | 0.0146 | 0.0 | 0.0 | 134.0 | 94.0 | 70.1 | 90.0 | 72.0 | 80.0 |
| | 1 | 4.25 | 0.0146 | 0.0149 | 0.7 | 1.3 | 129.6 | 85.6 | 66.0 | 103.0 | 62.0 | 60.1 |
| | 5 | 4.19 | 0.0142 | 0.0138 | 6.3 | 2.8** | 140.4 | 86.4 | 82.7 | 109.5 | 73.0 | 66.6 |
| | 10 | 4.04 | 0.0143 | 0.0148 | 2.5 | 1.3 | 109.5 | 65.8 | 60.1 | 120.5 | 67.5 | 56.0 |
| III | 0 | 3.86 | 0.0233 | 0.0227 | 0.0 | 0.0 | 113.0 | 83.0 | 73.4 | 102.0 | 64.0 | 62.7 |
| | 1 | 4.02 | 0.0249 | 0.0258 | 18.8 | 10.0 | 97.2 | 61.6 | 54.1 | 90.4 | 66.0 | 63.0 |
| | 5 | 4.08 | 0.0264 | 0.0269 | 19.4 | 10.0 | 110.4 | 71.6 | 64.8 | 89.0 | 64.5 | 72.4 |
| | 10 | 3.82 | 0.0255 | 0.0261 | 19.4 | 11.3 | 99.5 | 59.0 | 59.2 | 88.5 | 55.0 | 62.1 |
| IV | 0 | 5.33 | 0.0172 | 0.0162 | 0.0 | 0.0 | 144.4 | 82.6 | 57.2 | 106.4 | 71.6 | 67.2 |
| | 1 | 7.16 | 0.0157 | 0.0161 | 5.0 | 0.7 | 120.0 | 63.2 | 52.6 | 90.0 | 60.0 | 66.6 |
| | 5 | 7.09 | 0.0157 | 0.0162 | 8.8 | 0.7 | 135.4 | 72.0 | 67.9 | 94.3 | 67.5 | 53.2 |
| | 10 | 8.58 | 0.0155 | 0.0162 | 7.5 | 1.3 | 119.0 | 67.5 | 56.7 | 115.0 | 57.5 | 50.0 |
| V | 0 | 4.28 | 0.0175 | 0.0159 | 0.0 | 0.0 | 132.0 | 86.8 | 65.7 | 117.0 | 71.2 | 60.8 |
| | 1 | 4.45 | 0.0164 | 0.0163 | 1.3 | 2.5 | 127.6 | 73.2 | 57.3 | 104.0 | 54.0 | 51.9 |
| | 5 | 4.60 | 0.0169 | 0.0144 | 3.5 | 0.0 | 128.6 | 72.0 | 55.9 | 108.0 | 70.0 | 64.8 |
| | 10 | 4.59 | 0.0166 | 0.0174 | 5.0 | 2.8 | 115.0 | 64.5 | 56.1 | 96.2 | 50.5 | 52.4 |

* Ratio - $\frac{\text{angle 2}}{\text{angle 1}} \times 100$

** Stretch

Table 2. (cont.)

| Fabric | Number of launderings | Weight per square yard in ounces | Thickness before abrasion | Thickness after abrasion | Percent shrinkage warp | Percent shrinkage filling | Resilience Warp angle 1 | Resilience Warp angle 2 | Resilience Warp ratio* | Resilience Filling angle 1 | Resilience Filling angle 2 | Resilience Filling ratio* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VI | 0 | 3.86 | 0.0151 | 0.0152 | 0.0 | 0.0 | 119.8 | 79.0 | 65.9 | 120.0 | 75.8 | 63.1 |
| | 1 | 4.29 | 0.0151 | 0.0150 | 5.0 | 7.5 | 105.8 | 65.6 | 62.0 | 101.0 | 55.0 | 54.4 |
| | 5 | 4.45 | 0.0159 | 0.0160 | 5.0 | 3.5 | 129.4 | 78.6 | 60.7 | 105.5 | 60.2 | 57.1 |
| | 10 | 4.30 | 0.0157 | 0.0158 | 5.6 | 8.8 | 109.5 | 64.0 | 58.4 | 109.0 | 59.5 | 54.5 |
| VII | 0 | 4.23 | 0.0218 | 0.0216 | 0.0 | 0.0 | 118.6 | 79.0 | 66.6 | 109.4 | 77.2 | 70.5 |
| | 1 | 4.23 | 0.0187 | 0.0180 | 2.8 | 0.6 | 137.2 | 79.4 | 57.8 | 144.0 | 63.0 | 43.7 |
| | 5 | 4.69 | 0.0184 | 0.0180 | 8.8 | 0.6 | 133.0 | 94.6 | 71.1 | 109.5 | 65.3 | 59.6 |
| | 10 | 4.27 | 0.0193 | 0.0186 | 8.8 | 1.3 | 116.0 | 68.0 | 58.5 | 114.5 | 69.0 | 60.2 |
| VIII | 0 | 4.11 | 0.0175 | 0.0123 | 0.0 | 0.0 | 183.6 | 59.6 | 32.5 | 165.2 | 45.6 | 27.6 |
| | 1 | 4.69 | 0.0150 | 0.0151 | 4.4 | 0.6 | 171.6 | 51.4 | 29.8 | 161.4 | 52.2 | 32.3 |
| | 5 | 4.25 | 0.0157 | 0.0152 | 5.0 | 1.3 | 172.0 | 81.6 | 47.4 | 162.5 | 55.5 | 34.1 |
| | 10 | 4.18 | 0.0157 | 0.0149 | 6.3 | 0.0 | 170.5 | 62.0 | 36.1 | 163.5 | 60.0 | 36.7 |
| IX | 0 | 5.33 | 0.0105 | 0.0157 | 0.0 | 0.0 | 157.0 | 115.0 | 73.2 | 151.0 | 139.0 | 92.0 |
| | 1 | 5.51 | 0.0183 | 0.0185 | 0.0 | 0.6 | 171.0 | 103.0 | 60.5 | 156.0 | 99.0 | 63.4 |
| | 5 | 5.24 | 0.0186 | 0.0190 | 0.0 | 0.3 | 173.8 | 104.0 | 59.8 | 155.0 | 103.0 | 66.4 |
| | 10 | 5.06 | 0.0176 | 0.0187 | 0.7 | 0.6 | 169.0 | 97.0 | 58.1 | 148.5 | 92.7 | 62.4 |

* Ratio - $\frac{\text{angle 2}}{\text{angle 1}} \times 100$

all, 0.7 percent in warp and 0.6 percent in filling. All rayon fabric VI shrank 5.6 percent in warp and 8.8 percent in filling while all rayon fabric VII shrank 8.8 percent in warp and 1.3 percent in filling after the tenth laundering.

Resilience ratio on the controls and after one, five, and ten launderings is included in Table 2. Graphs (Figs. 1 to 9) were also prepared to show the trends of resilience for the fabrics. The resilience ratio was found by dividing angle 2 by angle 1 and multiplying by 100. Resilience ratio was about the same for all. The greatest variation was found in the 100 percent linen fabrics VIII and IX. Fabric VIII had the lowest resilience ratio, averaging about 30 percent. Fabric IX had the highest ratio on control but this decreased rapidly at the first laundering and remained fairly constant with additional washing and is comparable with the other fabrics tested. All of the fabrics showed a tendency to increase in resilience at the fifth laundering and to decrease after the tenth. The 100 percent viscose rayons had the same resilience ratio as the mixtures. Thus, the percentage of linen in the mixtures had little effect upon the resilience ratio. All of the fabrics except mixture fabric III and 100 percent

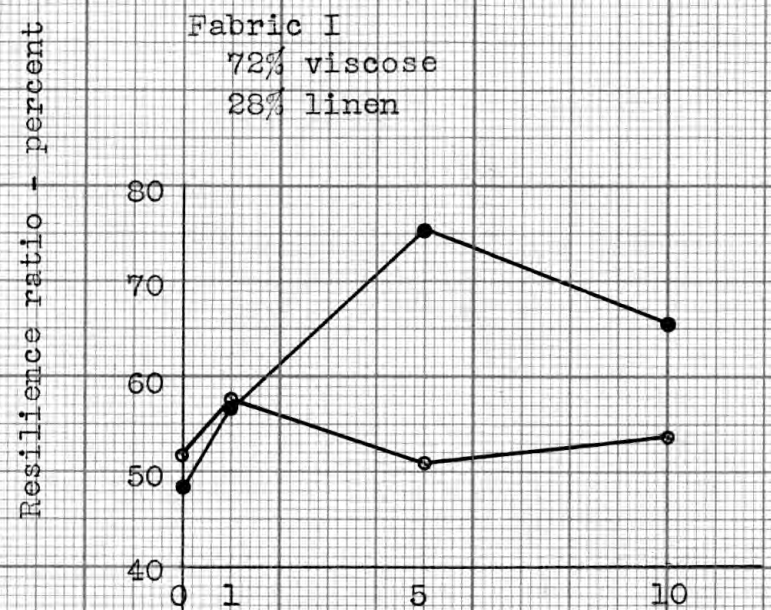


Fig. 1. Resilience for fabric I on controls and after one, five, and ten launderings.

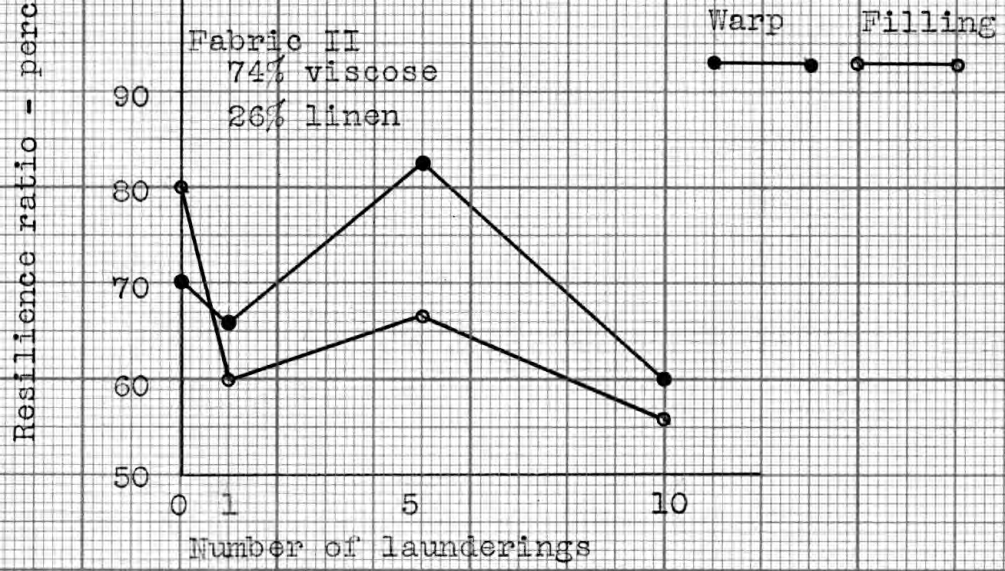


Fig. 2. Resilience for fabric II on controls and after one, five, and ten launderings.

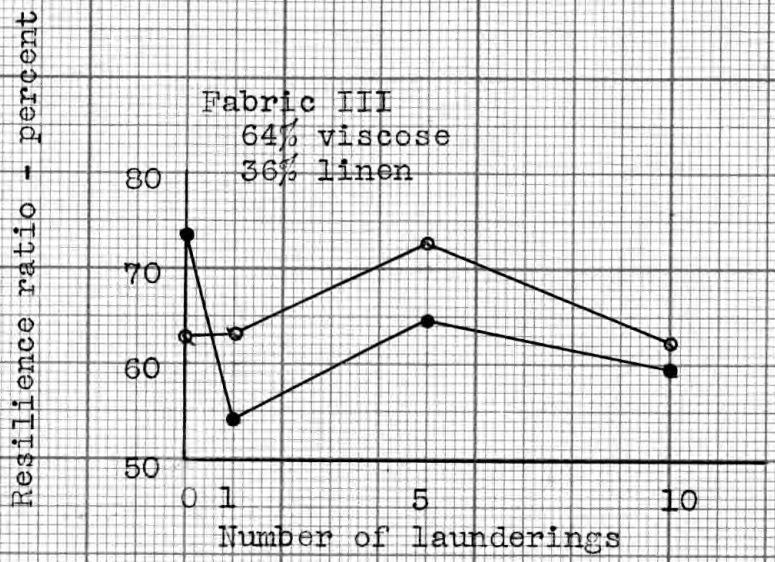


Fig. 3. Resilience for fabric III on controls and after one, five, and ten launderings.

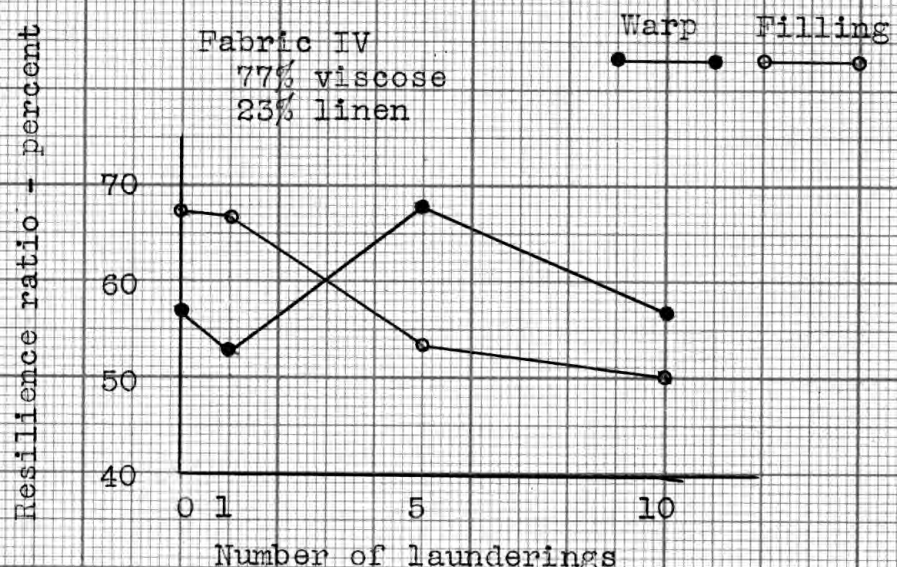


Fig. 4. Resilience for fabric IV on controls and after one, five, and ten launderings.

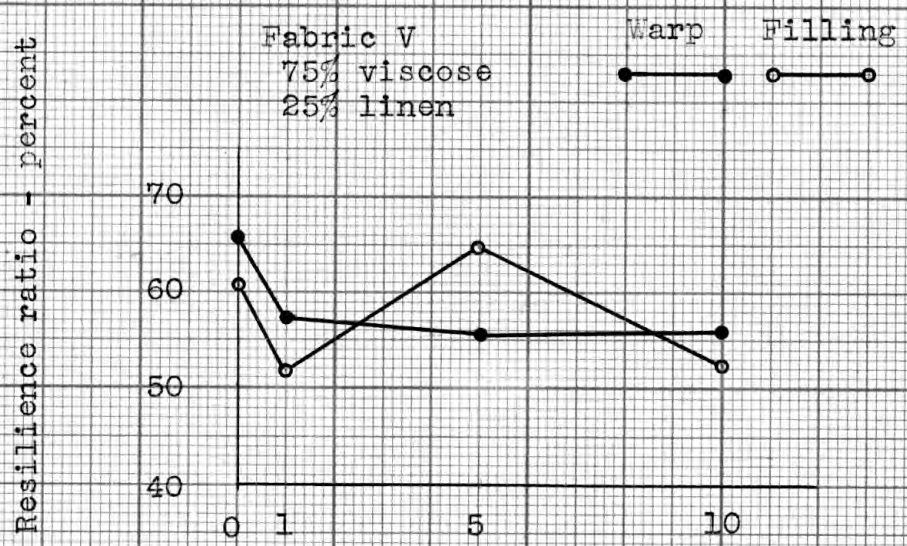


Fig. 5. Resilience for fabric V on controls and after one, five, and ten launderings.

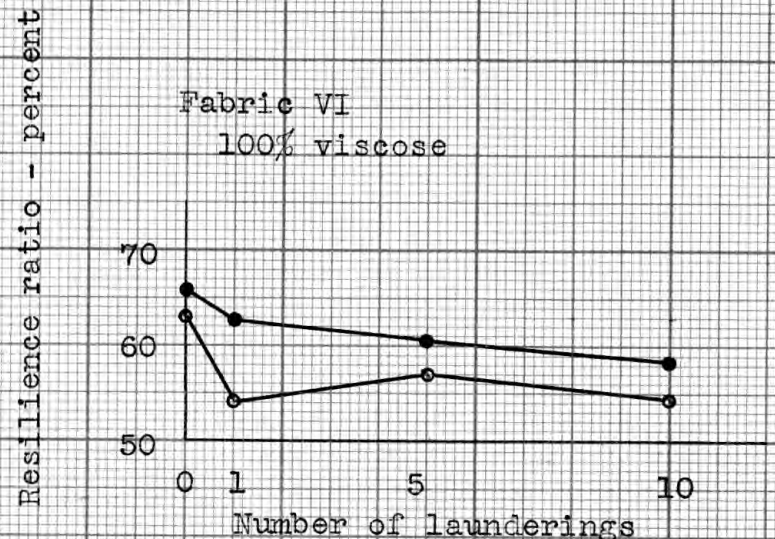


Fig. 6. Resilience for fabric VI on controls and after one, five, and ten launderings.

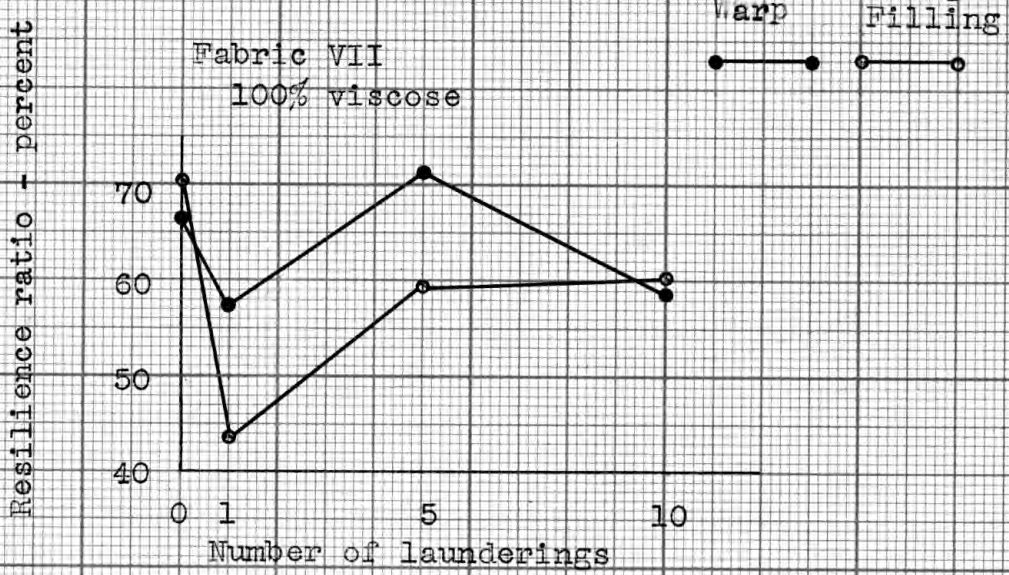


Fig. 7. Resilience for fabric VII on controls and after one, five, and ten launderings.

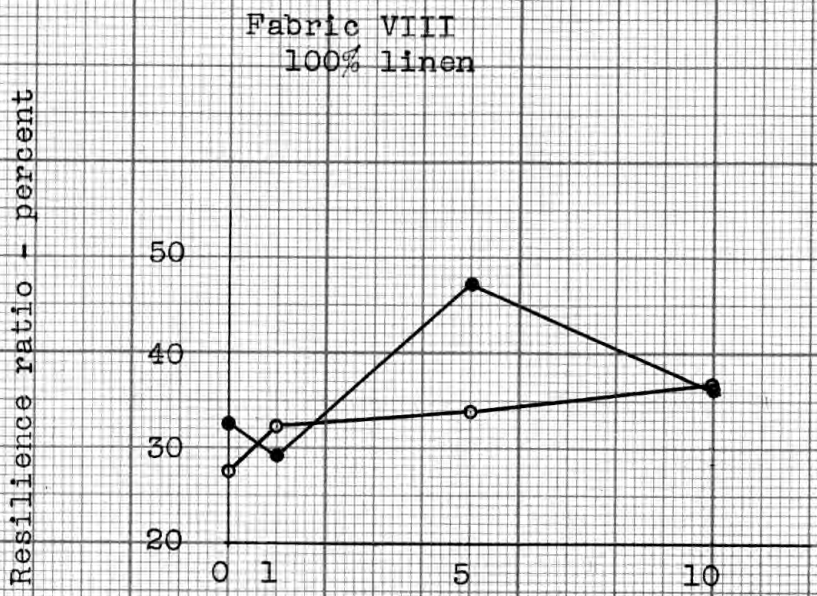


Fig. 8. Resiliemce for fabric VIII on controls and after one, five, and ten launderings.

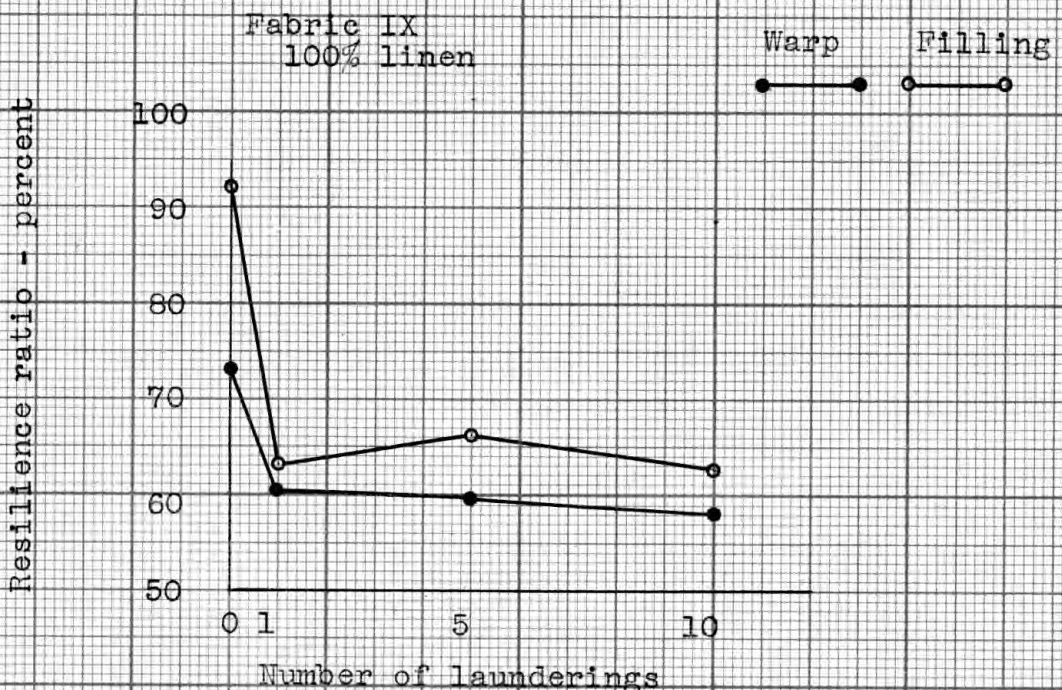


Fig. 9. Resilience for fabric IX on controls and after one, five, and ten launderings.

linen fabric VIII lost resilience upon being laundered. The increase of resilience in the above two fabrics was very slight.

Table 3 shows the breaking strengths of dry, wet, and abraded samples on controls and after one, five, and ten launderings. Since it was difficult to visualize and compare the data obtained in tabular form, graphs (Figs. 10 to 18) were prepared to show the trends of breaking strength.

The breaking strength was corrected for shrinkage by multiplying the breaking strength of the sample by the thread count of the control and dividing by the thread count of the sample. The percentage of breaking strength was then determined by dividing the corrected breaking strength of the sample by the breaking strength of the control and multiplying by 100.

The 100 percent viscose and the mixture fabrics were strongest when dry but decreased in strength upon being laundered. These fabrics also decreased in strength when wet and after abrasion. The wet breaking strength of the mixtures is comparable to the breaking strength of the 100 percent viscose; thus, it would seem that there was not enough linen in the mixture to affect the wet breaking

Table 3. Thread count and breaking strength of dry, wet, and abraded fabrics for controls and after one, five, and ten launderings for certain all rayon, all linen, and rayon and linen mixture fabrics.

| Fabric | Number of launderings | Warp thread count: before abrasion | Warp thread count: after abrasion | Breaking strength of warp: Pounds: dry | Pounds: wet | Pounds: after abrasion | Pounds corrected: dry | Pounds corrected: wet | Pounds corrected: after abrasion | Percent of control: dry | Percent of control: wet | Percent of control: after abrasion |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | 0 | 51 | 52 | 36.8±0.4 | 21.3±0.3 | 17.6±0.9 | 36.8 | 21.3 | 17.3 | 100.0 | 57.8 | 47.0 |
| | 1 | 58 | 56 | 30.2±0.2 | 16.4±0.2 | 16.8±0.6 | 26.6 | 14.4 | 15.3 | 72.3 | 39.2 | 41.6 |
| | 5 | 60 | 58 | 25.4±0.2 | 11.3±0.4 | 16.6±0.6 | 21.6 | 9.6 | 14.6 | 58.6 | 26.1 | 39.7 |
| | 10 | 60 | 58 | 14.7±0.8 | 9.1±0.1 | 17.5±1.2 | 12.5 | 7.7 | 15.4 | 34.0 | 20.9 | 41.8 |
| II | 0 | 50 | 52 | 35.8±0.3 | 24.1±0.3 | 5.0±0.6 | 35.8 | 24.1 | 4.8 | 100.0 | 67.3 | 13.2 |
| | 1 | 50 | 51 | 31.1±0.5 | 20.4±0.5 | 7.8±1.2 | 31.1 | 20.4 | 7.6 | 86.8 | 57.0 | 21.2 |
| | 5 | 51 | 62 | 31.1±0.8 | 17.4±0.5 | 8.2±0.5 | 30.5 | 16.9 | 6.6 | 85.3 | 47.5 | 18.4 |
| | 10 | 52 | 51 | 21.0±0.5 | 11.3±0.3 | 10.4±1.0 | 20.3 | 13.3 | 10.1 | 56.7 | 37.2 | 28.2 |
| III | 0 | 33 | 33 | 30.7±0.3 | 22.1±0.1 | 11.7±0.7 | 30.7 | 22.1 | 11.7 | 100.0 | 72.0 | 37.9 |
| | 1 | 39 | 37 | 30.9±0.4 | 20.3±0.9 | 13.4±0.9 | 26.2 | 17.2 | 11.9 | 85.3 | 56.0 | 38.8 |
| | 5 | 40 | 37 | 27.6±0.5 | 21.9±0.5 | 19.9±0.7 | 22.7 | 18.1 | 17.7 | 74.0 | 58.9 | 57.6 |
| | 10 | 41 | 37 | 22.9±0.7 | 20.7±0.5 | 14.4±1.4 | 18.5 | 16.7 | 12.8 | 60.2 | 54.5 | 41.7 |
| IV | 0 | 56 | 56 | 32.8±0.6 | 21.0±0.6 | 34.5±0.3 | 32.8 | 21.0 | 34.5 | 100.0 | 64.2 | 105.2 |
| | 1 | 58 | 57 | 31.1±0.7 | 19.4±0.6 | 14.4±0.4 | 30.1 | 18.7 | 14.1 | 91.8 | 57.2 | 43.1 |
| | 5 | 61 | 58 | 21.7±0.7 | 14.6±0.4 | 29.1±0.7 | 19.9 | 13.4 | 28.1 | 60.6 | 40.8 | 85.6 |
| | 10 | 58 | 56 | 20.6±0.6 | 14.9±0.2 | 15.3±0.4 | 19.9 | 14.4 | 15.3 | 60.6 | 43.9 | 46.7 |
| V | 0 | 40 | 40 | 28.2±0.3 | 17.8±0.5 | 11.3±0.9 | 28.2 | 17.8 | 11.3 | 100.0 | 63.2 | 40.1 |
| | 1 | 45 | 45 | 29.0±0.5 | 17.6±0.5 | 6.8±1.0 | 25.8 | 15.6 | 6.1 | 91.6 | 55.4 | 21.6 |
| | 5 | 48 | 48 | 24.4±0.4 | 14.8±0.5 | 5.8±0.4 | 20.3 | 12.3 | 4.8 | 72.2 | 43.7 | 17.0 |
| | 10 | 47 | 47 | 17.1±0.1 | 9.5±0.7 | 8.8±0.5 | 14.5 | 8.1 | 7.5 | 51.5 | 28.7 | 26.5 |

Table 3. (cont.)

| Fabric | Number of launderings | Warp thread count: before abrasion | Warp thread count: after abrasion | Breaking strength of warp: Pounds: dry | Pounds: wet | Pounds: after abrasion | Pounds corrected: dry | Pounds corrected: wet | Pounds corrected: after abrasion | Percent of control: dry | Percent of control: wet | Percent of control: after abrasion |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VI | 0 | 60 | 61 | 36.2±0.9 | 18.3±0.3 | 16.8±0.8 | 36.2 | 18.3 | 16.5 | 100.0 | 50.6 | 45.6 |
| | 1 | 61 | 62 | 35.2±0.8 | 15.5±0.4 | 22.6±1.3 | 34.6 | 15.2 | 21.8 | 95.6 | 42.0 | 60.3 |
| | 5 | 62 | 61 | 29.8±0.9 | 16.2±0.3 | 13.9±1.1 | 28.8 | 15.6 | 13.7 | 79.5 | 43.1 | 37.9 |
| | 10 | 61 | 61 | 24.0±0.7 | 10.4±0.3 | 17.5±1.2 | 23.6 | 10.2 | 17.3 | 65.2 | 28.2 | 46.5 |
| VII | 0 | 46 | 46 | 31.3±0.4 | 18.2±0.4 | 34.4±0.7 | 31.3 | 18.2 | 34.4 | 100.0 | 58.2 | 109.9 |
| | 1 | 46 | 46 | 36.2±0.3 | 14.3±0.4 | 18.9±1.1 | 36.2 | 14.3 | 18.9 | 115.3 | 45.7 | 60.3 |
| | 5 | 49 | 49 | 28.4±0.9 | 12.3±0.3 | 14.9±0.8 | 26.7 | 11.5 | 14.0 | 85.3 | 36.8 | 44.7 |
| | 10 | 47 | 46 | 24.7±0.5 | 14.3±0.3 | 16.5±0.8 | 24.2 | 14.0 | 16.5 | 77.3 | 44.7 | 52.7 |
| VIII | 0 | 41 | 41 | 56.3±1.8 | 62.3±3.9 | 11.5±0.7 | 56.3 | 62.3 | 11.5 | 100.0 | 110.5 | 20.4 |
| | 1 | 43 | 44 | 54.0±1.2 | 65.6±2.3 | 10.1±1.0 | 51.5 | 62.5 | 9.4 | 91.5 | 111.0 | 16.7 |
| | 5 | 44 | 42 | 50.5±2.2 | 56.8±0.8 | 10.2±0.4 | 47.1 | 52.9 | 9.9 | 83.7 | 94.0 | 17.6 |
| | 10 | 44 | 43 | 48.7±1.8 | 53.9±2.2 | 7.5±1.3 | 45.4 | 50.3 | 7.1 | 80.5 | 89.4 | 12.6 |
| IX | 0 | 36 | 36 | 49.0±1.1 | 63.3±0.9 | 18.0±0.2 | 49.0 | 63.3 | 18.0 | 100.0 | 129.1 | 36.7 |
| | 1 | 36 | 36 | 45.8±1.1 | 58.1±0.9 | 17.6±2.4 | 45.8 | 58.1 | 17.6 | 93.5 | 118.6 | 36.0 |
| | 5 | 36 | 36 | 49.2±0.9 | 59.6±1.3 | 18.7±1.0 | 49.2 | 59.5 | 18.7 | 100.3 | 121.6 | 38.0 |
| | 10 | 36 | 35 | 42.8±1.0 | 57.4±1.3 | 17.1±1.1 | 42.8 | 57.4 | 17.6 | 87.4 | 117.0 | 36.0 |

Table 3. (cont.)

| Fabric | Number of launderings | Filling thread count: before abrasion | Filling thread count: after abrasion | Breaking strength of filling: Pounds: dry | Pounds: wet | Pounds: after abrasion | Pounds corrected: dry | Pounds corrected: wet | Pounds corrected: after abrasion | Percent of control: dry | Percent of control: wet | Percent of control: after abrasion |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | 0 | 74 | 75 | 30.8±0.4 | 18.7±0.2 | 15.7±0.3 | 30.8 | 18.7 | 15.5 | 100.0 | 61.4 | 50.4 |
| | 1 | 73 | 72 | 28.8±0.7 | 19.2±0.8 | 6.3±0.9 | 29.2 | 19.5 | 6.5 | 94.8 | 63.3 | 21.1 |
| | 5 | 72 | 71 | 32.1±0.6 | 20.4±0.4 | 12.1±0.7 | 32.9 | 20.9 | 12.6 | 103.5 | 67.9 | 40.8 |
| | 10 | 73 | 72 | 20.9±0.5 | 16.7±0.3 | 5.3±0.6 | 21.2 | 16.9 | 5.5 | 69.0 | 54.8 | 17.8 |
| II | 0 | 63 | 64 | 27.3±0.7 | 17.9±0.3 | 16.9±0.8 | 27.3 | 17.9 | 16.6 | 100.0 | 65.5 | 60.1 |
| | 1 | 63 | 64 | 23.2±0.5 | 13.6±0.3 | 13.4±0.9 | 23.2 | 13.6 | 13.1 | 85.0 | 49.9 | 47.9 |
| | 5 | 61 | 62 | 24.2±0.7 | 14.0±0.4 | 16.5±0.8 | 25.4 | 14.4 | 16.8 | 93.1 | 52.7 | 61.6 |
| | 10 | 63 | 58 | 19.2±0.6 | 9.9±0.4 | 16.7±0.5 | 19.2 | 9.9 | 18.1 | 70.4 | 36.3 | 66.3 |
| III | 0 | 36 | 37 | 27.8±0.1 | 19.5±0.4 | 18.3±0.9 | 27.8 | 19.5 | 17.8 | 100.0 | 70.1 | 64.0 |
| | 1 | 41 | 37 | 29.3±0.5 | 19.3±0.4 | 18.2±0.5 | 25.8 | 16.9 | 17.7 | 92.9 | 60.8 | 63.8 |
| | 5 | 41 | 37 | 28.6±0.8 | 22.3±0.5 | 16.9±0.5 | 25.2 | 19.6 | 16.4 | 90.8 | 70.5 | 59.0 |
| | 10 | 42 | 39 | 23.9±0.5 | 22.4±0.6 | 15.5±0.6 | 20.4 | 19.2 | 13.2 | 73.4 | 69.3 | 47.5 |
| IV | 0 | 60 | 60 | 31.2±0.8 | 17.8±0.4 | 29.1±0.6 | 31.2 | 17.8 | 29.1 | 100.0 | 57.0 | 93.3 |
| | 1 | 61 | 58 | 34.9±0.4 | 19.1±0.5 | 16.8±0.5 | 34.3 | 18.8 | 17.4 | 110.0 | 60.3 | 55.8 |
| | 5 | 59 | 58 | 27.6±0.7 | 15.2±0.3 | 28.9±0.6 | 28.1 | 15.5 | 29.9 | 90.1 | 49.4 | 95.8 |
| | 10 | 59 | 58 | 22.6±0.5 | 15.6±0.3 | 16.4±0.9 | 22.9 | 15.8 | 16.9 | 73.4 | 50.6 | 54.3 |
| V | 0 | 52 | 53 | 21.3±0.3 | 13.0±0.2 | 15.3±0.6 | 21.3 | 13.0 | 15.0 | 100.0 | 61.0 | 70.4 |
| | 1 | 54 | 53 | 22.5±0.3 | 12.9±0.5 | 20.8±0.9 | 21.6 | 12.4 | 20.4 | 101.2 | 58.3 | 95.7 |
| | 5 | 52 | 53 | 19.2±0.6 | 11.1±0.5 | 11.5±0.6 | 19.2 | 11.1 | 11.3 | 90.3 | 52.2 | 53.1 |
| | 10 | 53 | 53 | 12.3±0.2 | 7.5±0.3 | 9.9±0.6 | 12.1 | 7.4 | 9.7 | 56.8 | 34.7 | 45.5 |

Table 3. (cont.)

| Fabric | Number of launderings | Filling thread count: before abrasion | Filling thread count: after abrasion | Breaking strength of filling: Pounds: dry | Pounds: wet | Pounds: after abrasion | Pounds corrected: dry | Pounds corrected: wet | Pounds corrected: after abrasion | Percent of control: dry | Percent of control: wet | Percent of control: after abrasion |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VI | 0 | 64 | 64 | 34.3±0.7 | 16.3±0.3 | 17.8±1.1 | 34.3 | 16.3 | 17.8 | 100.0 | 47.5 | 51.8 |
| | 1 | 67 | 69 | 33.4±0.8 | 16.3±0.3 | 11.6±0.6 | 31.9 | 15.6 | 10.8 | 93.0 | 45.5 | 31.6 |
| | 5 | 67 | 67 | 31.0±0.8 | 14.7±0.7 | 15.8±1.2 | 29.6 | 14.0 | 15.1 | 86.5 | 40.8 | 44.0 |
| | 10 | 67 | 67 | 24.2±1.0 | 13.1±0.3 | 16.7±1.4 | 23.1 | 12.5 | 15.9 | 67.4 | 36.5 | 46.4 |
| VII | 0 | 59 | 59 | 23.6±1.1 | 16.1±0.4 | 13.9±0.9 | 23.6 | 16.1 | 13.9 | 100.0 | 68.2 | 58.8 |
| | 1 | 58 | 57 | 30.2±0.8 | 11.9±0.9 | 10.4±0.3 | 30.7 | 12.1 | 10.8 | 130.0 | 51.3 | 45.3 |
| | 5 | 57 | 57 | 26.9±0.6 | 11.9±0.3 | 13.1±0.7 | 27.8 | 12.3 | 13.5 | 117.8 | 52.2 | 57.2 |
| | 10 | 58 | 57 | 27.9±0.6 | 10.9±0.3 | 11.5±0.6 | 28.3 | 11.1 | [illegible] | 120.0 | 47.1 | 50.4 |
| VIII | 0 | 50 | 49 | 41.5±0.9 | 44.6±1.3 | 11.8±1.9 | 41.5 | 44.6 | 12.0 | 100.0 | 107.5 | 28.9 |
| | 1 | 50 | 48 | 39.8±1.0 | 48.1±1.5 | 13.4±1.1 | 39.8 | 48.1 | 13.9 | 95.9 | 116.0 | 33.5 |
| | 5 | 50 | 48 | 40.8±1.1 | 43.6±0.9 | 20.3±1.7 | 40.8 | 43.6 | 21.1 | 98.5 | 105.1 | 51.1 |
| | 10 | 50 | 48 | 36.6±1.5 | 37.9±1.5 | 15.5±1.5 | 36.6 | 37.9 | 16.1 | 88.3 | 91.4 | 38.9 |
| IX | 0 | 40 | 41 | 29.8±1.0 | 35.2±0.8 | 26.1±0.2 | 29.8 | 35.2 | 25.4 | 100.0 | 118.1 | 85.2 |
| | 1 | 41 | 43 | 29.9±0.6 | 32.8±1.1 | 13.9±1.1 | 29.2 | 32.0 | 12.9 | 98.2 | 107.4 | 43.3 |
| | 5 | 42 | 41 | 29.8±0.9 | 36.5±0.8 | 16.8±0.2 | 28.4 | 34.7 | 16.4 | 94.4 | 116.3 | 55.0 |
| | 10 | 42 | 41 | 19.7±1.3 | 32.0±0.9 | 16.7±1.9 | 18.8 | 30.4 | 16.2 | 63.2 | 102.0 | 54.3 |

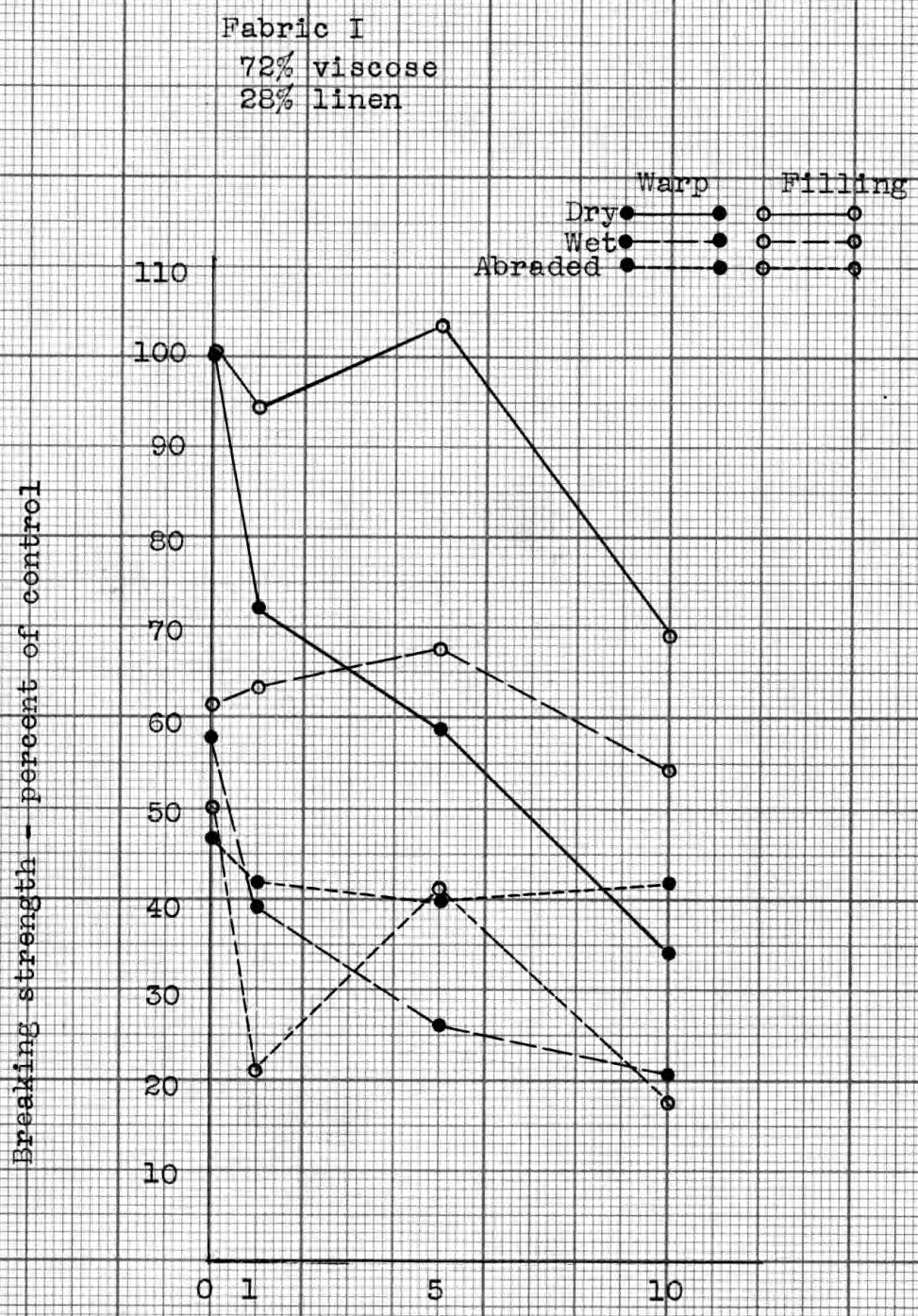


Fig. 10. Breaking strength in percent of control for dry, wet, and abraded samples of fabric I on controls and after one, five, and ten launderings.

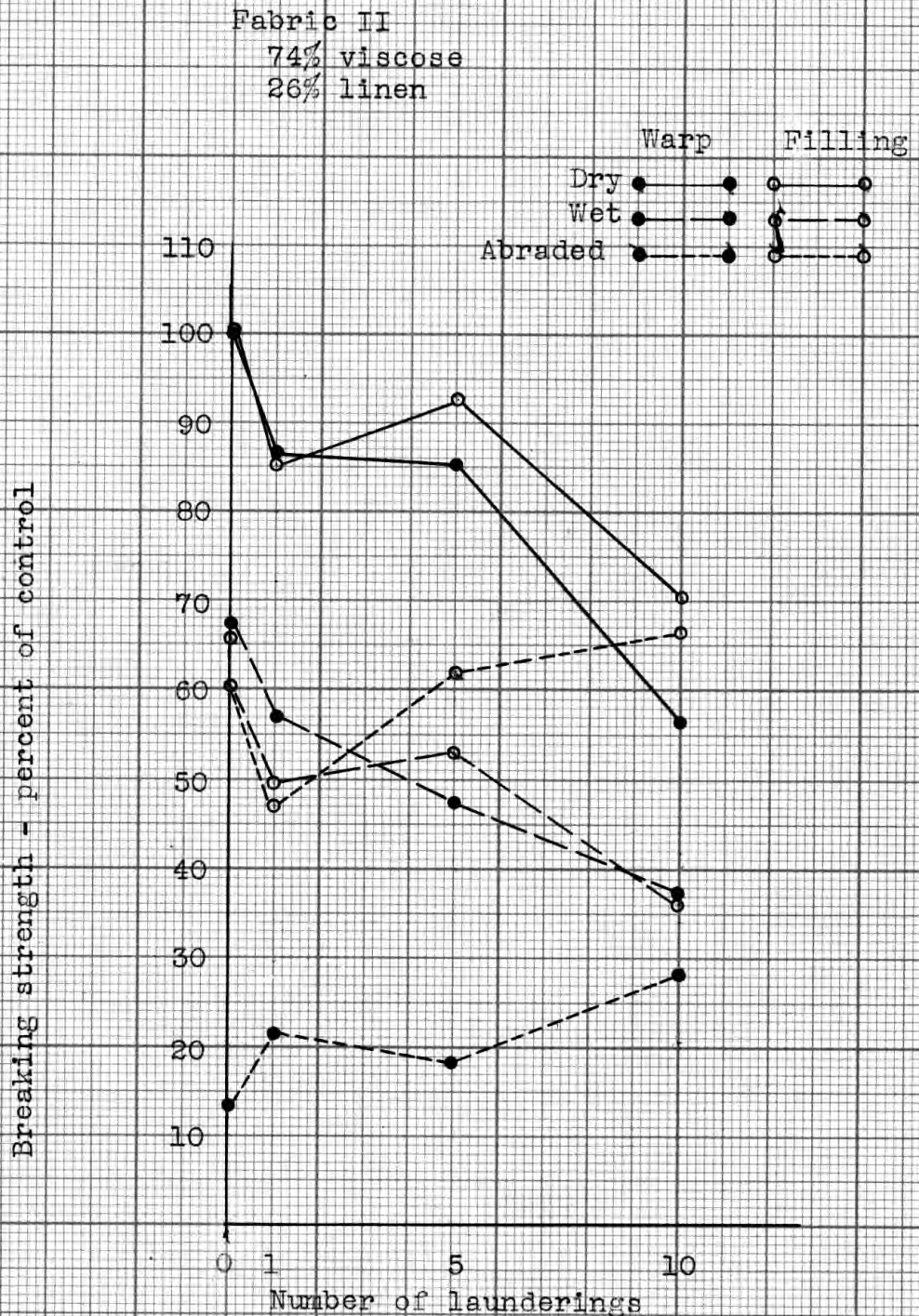


Fig. 11. Breaking strength in percent of control for dry, wet, and abraded samples of fabric II on controls and after one, five, and ten launderings.

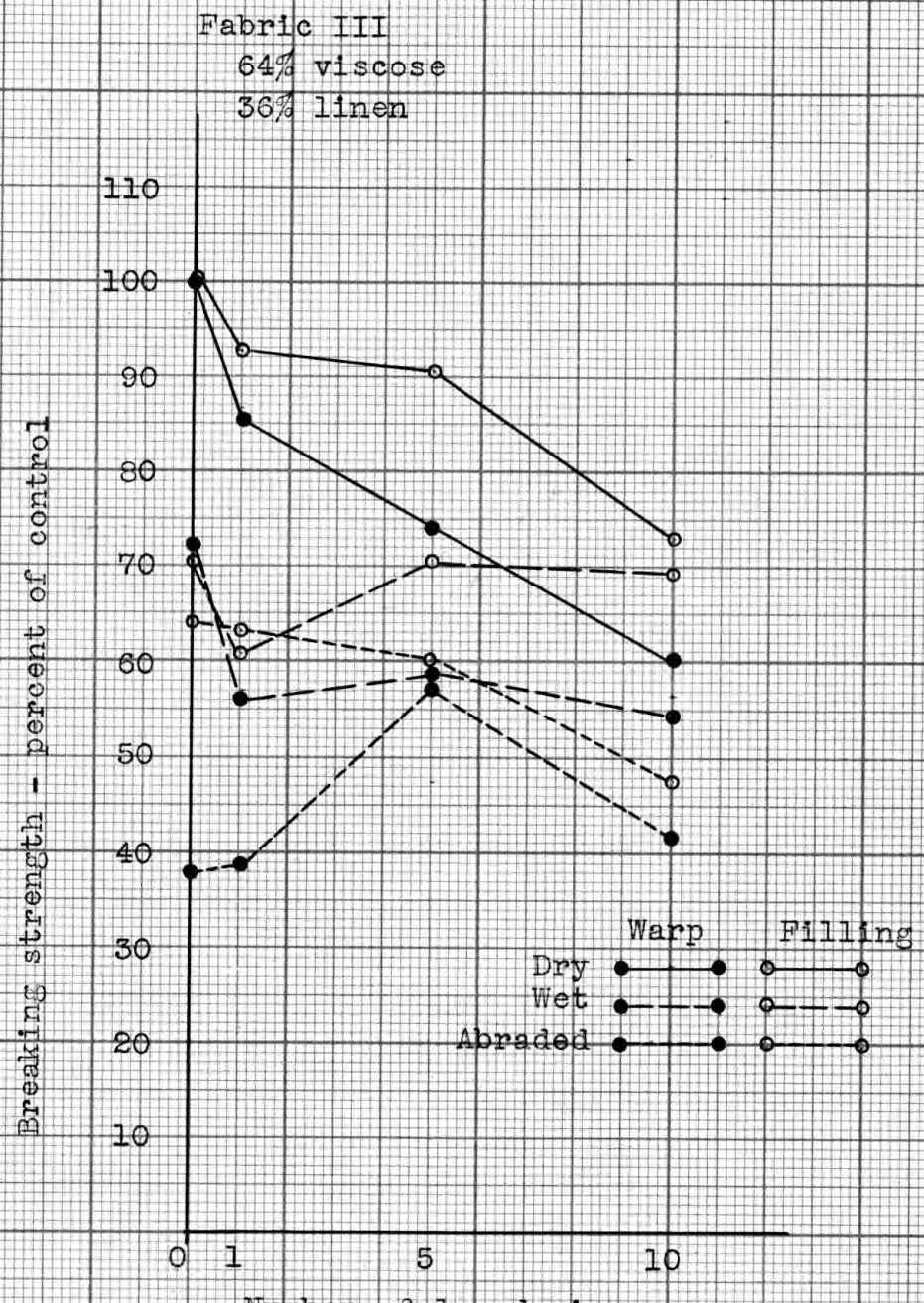


Fig. 12. Breaking strength in percent of control for dry, wet, and abraded samples of fabric III on controls and after one, five, and ten launderings.

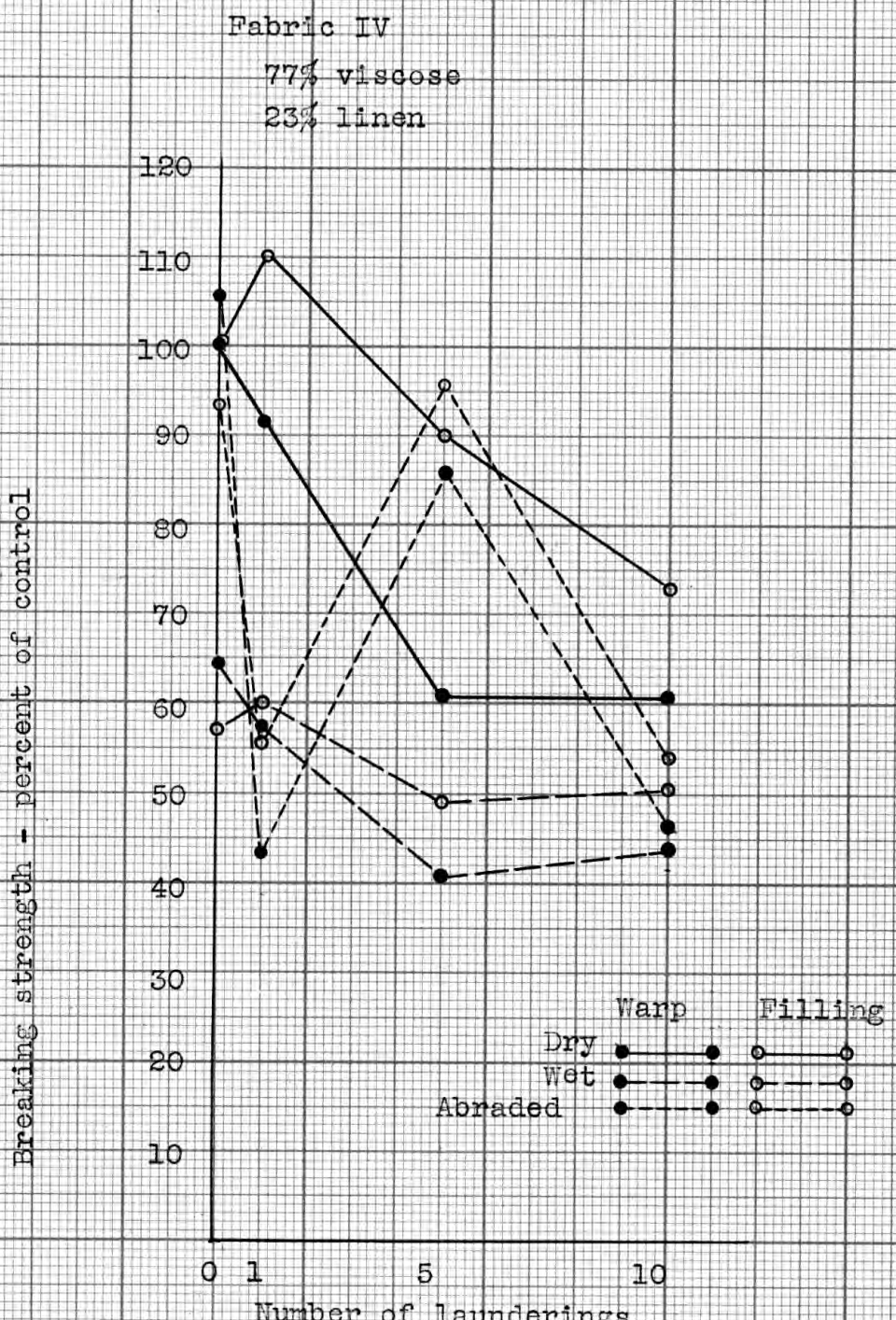


Fig. 13. Breaking strength in percent of control for dry, wet, and abraded samples of fabric IV on controls and after one, five, and ten launderings.

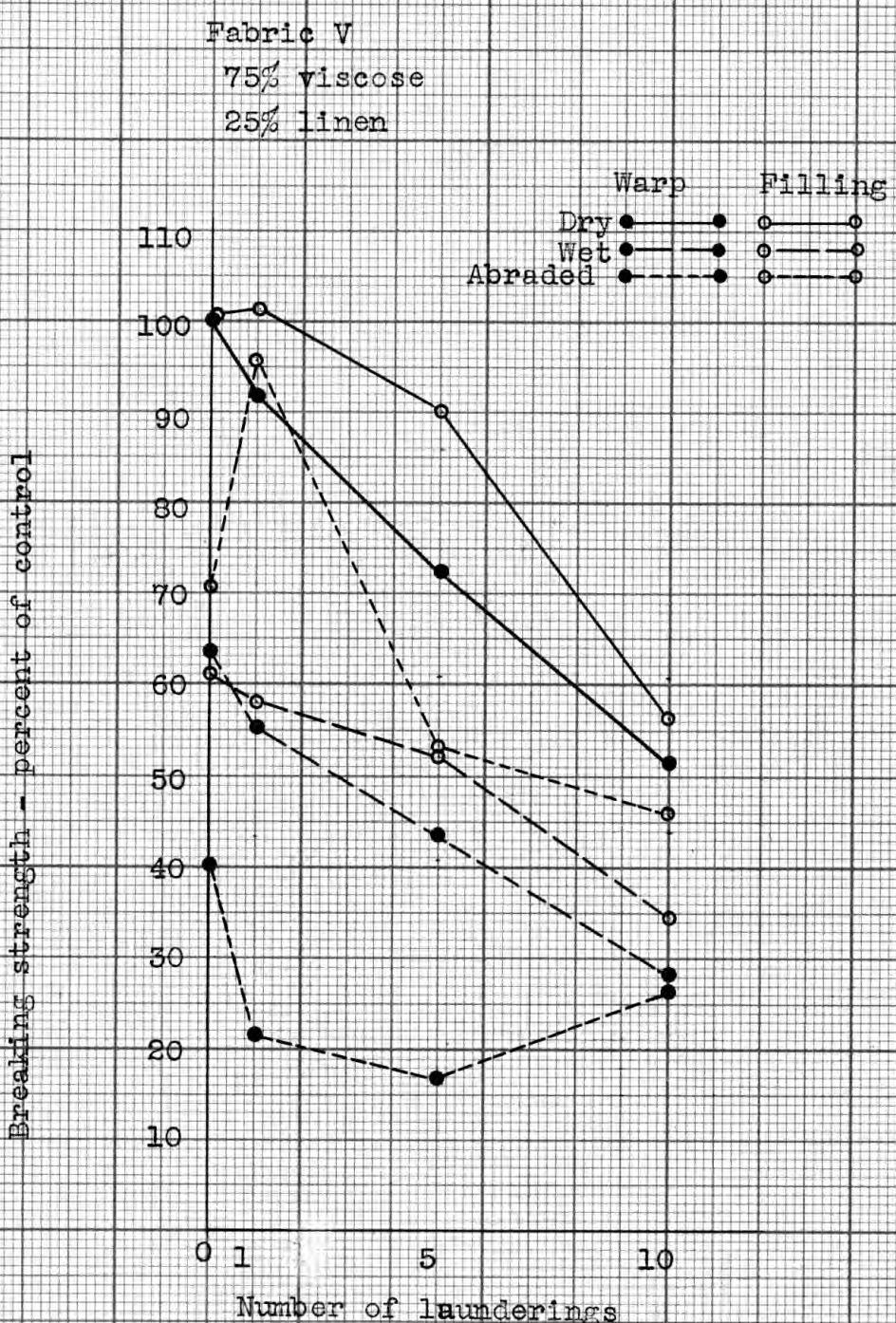


Fig. 14. Breaking strength in percent of control for dry, wet, and abraded samples of fabric V on controls and after one, five, and ten launderings.

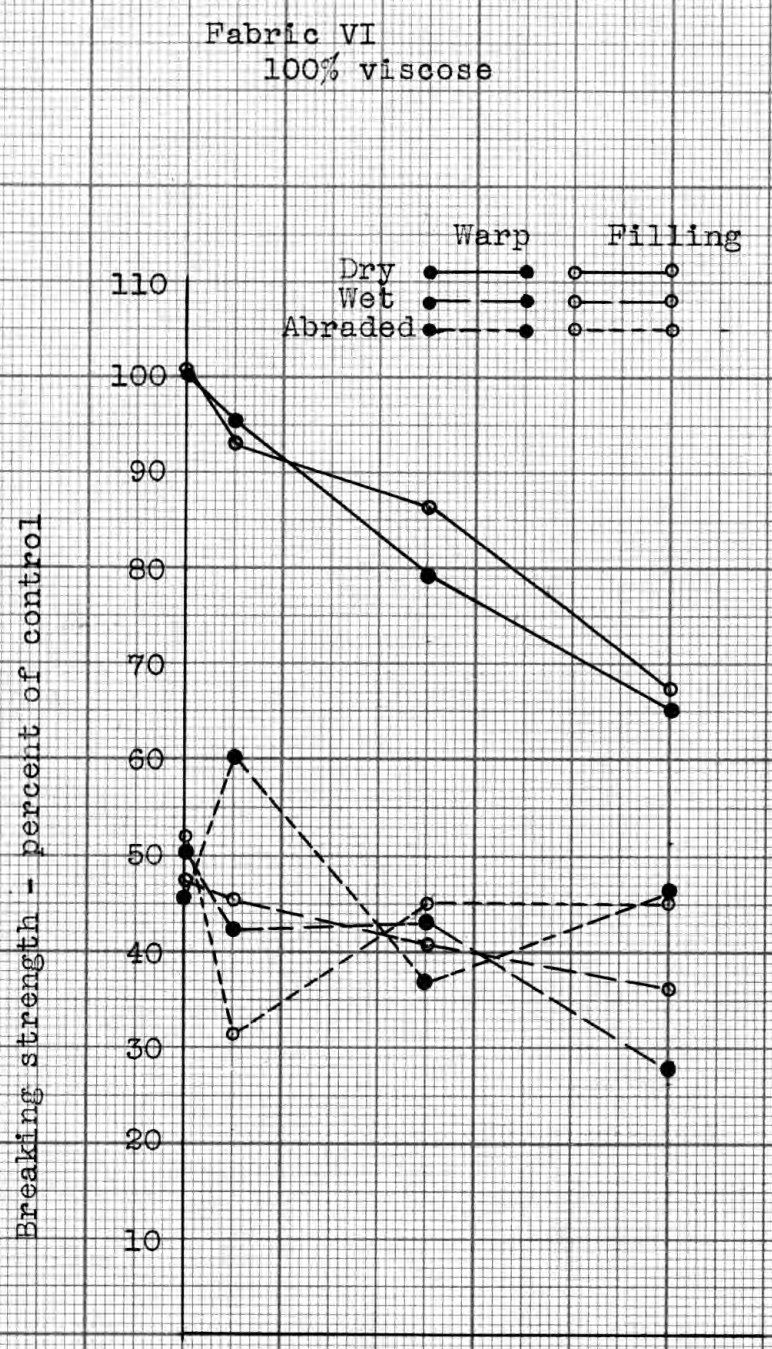


Fig. 15. Breaking strength in percent of control for dry, wet, and abraded samples of fabric VI on controls and after one, five, and ten launderings.

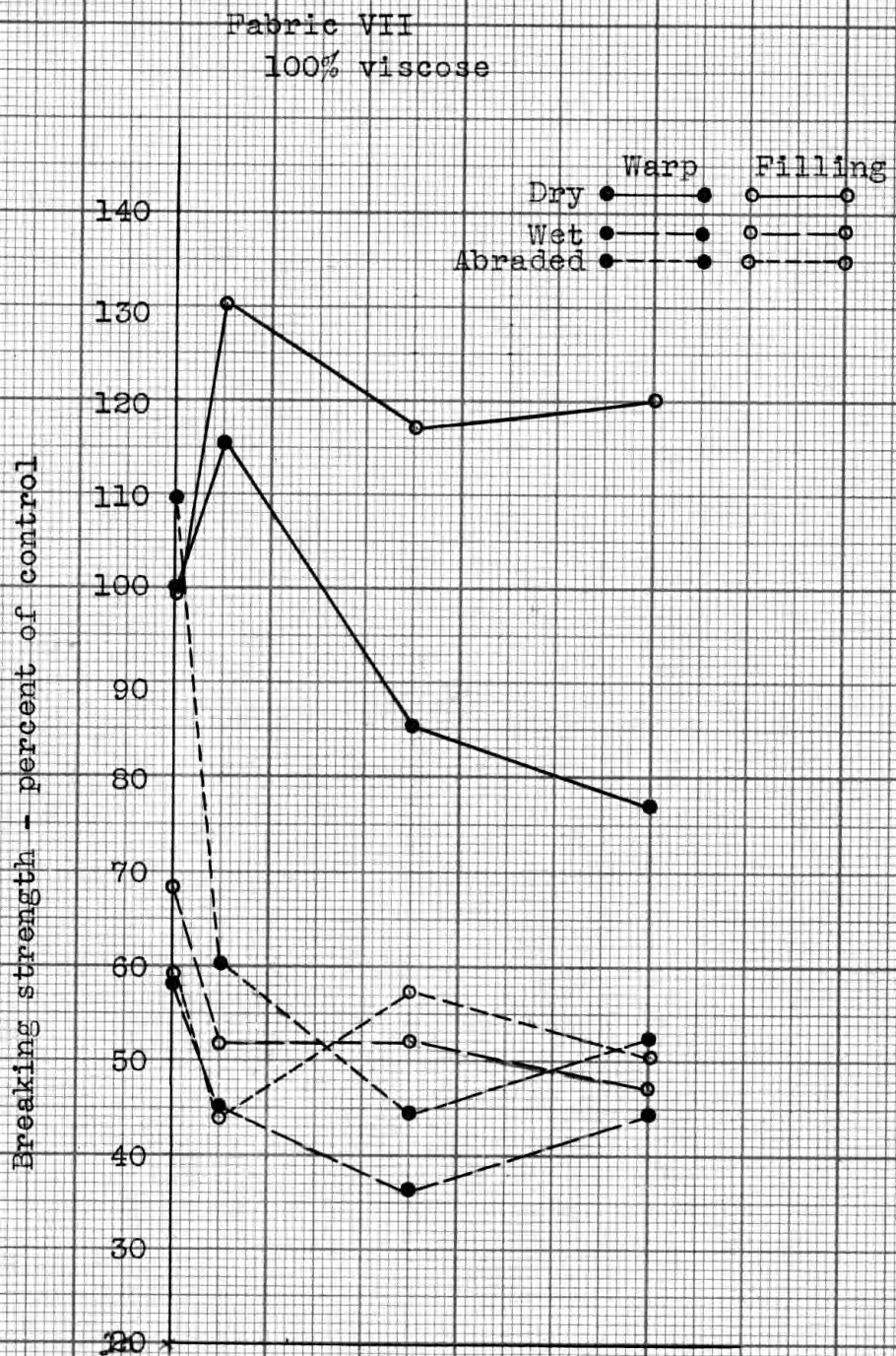


Fig. 16. Breaking strength in percent of control for dry, wet, and abraded samples of fabric VII on controls and after one, five, and ten launderings.

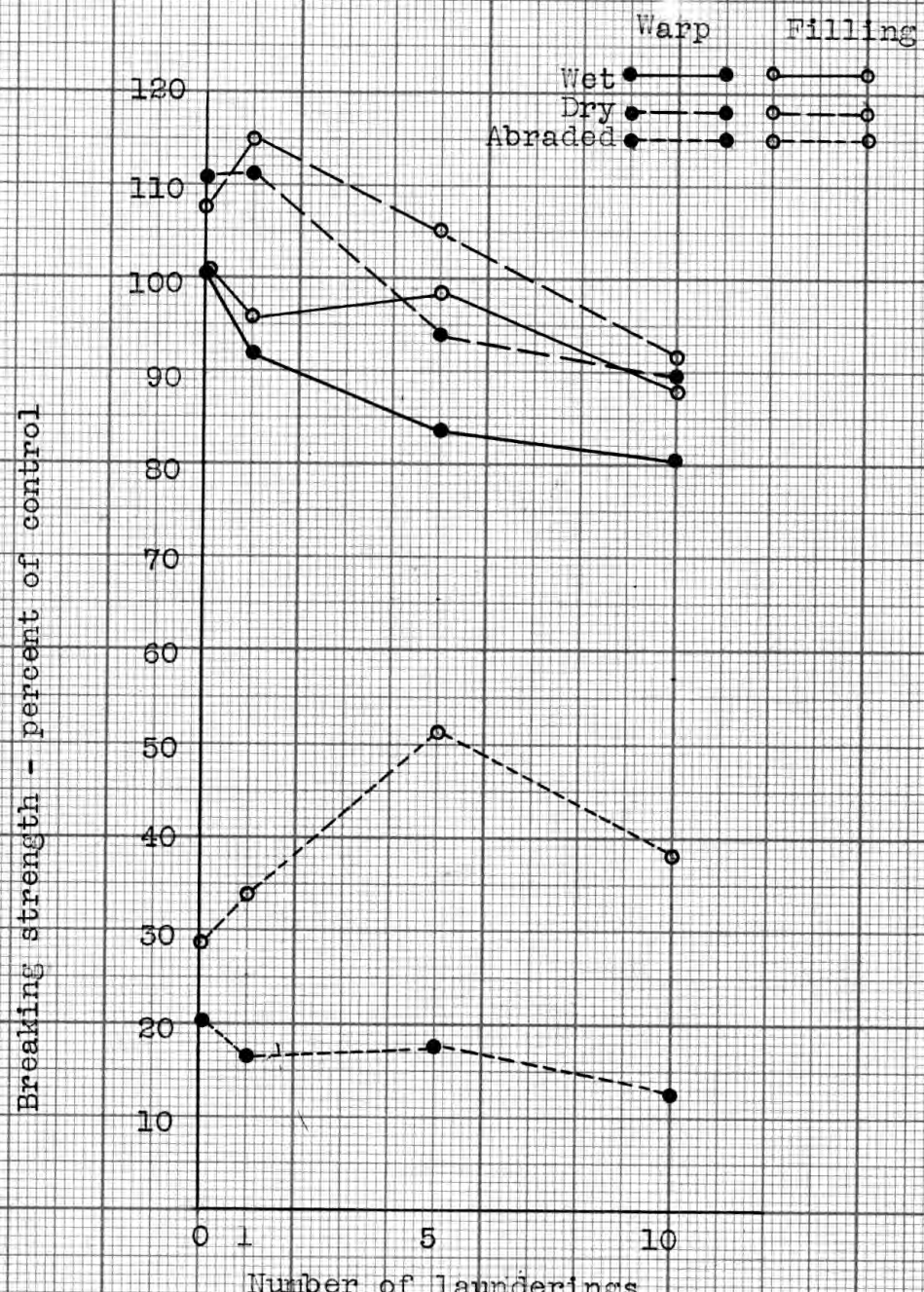


Fig. 17. Breaking strength in percent of control for dry, wet, and abraded samples of fabric VIII on controls and after one, five, and ten launderings.

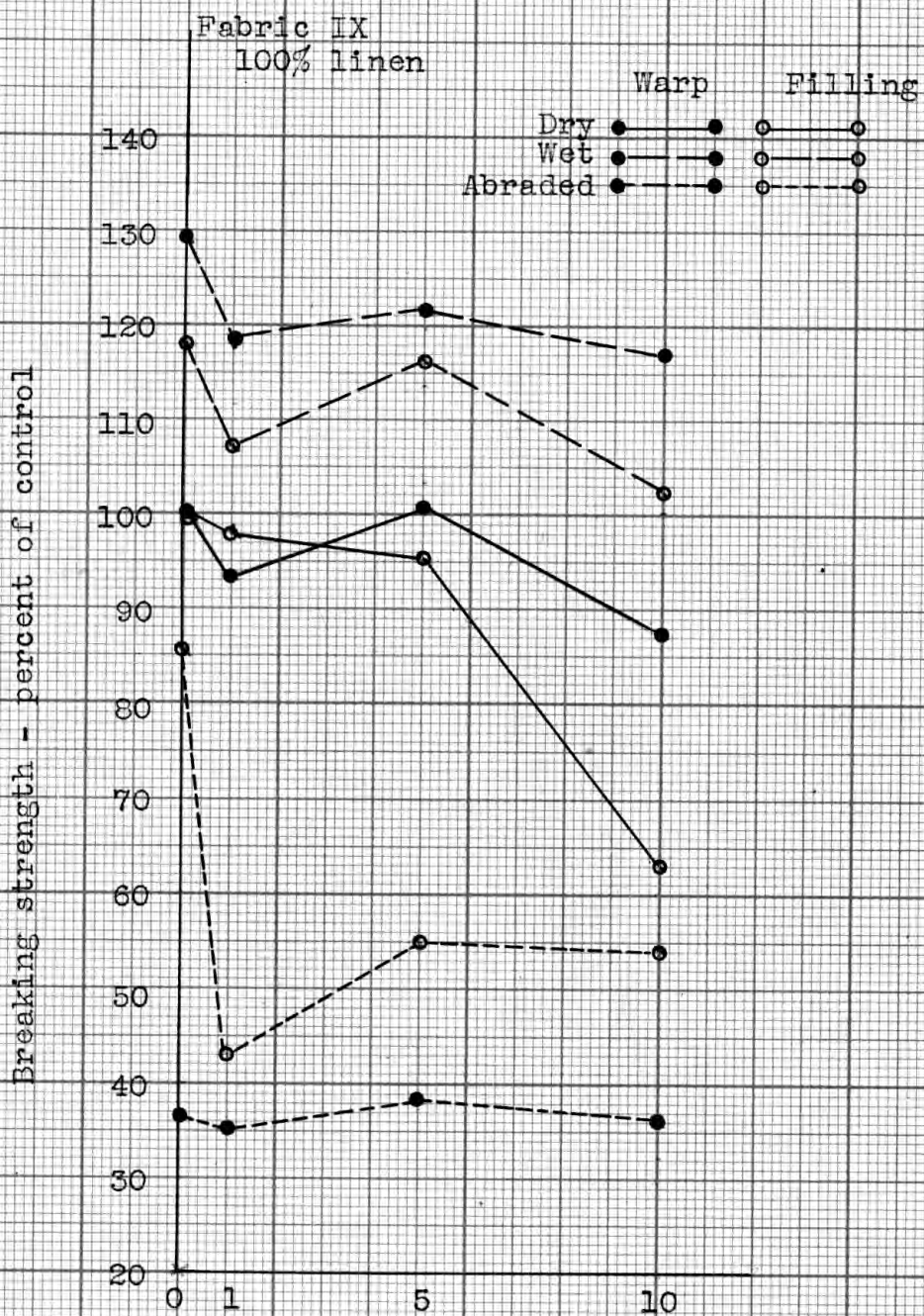


Fig. 18. Breaking strength in percent of control for dry, wet, and abraded samples of fabric IX on controls and after one, five, and ten launderings.

strength. The 100 percent linens were strongest when wet and decreased in strength very little with laundering. This agrees with the findings of Furry (4) who decided that linens increased in strength upon laundering. Abrasion decreased the strength of the two linens, having affected the warp more than the filling.

The elongation of dry, wet, and abraded samples for controls and after one, five, and ten launderings are shown in Table 4. The percentage of elongation was found by dividing the elongation in inches by the three-inch gauge length and multiplying by 100.

Graphs (Figs. 19 to 27) were prepared to show the relation of the percentage of elongation to the number of launderings. Abrasion decreased the elongation of all the fabrics, but repeated launderings had little effect upon the elongation. The mixture fabrics and the all linen fabrics had about the same percentage of elongation for both wet and dry samples. The 100 percent viscose fabrics had higher percentages of elongation when dry than when wet. Laundering, in general, had little effect upon the elongation of any of these fabrics.

With the exception of fabric III, which is a mixture of rayon and linen, laundering had little effect upon the

Table 4. Elongation of dry, wet, and abraded fabrics for controls and after one, five, and ten launderings for certain all rayon, all linen, and rayon and linen mixture fabrics.

| Fabric | Number of launderings | Warp elongation | | | | | | Filling elongation | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Dry | | Wet | | After abrasion | | Dry | | Wet | | After abrasion | |
| | | inches | percent | inches | percent | inches | percent | inches | percent | inches | percent | inches | percent |
| I | 0 | 0.49±0.01 | 16.3 | 0.62±0.01 | 20.6 | 0.29±0.00 | 9.7 | 0.50±0.01 | 16.6 | 0.47±0.01 | 15.7 | 0.09±0.00 | 3.0 |
| | 1 | 0.60±0.02 | 20.0 | 0.48±0.01 | 16.0 | 0.13±0.00 | 4.3 | 0.47±0.01 | 15.7 | 0.38±0.01 | 12.7 | 0.11±0.00 | 3.7 |
| | 5 | 0.52±0.01 | 17.3 | 0.41±0.02 | 13.7 | 0.10±0.00 | 3.3 | 0.34±0.01 | 11.3 | 0.28±0.01 | 9.3 | 0.17±0.01 | 5.7 |
| | 10 | 0.43±0.01 | 14.3 | 0.33±0.01 | 11.0 | 0.13±0.01 | 4.3 | 0.34±0.01 | 11.3 | 0.38±0.01 | 12.7 | 0.14±0.01 | 4.7 |
| II | 0 | 0.30±0.00 | 10.0 | 0.32±0.01 | 10.7 | 0.13±0.01 | 4.3 | 0.41±0.01 | 13.7 | 0.46±0.00 | 15.3 | 0.10±0.00 | 3.3 |
| | 1 | 0.30±0.00 | 10.0 | 0.30±0.01 | 10.0 | 0.25±0.00 | 8.3 | 0.39±0.01 | 13.0 | 0.32±0.01 | 10.7 | 0.23±0.00 | 7.7 |
| | 5 | 0.29±0.01 | 9.7 | 0.32±0.01 | 10.7 | 0.12±0.01 | 4.0 | 0.23±0.01 | 7.7 | 0.27±0.01 | 9.0 | 0.13±0.00 | 4.3 |
| | 10 | 0.23±0.00 | 7.7 | 0.33±0.01 | 11.0 | 0.09±0.00 | 3.0 | 0.28±0.01 | 9.3 | 0.27±0.02 | 9.0 | 0.12±0.01 | 4.0 |
| III | 0 | 0.28±0.01 | 9.3 | 0.57±0.01 | 19.0 | 0.27±0.01 | 9.0 | 0.64±0.00 | 21.3 | 0.61±0.02 | 20.3 | 0.13±0.01 | 4.3 |
| | 1 | 0.80±0.00 | 26.7 | 0.73±0.02 | 24.3 | 0.30±0.02 | 10.0 | 0.91±0.02 | 30.3 | 0.74±0.04 | 24.3 | 0.33±0.01 | 11.0 |
| | 5 | 0.56±0.02 | 18.6 | 0.80±0.01 | 26.7 | 0.44±0.01 | 14.7 | 0.62±0.01 | 20.7 | 0.90±0.02 | 30.0 | 0.43±0.01 | 14.3 |
| | 10 | 0.47±0.01 | 15.7 | 0.65±0.01 | 21.7 | 0.33±0.02 | 11.0 | 0.53±0.01 | 17.7 | 0.72±0.01 | 24.0 | 0.32±0.01 | 10.7 |
| IV | 0 | 0.23±0.01 | 7.7 | 0.17±0.02 | 5.7 | 0.25±0.00 | 8.3 | 0.39±0.01 | 13.0 | 0.37±0.02 | 12.3 | 0.40±0.01 | 13.3 |
| | 1 | 0.25±0.00 | 8.3 | 0.22±0.01 | 7.3 | 0.20±0.02 | 6.7 | 0.45±0.01 | 15.0 | 0.32±0.01 | 10.7 | 0.14±0.01 | 4.7 |
| | 5 | 0.30±0.01 | 10.0 | 0.24±0.01 | 8.0 | 0.25±0.00 | 8.3 | 0.34±0.01 | 11.7 | 0.29±0.01 | 9.7 | 0.34±0.01 | 11.3 |
| | 10 | 0.26±0.00 | 8.7 | 0.24±0.01 | 8.0 | 0.25±0.01 | 8.3 | 0.35±0.01 | 11.7 | 0.27±0.01 | 9.0 | 0.21±0.01 | 7.0 |

Table 4. (cont.)

| Fabric | Number of launderings | Warp elongation: Dry inches | Warp elongation: Dry percent | Warp elongation: Wet inches | Warp elongation: Wet percent | Warp elongation: After abrasion inches | Warp elongation: After abrasion percent | Filling elongation: Dry inches | Filling elongation: Dry percent | Filling elongation: Wet inches | Filling elongation: Wet percent | Filling elongation: After abrasion inches | Filling elongation: After abrasion percent |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| V | 0 | 0.33±0.01 | 11.0 | 0.38±0.01 | 12.7 | 0.17±0.01 | 4.3 6.7 | 0.43±0.01 | 14.3 | 0.40±0.01 | 13.3 | 0.17±0.01 | ~~4.3~~ 5.7 |
| | 1 | 0.35±0.00 | 11.7 | 0.33±0.01 | 11.0 | 0.16±0.01 | 4.0 5.3 | 0.46±0.01 | 15.3 | 0.31±0.01 | 10.3 | 0.26±0.01 | 8.7 |
| | 5 | 0.34±0.00 | 11.3 | 0.29±0.01 | 9.7 | 0.12±0.01 | 4.0 | 0.38±0.01 | 12.7 | 0.28±0.01 | 9.3 | 0.16±0.01 | 5.3 |
| | 10 | 0.31±0.01 | 10.3 | 0.23±0.01 | 7.7 | 0.16±0.01 | 5.3 | 0.31±0.01 | 10.3 | 0.21±0.01 | 7.0 | 0.18±0.01 | 6.0 |
| VI | 0 | 0.51±0.01 | 17.0 | 0.59±0.00 | 19.7 | 0.22±0.01 | 7.3 | 0.49±0.01 | 16.3 | 0.48±0.01 | 16.0 | 0.12±0.01 | 4.0 |
| | 1 | 0.60±0.01 | 20.0 | 0.49±0.01 | 16.3 | 0.29±0.01 | 9.7 | 0.59±0.01 | 19.7 | 0.46±0.01 | 15.3 | 0.22±0.01 | 7.3 |
| | 5 | 0.45±0.01 | 15.0 | 0.40±0.01 | 13.3 | 0.24±0.01 | 8.0 | 0.52±0.01 | 17.3 | 0.33±0.01 | 11.0 | 0.25±0.01 | 8.3 |
| | 10 | 0.36±0.01 | 12.0 | 0.27±0.01 | 9.0 | 0.21±0.02 | 7.0 | 0.42±0.01 | 14.0 | 0.29±0.01 | 9.7 | 0.20±0.02 | 6.7 |
| VII | 0 | 0.45±0.00 | 15.0 | 0.47±0.03 | 15.7 | 0.25±0.02 | 8.3 | 0.39±0.01 | 13.0 | 0.37±0.01 | 12.3 | 0.20±0.01 | 6.7 |
| | 1 | 0.51±0.00 | 17.0 | 0.35±0.01 | 11.7 | 0.25±0.03 | 8.3 | 0.40±0.02 | 13.3 | 0.32±0.01 | 10.7 | 0.12±0.01 | 4.0 |
| | 5 | 0.45±0.01 | 15.0 | 0.35±0.01 | 11.7 | 0.25±0.01 | 8.3 | 0.36±0.01 | 12.0 | 0.30±0.00 | 10.0 | 0.26±0.01 | 8.7 |
| | 10 | 0.43±0.01 | 14.3 | 0.39±0.01 | 13.0 | 0.29±0.01 | 9.7 | 0.39±0.01 | ~~12.7~~ 13.0 | 0.28±0.01 | 9.3 | 0.24±0.02 | 8.0 |
| VIII | 0 | 0.13±0.00 | 4.3 | 0.13±0.00 | 4.3 | 0.09±0.00 | 3.0 | 0.22±0.01 | 7.3 | 0.15±0.00 | 5.0 | 0.10±0.01 | 3.3 |
| | 1 | 0.19±0.01 | 6.3 | 0.20±0.01 | 6.7 | 0.12±0.01 | 4.0 | 0.16±0.00 | 5.3 | 0.17±0.00 | 5.7 | 0.09±0.00 | 3.0 |
| | 5 | 0.20±0.02 | 6.7 | 0.20±0.01 | 6.7 | 0.10±0.00 | 3.3 | 0.14±0.00 | 4.7 | 0.17±0.00 | 5.7 | 0.11±0.01 | 3.7 |
| | 10 | 0.15±0.00 | 5.0 | 0.16±0.00 | ~~4.0~~ 5.3 | 0.10±0.00 | 3.3 | 0.15±0.00 | 5.0 | 0.14±0.00 | 4.7 | 0.10±0.01 | 3.3 |
| IX | 0 | 0.23±0.00 | 7.7 | 0.29±0.01 | 9.7 | 0.16±0.01 | 5.3 | 0.34±0.01 | 11.3 | 0.37±0.01 | 12.3 | 0.07±0.01 | 2.3 |
| | 1 | 0.18±0.01 | 6.0 | 0.32±0.00 | 10.7 | 0.12±0.01 | 4.0 | 0.30±0.01 | 10.0 | 0.25±0.01 | 8.3 | 0.12±0.01 | 4.0 |
| | 5 | 0.15±0.01 | 5.0 | 0.27±0.01 | 9.0 | 0.15±0.01 | 5.0 | 0.21±0.00 | 7.0 | 0.28±0.01 | 9.3 | 0.07±0.01 | 2.3 |
| | 10 | 0.14±0.01 | 4.7 | 0.24±0.01 | 8.0 | 0.12±0.01 | 4.0 | 0.23±0.01 | 7.7 | 0.24±0.01 | 8.0 | 0.10±0.00 | 3.3 |

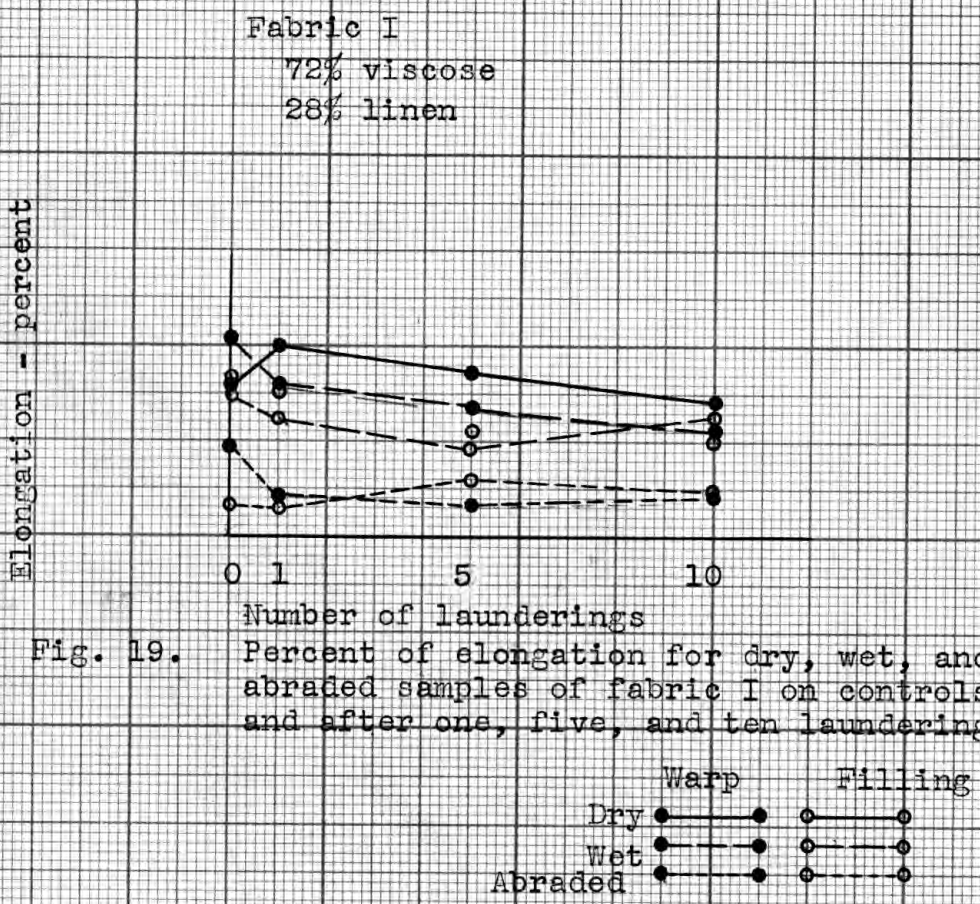


Fig. 19. Percent of elongation for dry, wet, and abraded samples of fabric I on controls and after one, five, and ten launderings.

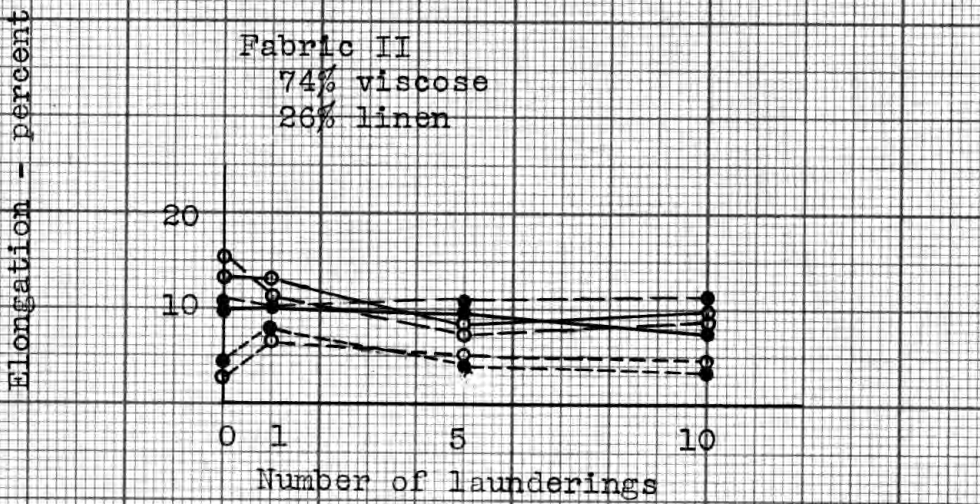


Fig. 20. Percent of elongation for dry, wet, and abraded samples of fabric II on controls and after one, five, and ten launderings.

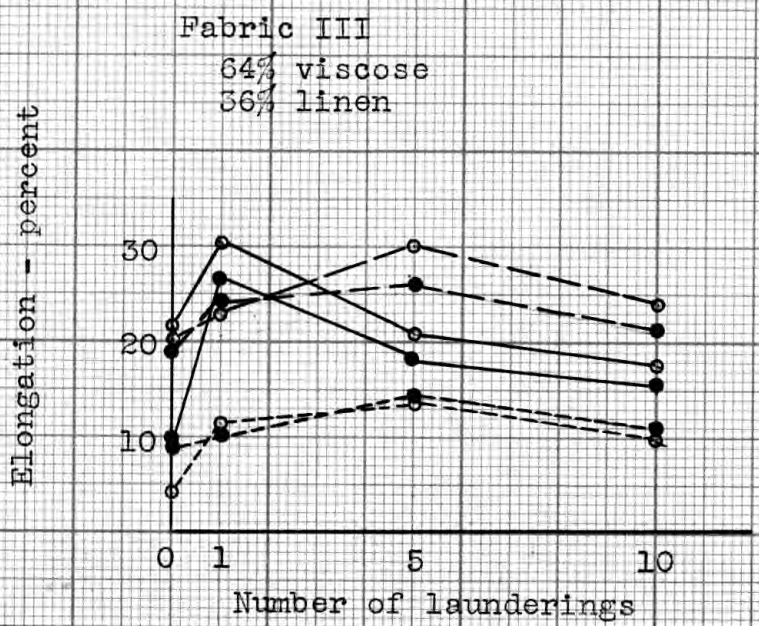


Fig. 21. Percent of elongation for dry, wet, and abraded samples of fabric III on controls and after one, five, and ten launderings.


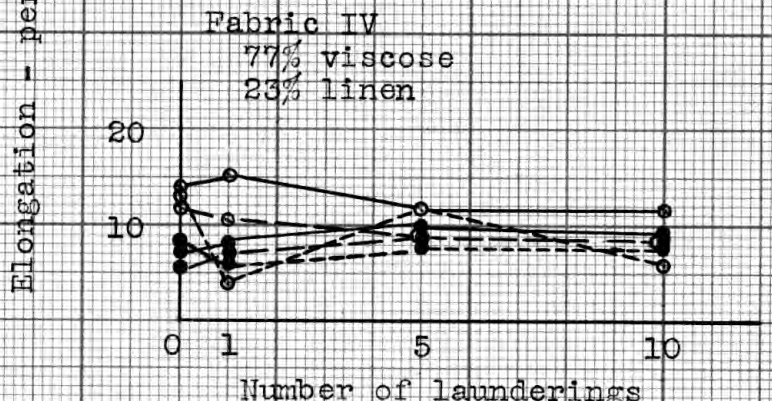


Fig. 22. Percent of elongation for dry, wet, and abraded samples of fabric IV on controls and after one, five, and ten launderings.

Fabric V
75% viscose
25% linen

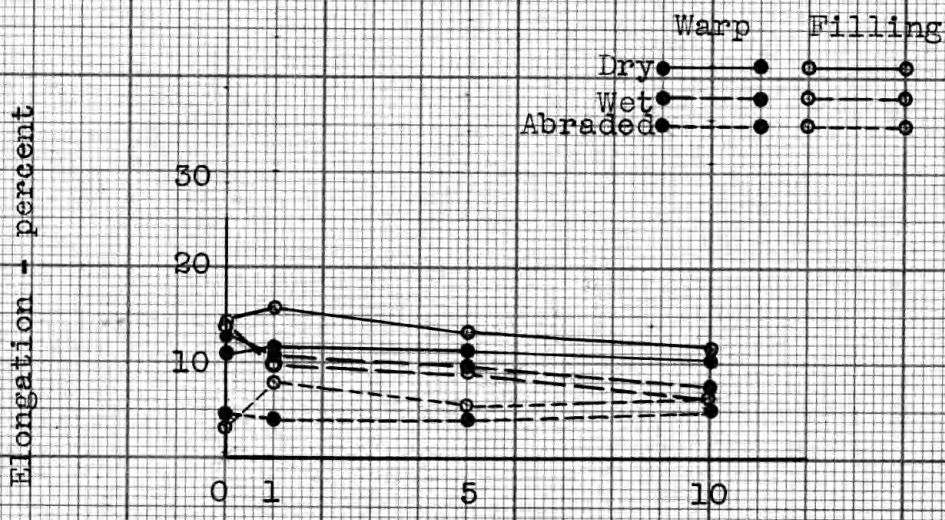


Fig. 23. Percent of elongation for dry, wet, and abraded samples of fabric V on controls and after one, five, and ten launderings.

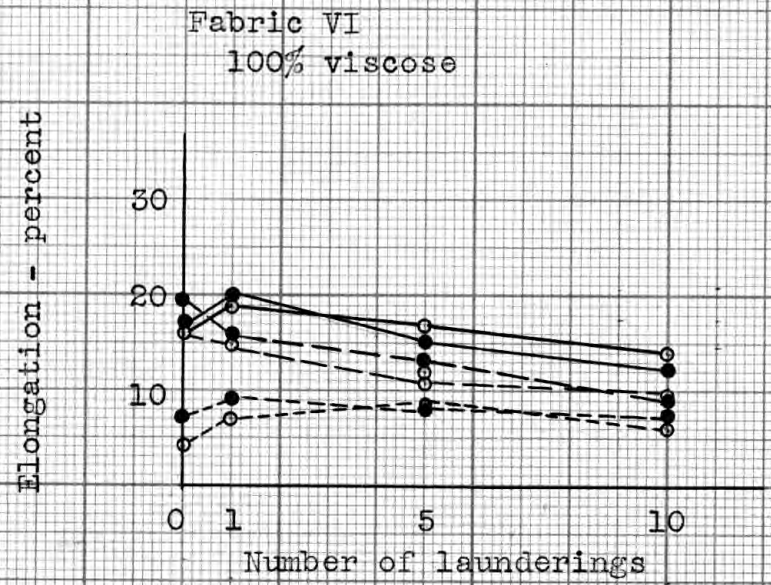


Fig. 24. Percent of elongation for dry, wet, and abraded samples of fabric VI on controls and after one, five, and ten launderings.

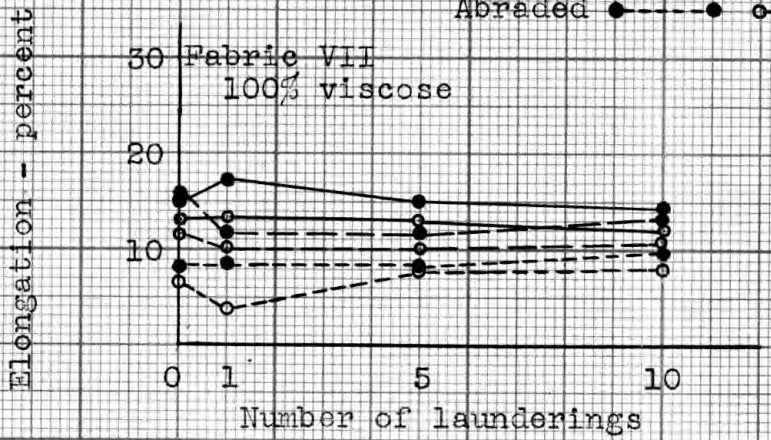


Fig. 25. Percent of elongation for dry, wet, and abraded samples of fabric VII on controls and after one, five, and ten launderings.

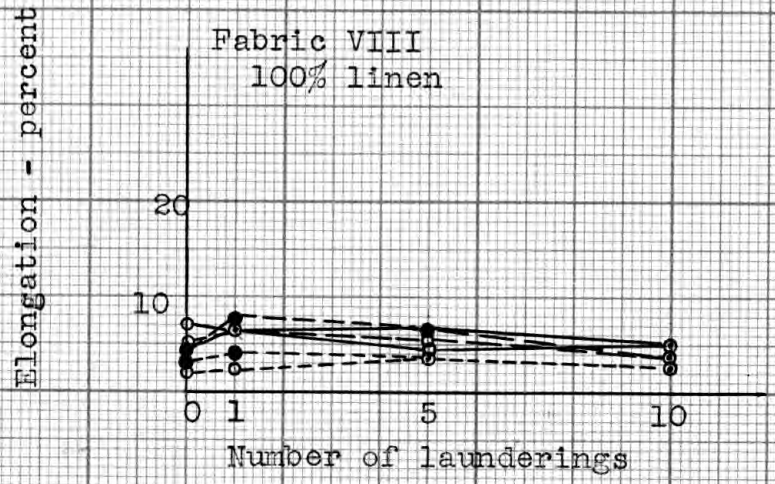


Fig. Percent of elongation for dry, wet, and abraded samples of fabric VIII on controls and after one, five, and ten launderings.

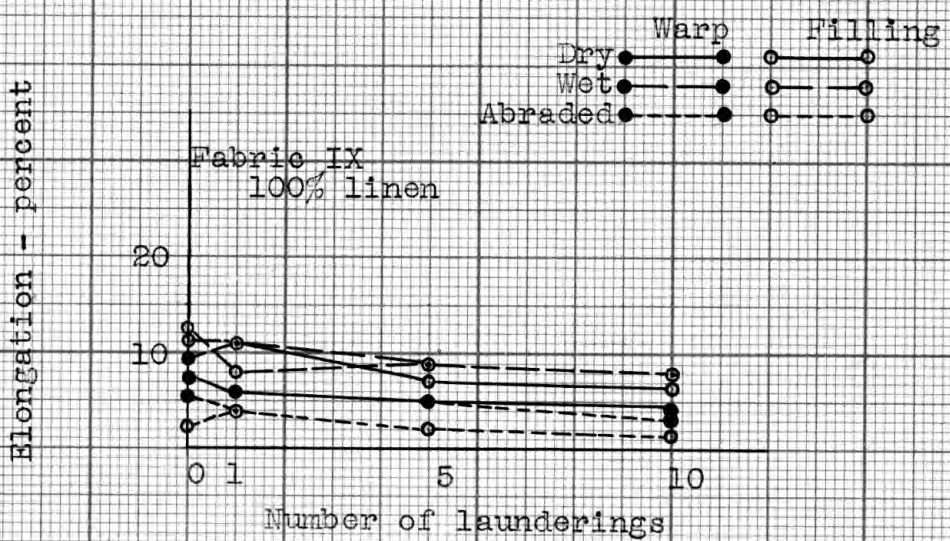


Fig. 27. Percent of elongation for dry, wet, and abraded samples of fabric IX on controls and after one, five, and ten launderings.

appearance of the fabrics. The printed and dyed fabrics were somewhat lighter in color. This was noticeable upon comparison with the original samples. All the fabrics felt softer to the touch. Fabric III, mentioned above, shrank upon laundering and would probably be satisfactory as a dress fabric if it were stretched when ironed.

## CONCLUSIONS

All the fabrics can be laundered with little change in appearance. With the exception of the filling of fabric VII which increased in strength, the dry breaking strength of the fabrics decreased to a high degree upon laundering. Mixture fabrics were comparable to the all linen and the all rayon fabrics in dry breaking strength. The 100 percent linens were strongest when wet while the 100 percent rayon fabrics and the mixtures were strongest when dry. The linen content of the mixture fabrics was not great enough to give these fabrics a high wet breaking strength.

Abrasion decreased the strength of all the fabrics. The mixture fabrics were similar to the all viscose and the all linen fabrics in breaking strength after they were abraded.

Laundering had little effect upon elongation. The mixture fabrics gave results for both wet and dry much the same as the 100 percent fabrics. Abrasion decreased the percentage of elongation for every fabric.

All of the fabrics shrank somewhat. The mixture fabrics and the all rayon fabrics shrank more than the all linens. Fabric IX, which is all linen, shrank the least of all.

The fabrics studied were fairly crease resistant and with the exception of the linens were about as resilient after the ten launderings as before laundering. The linen which was not treated for crease resistance had the lowest resilience ratio. The resilience of this fabric increased slightly upon laundering. The linen which had been given crease resistance treatment had the highest ratio on the control. This decreased rapidly with the first laundering but remained constant after that and comparable with the other fabrics.

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