COMPARISON OF THE SERVICE QUALITIES OF CERTAIN ALL-SILK, ALL-RAYON, AND SILK AND RAYON MIXED FABRICS BEFORE AND AFTER LAUNDERING

by

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INTRODUCTION

The use of rayon for women's underwear now is a well-established practice, for garments made of rayon long have been accepted as substitutes for inexpensive cotton ones. Knit garments of rayon gradually are replacing other types of underwear for women and children, except women's slips. Here the popularity of bias slips of a woven fabric has prevailed. Until recently rayon was used only for inexpensive slips of this type and showed no tendency to encroach upon the position held by silk for slips in the moderate price range.

However, a silk and rayon mixed satin slip, introduced in 1938 by a well-known manufacturer of women's slips, has gained a considerable popularity. The satin of this slip is constructed of a silk warp and a rayon filling, and has the appearance of a silk satin. An even more recently developed all-rayon crepe, resembling silk crepe in appearance and handle, also has gained in popularity. The increasing use of these two materials indicates a trend toward substitution of rayon for silk in the manufacture of moderately priced garments.

The introduction in recent months of an all-rayon satin and a silk and rayon mixed crepe, both closely re-

sembling silk fabrics, presents two more materials which in time may tend to replace lingerie fabrics of all silk.

The fact that these materials are not yet available over the counter in most stores, except in ready-made garments, is evidence that they still are in the experimental stage. Wenrich (12) ascribed their limited availability partly to the shortage in the production of first class cuprammonium rayon. He pointed out that the very best grade of cuprammonium is required for this new fabric and that the demand for it has exceeded the supply to the extent that orders cannot be filled and looms are kept idle.

Since these all- or part-rayon materials possess the appearance and handle of all-silk fabrics, and yet are cheaper than the silk, there is reason to believe they are the answer to the average consumer's desire for slips that are serviceable and attractive, but less expensive.

The purpose of this study was to compare the service qualities of certain all-silk, all-rayon, and silk and rayon mixed satins and crepes suitable for slips, as ascertained by laboratory tests, and to determine the effects of laundering on these service qualities, thereby adding to the available information concerning the relative merits of all- or part-rayon fabrics as compared with those of all silk.

PRESENT STATUS OF KNOWLEDGE

Although a number of studies have been made of the service qualities of all-rayon and all-silk materials, none has been made which deals with the service qualities of silk and rayon mixed fabrics.

In a study of the serviceability of rayon crepes, Hall (4) reported that tests showed rayon weak as compared with silk, but he concluded that the rayon was sufficiently strong to meet normal requirements in garments. His study found the warp superior to the filling in rayon crepes, and he attributed this weakness of the filling to its high twist, which created tension and left the yarns permanently stretched.

A recent study of the serviceability of differently priced rayon slips was reported by Sommaripa (11), but this study made no comparison of rayon and silk. His study pointed out the importance of resistance to slippage and stated that seam slippage is least when the filling of a fabric is around 50 percent of the weight of the fabric.

Crawford (2) reported a study of all-rayon materials suitable for slips, but she made no comparison of rayon with silk. She concluded that high-count acetate taffetas were more durable than satins or taffetas of other rayons.

In a study of slip materials, Smith (9) concluded that cheap rayons do not wear well, but that a good grade of rayon is superior to a poor grade of silk. Ekstrom (3) made a study of ready-made silk slips, but her study drew no comparison between silk slips and those of rayon.

PROCEDURE

The original plan was to procure eight fabrics, as follows: Two all-silk satins, two silk and rayon mixed satins, an all-silk crepe, a silk and rayon mixed crepe, and two all-rayon crepes, all of similar appearance, weight and construction. An attempt was made to obtain only white fabrics, so as to eliminate any effects that dyes might have upon the fabrics studied.

Intensive shopping for all- and part-rayon satins and crepes suitable for slips disclosed that some of these were available only in the tearose shade and that some were not available at all on the retail market. An effort was made to obtain pieces of the silk and rayon mixed satin and the all-rayon crepe used by Barbizon in the manufacture of women's slips, but that company wrote that it could not sell the materials requested and that they were not available on the market.

Through correspondence with the Bemberg Corporation of

America, it was learned that this company was making a silk and rayon mixed satin and a silk and rayon mixed crepe, and that it was then introducing an all-cuprammonium rayon satin having the appearance and feel of silk satin. The Bemberg corporation courteously supplied pieces of each of these three fabrics through one of its converters. The new all-rayon satin was welcomed for the experiments and replaced one of the silk satins in the original plan.

The silk and rayon mixed satin and crepe furnished by Bemberg both were composed of a silk warp and a cuprammonium rayon filling. Another mixed satin, also of a silk warp and cuprammonium rayon filling, was purchased from a St. Louis, Missouri, store. An all-silk satin, an all-silk crepe and an all-rayon crepe also were purchased from the St. Louis store. Another all-rayon crepe was purchased from a local store, making a total of eight materials obtained for the study (Plates I to IV).

A three-yard sample of each was used. The materials were of similar appearance, handle and weight, and resembled those of which ready-made slips are fashioned. Their prices ranged from $0.45 to $1.59 a yard. Some of these prices were wholesale, others retail. The widths of the materials varied from 41¼ inches to 42 inches. Table 1 records the source, price, and width of the materials used.

Table 1. Source, price, and physical characteristics of the eight fabrics tested.

Fabric	Where purchased	When purchased	Price per yard	Width (inches)	Weave	Fiber content (percentage composition)		Thread count in inches		Crimp (percent)		Twist				Yarn counts (deniers)		Sizing (percent)[1]	Weighting (percent) soluble	Total
						silk	rayon	warp	filling	warp	filling	Warp direction	Warp turns per inch	Filling direction	Filling turns per inch	warp	filling			
Satin A	Chas. F. Welek St. Louis, Mo.	Feb.1940	$1.50	41½	$(\frac{4}{1})_3$	100.0		314.3	119.5	6.0	7.3		occasional	S and Z	58.6	30.8	35.4		7.93	8.87
B	Chas. F. Welek St. Louis, Mo.	Feb.1940	1.00	41½	$(\frac{4}{1})_3$	46.6	53.4 cuprammonium	223.0	95.3	2.4	3.3		occasional		occasional	31.3	83.5	1.77		
C	American Bemberg Corp. New York City	Apr.1940	0.52½	42	$(\frac{4}{1})_3$	41.7	58.3 cuprammonium	226.1	101.4	2.1	3.9		occasional		occasional	30.4	93.8	4.53		
D	American Bemberg Corp. New York City	Apr.1940		41½	$(\frac{4}{1})_2$		100.0 cuprammonium	228.7	104.1	2.6	4.1	Z	5.2	S	0.4	44.9	89.1	1.04		
Crepe A	Chas. F. Welek St. Louis, Mo.	Feb.1940	1.59	42	$\frac{1}{1}$	100.0		187.1	121.4	9.1	6.8		occasional	S and Z	59.3	33.3	35.1		10.69	12.63
B	American Bemberg Corp. New York City	Apr.1940	0.45	41½	$\frac{1}{1}$	41.5	58.5 cuprammonium	169.4	85.8	5.7	4.1		occasional		occasional	31.0	90.4	2.57		
C	Chas. F. Welek St. Louis, Mo.	Feb.1940	0.85	41¼	$\frac{1}{1}$		36.5 viscose 63.5 acetate	153.9	98.6	15.8	3.2	Z	4.3	Z	34.8	70.6	71.1	0.47		
D	Ward Keller Manhattan, Kan.	Feb.1940	0.79	42	$\frac{1}{1}$		36.7 viscose 63.3 acetate	155.1	107.0	20.1	4.4	Z	4.4	Z	36.6	71.8	69.2	0.44		

EXPLANATION OF PLATE I

Fig. 1. Satin A. Silk satin before laundering

Fig. 2. Satin A. Silk satin after 10 launderings

Fig. 3. Satin A. Silk satin after 20 launderings

Fig. 4. Satin B. Silk and cuprammonium satin before laundering

Fig. 5. Satin B. Silk and cuprammonium satin after 10 launderings

Fig. 6. Satin B. Silk and cuprammonium satin after 20 launderings

PLATE I

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

EXPLANATION OF PLATE II

Fig. 7. Satin C. Silk and cuprammonium satin before laundering

Fig. 8. Satin C. Silk and cuprammonium satin after 10 launderings

Fig. 9. Satin C. Silk and cuprammonium satin after 20 launderings

Fig.10. Satin D. Cuprammonium satin before laundering

Fig.11. Satin D. Cuprammonium satin after 10 launderings

Fig.12. Satin D. Cuprammonium satin after 20 launderings

PLATE II

Fig. 7.

Fig. 8.

Fig. 9.

Fig. 10.

Fig. 11.

Fig. 12.

EXPLANATION OF PLATE III

Fig. 13. Crepe A. Silk crepe before laundering

Fig. 14. Crepe A. Silk crepe after 10 launderings

Fig. 15. Crepe A. Silk crepe after 20 launderings

Fig. 16. Crepe B. Silk and cuprammonium crepe before laundering

Fig. 17. Crepe B. Silk and cuprammonium crepe after 10 launderings

Fig. 18. Crepe B. Silk and cuprammonium crepe after 20 launderings

PLATE III

Fig. 13.

Fig. 14.

Fig. 15.

Fig. 16.

Fig. 17.

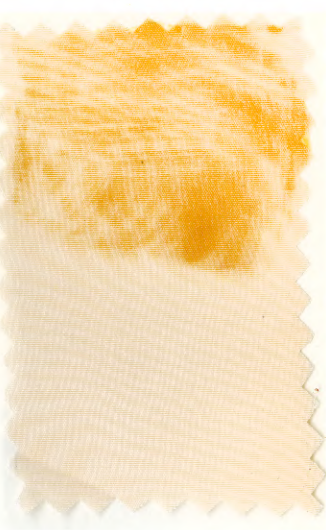

Fig. 18.

EXPLANATION OF PLATE IV

Fig. 19. Crepe C. Viscose and acetate crepe before laundering

Fig. 20. Crepe C. Viscose and acetate crepe after 10 launderings

Fig. 21. Crepe C. Viscose and acetate crepe after 20 launderings

Fig. 22. Crepe D. Viscose and acetate crepe before laundering

Fig. 23. Crepe D. Viscose and acetate crepe after 10 launderings

Fig. 24. Crepe D. Viscose and acetate crepe after 20 launderings

PLATE IV

Fig. 19.

Fig. 20.

Fig. 21.

Fig. 22.

Fig. 23.

Fig. 24.

Analysis of Fabrics

The fabrics were analyzed to determine weave, thread count, thickness, twist of yarn, crimp, yarn counts, and weight per square yard. The thickness, weight per square yard, and thread count were determined according to the method accepted by Committee D-13 (1). The weave was determined by examination through a microscopic hand lens.

The twist of the yarns was determined on a Suter twist counter. For the yarns having a low twist, a five-inch strand was inserted in the counter and untwisted until the filaments were parallel. An average of 10 counts was taken as the number of twists in the yarn. For the yarns having a high twist, a 10-inch length was inserted in the counter and twisted under tension until it broke. The number of twists necessary to rupture the yarn was recorded. Another 10-inch length was inserted, the yarn was untwisted and then retwisted in the opposite direction until it broke, and the number of turns used here was recorded. From these two readings, the yarn twist was calculated by the following formula:

$$N_1 - N_2 = 2T$$

and

$$t = \frac{T}{l} = \frac{N_1 - N_2}{2\ l}$$

in which

N_2 = number of turns to twist to rupture

N_1 = number of turns to untwist and retwist to rupture

T = total number of turns in yarn

t = turns per inch

l = length of yarn used

The crimp was determined by the use of camera lucida drawings of yarns taken from warp and filling sections of the fabrics. The distance along the curve of the crimp was measured between two nodes by a pair of dividers set at a small unit. The length of a straight line between the two nodes was measured by the same unit, and the percentage of crimp was calculated from the following ratio, as given by Schwarz (7):

$$\text{Percentage of crimp} = \frac{\text{length of curved line-length of straight line}}{\text{length of straight line}} \times 100$$

In calculating the yarn counts, the dry weight of an eight-inch square of each fabric was determined. The square then was raveled, and the warp and filling yarns counted and weighed separately. A small weight discrepancy noted in favor of the raveled yarns was divided equally and sub-

tracted from warp and filling, in order that their total weight would agree with the weight of the original square. This discrepancy occurred in every instance and probably was due to foreign matter accumulated by the yarns in the extensive handling necessary to ravel them. The yarn counts were calculated in deniers by use of the known weight, percentage of crimp, and number of the eight-inch warp and filling lengths.

The type of rayon fibers used in the part- and all-rayon materials was identified by microscopic examination of cross-sections of the fibers. This examination revealed that cuprammonium rayon was used in all of the silk and rayon mixed fabrics. In the all-rayon crepes, viscose rayon was used for the filling and acetate rayon for the warp.

A quantitative analysis of the fabrics containing rayon was made to determine the amount of sizing present. This was carried out by the method accepted by Committee D-13 (1). The sizing found to be present then was qualitatively analyzed, according to the method accepted by the American Association of Textile Chemists and Colorists (13).

The silk materials were quantitatively and qualitatively analyzed for the presence of soluble and insoluble weighting, according to the method presented by Mease (6).

Serviceability Tests

Since one of the purposes of the study was to determine the effects of laundering on the service qualities of the materials, tests for serviceability were made on the fabrics before laundering, and after 10 and 20 launderings. The latter number was taken as the minimum number of launderings a slip would undergo during service. The fabrics were laundered by a commercial laundry and were accorded the same treatment that garments of like materials would receive.

This laundering consisted of approximately 15 minutes' agitation in neutral suds by a cylinder-type washing machine, followed by four rinsings. The water used was softened to zero hardness, as far as action of soap was concerned, and kept at a temperature of 65 to 70°F. The materials were pressed in a flat-work roller press, operated by steam which produced a temperature of 325°F.

Serviceability tests included those for seam slippage, shrinkage, wet and dry breaking strengths, and breaking strength after abrasion. Tests to determine seam slippage and shrinkage were conducted according to the method accepted by Committee D-13 (1).

The abrasion was done on an abrasion machine (designed

at Massachusetts Institute of Technology) according to Haven's method (5). The materials were abraded 100 strokes over a one-inch roller by a piece of crocus cloth. A constant tension in the cloth was maintained by three weights totaling one and one-half pounds.

FINDINGS AND DISCUSSION

Analysis of Materials

The yarn twist in the fabrics studied varied from 59.3 turns per inch to approximately 0.0 turns. The warp yarns had a low twist, the highest being 5.2 per inch in satin D, the cuprammonium satin. The crepe fillings had a high twist, with the exception of crepe B, which had none. The only satin filling which had any appreciable twist was satin A, with a yarn twist of 58.6 per inch.

The percentage of crimp in the yarns ranged from 2.1 to 20.1, the highest percentage of crimp occurring in the warps of crepes C and D, the all-rayon crepes.

The yarn counts ranged from 30.4 deniers to 93.8 deniers. The silk yarns, both warp and filling, ranged from 30.4 to 35.4 deniers, while the rayon yarns ranged from 44.9 to 93.8 deniers.

The weave, twist of yarn, percentage of crimp, and yarn counts are presented in Table 1.

The weight per square yard of the fabrics, before laundering, ranged from 1.49 ounces to 2.71 ounces (Table 2). After laundering the weights increased as a result of shrinkage of the fabrics, with the exception of crepe A. In this fabric a decrease in weight per square yard occurred with laundering, probably as a result of loss of soluble weighting.

None of the fabrics studied was balanced as to thread count, for in all cases the warp thread count exceeded that of the filling. The warp thread counts ranged from 155.1 to 314.3 threads per inch. All the satins had high warp thread counts, ranging from 223.0 to 314.3 threads per inch. The warp thread counts were lower in the crepes, ranging from 153.9 to 187.1 threads per inch (Table 3). The filling thread counts were comparable for satins and crepes, ranging from 85.8 to 121.4 threads per inch (Table 4).

The percentage of sizing found in the all- or part-rayon fabrics ranged from .44 to 4.53. Satins B, C, and D were found to contain either calcium or barium sulphate. Tests also revealed the presence of starch in satin B and cane sugar in satin C. In satin A and crepe A, the two all-silk fabrics, the percentage of soluble weighting was 7.93 and 10.69 respectively, while the total weighting in

Table 2. Percentage of shrinkage, weight per square yard in ounces, and thickness in 1/1000 inches of the eight fabrics tested, before and after laundering.

Fabric	No. of launderings	Percentage of shrinkage: Warp	Filling	Area	Wt. per square yard in ounces	Thickness in 1/1000 inches
Satin A	0				1.93	64
	1	2.2	4.1	6.4		
	10	3.4	3.1	6.4	1.94	91
	20	4.7	2.5	7.0	1.97	89
Satin B	0				2.01	56
	1	1.9	1.6	3.5		
	10	1.3	1.3	2.6	2.11	75
	20	4.4	0.6	5.0	2.10	76
Satin C	0				2.17	59
	1	2.2	3.1	5.3		
	10	2.5	2.8	5.2	2.18	72
	20	4.4	2.5	6.7	2.29	72
Satin D	0				2.61	66
	1	2.5	2.2	4.6		
	10	3.1	1.9	5.0	2.72	78
	20	5.3	1.6	6.8	2.76	81
Crepe A	0				1.49	59
	1	3.1	1.9	5.0		
	10	1.9	0.0	1.9	1.36	60
	20	2.2	0.6	2.8	1.40	65
Crepe B	0				1.72	48
	1	4.1	0.0	4.1		
	10	3.4	+ 0.6	2.8	1.80	72
	20	5.0	+ 0.6	4.4	1.76	62
Crepe C	0				2.58	77
	1	7.2	2.5	9.5		
	10	6.6	1.6	8.1	2.79	80
	20	10.0	2.2	11.9	2.88	80
Crepe D	0				2.71	82
	1	6.2	7.2	12.9		
	10	5.6	2.0	7.8	2.92	85
	20	7.5	2.2	9.5	2.96	81

Table 3. Warp breaking strengths of the eight fabrics tested in pounds, in pounds corrected, and in percentages of the controls.

Fabric	No. of launderings	Thread count: Dry	Thread count: Abraded	In pounds: Dry	In pounds: Wet	In pounds: Ab.	In pounds corrected: Dry	In pounds corrected: Wet	In pounds corrected: Ab.	In percentages: Dry	In percentages: Wet	In percentages: Ab.
Satin A	0	314.3	305.6	73.9± .9	61.4± .7	48.6± .8	73.9	61.4	50.0	100.0	83.0	67.7
	10	318.9	309.8	80.0±1.2	55.4± .4	49.3±1.5	78.8	54.6	50.0	106.6	73.9	67.7
	20	310.1	303.3	55.1±2.2	49.0±1.5	40.3±1.8	55.8	49.7	41.8	75.6	67.4	56.6
Satin B	0	223.0	224.4	61.2± .2	43.0± .3	17.2±1.2	61.2	43.0	17.1	100.0	70.2	27.9
	10	227.8	228.2	50.1±1.0	37.8± .8	12.7±1.3	49.0	37.1	12.4	80.1	60.6	20.2
	20	223.0	223.6	50.9± .7	35.6± .6	27.3±1.4	50.9	35.6	27.2	83.2	58.2	44.5
Satin C	0	226.1	225.6	57.0± .5	41.6± .3	37.7± .3	57.0	41.6	37.7	100.0	73.0	66.1
	10	232.0	232.9	61.1± .5	37.8±1.2	30.5±1.3	59.5	36.8	29.5	104.4	64.5	51.7
	20	232.0	231.4	50.5± .8	37.9± .2	24.2±1.9	49.2	36.8	23.6	86.3	64.5	41.4
Satin D	0	228.7	228.5	33.2± .4	14.0± .2	17.4± .4	33.2	14.0	17.4	100.0	42.2	52.4
	10	232.9	231.4	32.3± .3	19.1± .2	14.8± .8	31.7	18.8	14.6	95.5	56.6	44.0
	20	230.4	225.7	31.4± .3	18.0± .1	17.4± .6	31.2	17.8	17.5	94.2	53.7	52.7
Crepe A	0	187.1	190.5	41.8± .2	28.0±1.0	30.2± .4	41.8	28.0	29.6	100.0	66.9	70.8
	10	189.0	190.8	36.3± .4	25.1± .7	9.7± .7	35.9	24.8	9.5	85.9	59.3	22.7
	20	187.8	189.9	32.1± .4	21.0± .3	12.0± .5	31.9	20.9	11.8	76.3	50.0	28.2
Crepe B	0	169.4	173.3	39.1± .4	31.6± .6	21.8± .7	39.1	31.6	21.3	100.0	80.8	54.5
	10	169.2	166.7	41.0± .3	30.8± .4	11.4± .5	41.0	30.8	11.6	104.9	78.8	29.7
	20	167.6	167.6	35.3± .4	26.2± .7	20.0± .7	36.2	27.0	20.2	92.6	69.1	51.6
Crepe C	0	153.9	154.0	28.2± .4	10.7± .3	11.1± .7	28.2	10.7	11.1	100.0	38.0	39.4
	10	156.6	150.7	28.0± .3	16.1±1.0	9.6± .5	27.5	15.8	9.8	97.5	56.1	34.7
	20	155.4	158.6	28.6± .3	14.7± .7	15.7± .8	28.3	14.6	15.2	100.3	51.8	53.9
Crepe D	0	155.1	155.7	30.1± .6	18.4± .8	9.4± .4	30.1	18.4	9.3	100.0	61.1	30.9
	10	159.4	159.7	27.8± .3	17.2± .8	10.2± .5	27.1	16.8	9.9	90.1	55.8	32.8
	20	156.7	155.2	25.5± .2	17.4± .8	15.8± .6	25.2	17.2	15.8	83.7	57.2	52.5

Table 4. Filling breaking strengths for the eight fabrics tested in pounds, in pounds corrected, and in percentages of the controls.

Fabric	No. of launderings	Thread count: Dry	Thread count: Abraded	In pounds: Dry	In pounds: Wet	In pounds: Ab.	In pounds corrected: Dry	In pounds corrected: Wet	In pounds corrected: Ab.	In percentages: Dry	In percentages: Wet	In percentages: Ab.
Satin A	0	119.5	121.1	22.7+.4	22.5+.7	28.6+ .5	22.7	22.5	28.2	100.0	99.2	124.2
	10	124.8	124.9	27.4∓.4	21.5∓.3	30.8∓ .3	26.2	20.6	29.5	115.4	90.8	130.0
	20	123.5	123.5	27.4∓.4	19.4∓.5	28.1∓ .8	26.5	18.8	27.2	116.7	82.8	119.8
Satin B	0	95.3	96.4	25.9+.3	13.8+.2	27.6+ .3	25.9	13.8	27.2	100.0	53.3	105.1
	10	98.1	98.8	23.2∓.3	13.4∓.1	24.0∓ .3	22.6	13.0	23.1	87.3	50.3	89.3
	20	100.6	99.9	21.3∓.2	10.9∓.2	19.5∓ .3	20.2	10.4	18.6	78.0	40.2	71.9
Satin C	0	101.4	101.6	27.4+.5	12.7+.6	30.1+ .3	27.4	12.7	30.1	100.0	46.4	109.8
	10	104.6	104.2	29.2∓.3	14.8∓.1	26.4∓ .4	28.3	14.4	25.7	103.1	52.6	93.9
	20	104.8	104.9	24.6∓.3	12.9∓.2	22.7∓ .3	23.8	12.5	22.0	87.0	45.6	80.4
Satin D	0	104.1	106.4	26.8+.3	9.0+.1	31.4+ .3	26.8	9.0	30.7	100.0	33.5	114.6
	10	109.1	107.4	26.7∓.2	12.5∓.2	23.7∓ .4	25.5	11.9	23.0	95.2	44.4	86.0
	20	111.4	108.3	22.2∓.2	11.2∓.3	19.4∓ .4	20.7	10.5	18.7	77.4	39.2	69.8
Crepe A	0	121.4	121.7	23.6+.4	18.4+.4	24.4+1.0	23.6	18.4	24.4	100.0	78.0	103.5
	10	120.1	122.2	26.1∓.6	16.9∓.6	17.7∓1.1	26.3	17.1	17.6	111.3	72.5	74.6
	20	127.3	123.7	26.7∓.7	18.7∓.4	25.0∓ .7	25.4	17.8	24.5	107.5	75.5	103.8
Crepe B	0	85.8	85.5	20.5+.3	11.0+.3	15.7+ .4	20.5	11.0	15.8	100.0	53.7	77.2
	10	91.5	89.7	27.5∓.2	14.3∓.2	14.7∓ .3	25.8	13.4	14.1	125.8	65.4	69.0
	20	91.9	91.4	24.6∓.3	14.4∓.1	18.5∓ .6	23.0	13.5	17.4	112.1	66.0	85.0
Crepe C	0	98.6	99.8	23.2+.3	7.4+.2	25.3+ .2	23.2	7.4	25.0	100.0	31.9	107.7
	10	106.4	103.4	27.4∓.1	14.7∓.1	25.9∓ .3	25.4	13.6	24.7	109.5	58.6	106.5
	20	110.0	106.0	27.0∓.3	16.5∓.1	24.5∓ .1	24.2	14.8	22.8	104.4	63.7	98.3
Crepe D	0	107.0	107.2	22.4+.2	7.9+.2	24.3+ .3	22.4	7.9	24.3	100.0	35.3	108.5
	10	112.7	109.8	28.2∓.5	14.2∓.1	27.5∓ .2	26.8	13.5	26.8	119.6	60.3	119.6
	20	115.1	112.6	25.4∓.3	15.0∓.2	29.5∓ .2	23.6	13.9	28.0	105.3	62.0	125.0

these materials was 8.87 percent and 12.63 percent respectively.

Serviceability Tests

Only two of the fabrics showed any slippage. These were satin A, the all-silk satin, which showed a resistance to slippage of only 7.2 pounds, and crepe A, the all-silk crepe, which had a resistance to slippage of 18.2 pounds. The slippage in both instances was of warp on the filling threads.

Simon (8) stated that if a fabric's resistance to slippage is less than 10 pounds, the serviceability of that fabric is doubtful, and that if the resistance is greater than 20 pounds, there is little possibility of trouble. Judged by this standard, satisfactory serviceability of satin A is very unlikely, and crepe A is not out of the slippage danger zone.

The slippage in satin A and crepe A was evident in the samples that were abraded, especially those abraded after laundering. Slippage of the warp threads was so great that few of them were parallel after the abrasive action.

The shrinkage was calculated in percentage (Table 2). In the warp it ranged from 1.3 to 10.0 percent, and in the filling, from a stretch of 0.6 to a shrinkage of 7.2 per-

cent. Since the warp and filling shrinkage for the fabrics varied after the different launderings, it was decided to calculate the shrinkage in percentage of area, in order to eliminate variations caused by stretch of either warp or filling in the pressing of the materials. The percentage of shrinkage in area ranged from 1.9 to 12.9 (Table 2), the greatest amount occurring in the all-rayon crepes.

Since the thread count of the samples for breaking strength varied as a result of shrinkage and abrasion, all the breaking strengths for each material were corrected to the thread count of the dry control as follows: The breaking strength was multiplied by the thread count of the control and the product was divided by the thread count of the sample broken.

The corrected breaking strengths then were calculated in percentage of the dry control sample by dividing them by the breaking strength of the dry control and multiplying by 100.

The breaking strengths in pounds, the corrected breaking strengths in pounds, and the breaking strengths in percentage of control are presented in Tables 3 and 4. In order to visualize better the reactions of the materials, graphs (Figs. 25 to 32) were made of the warp and filling breaking strengths of each fabric. Because of the vari-

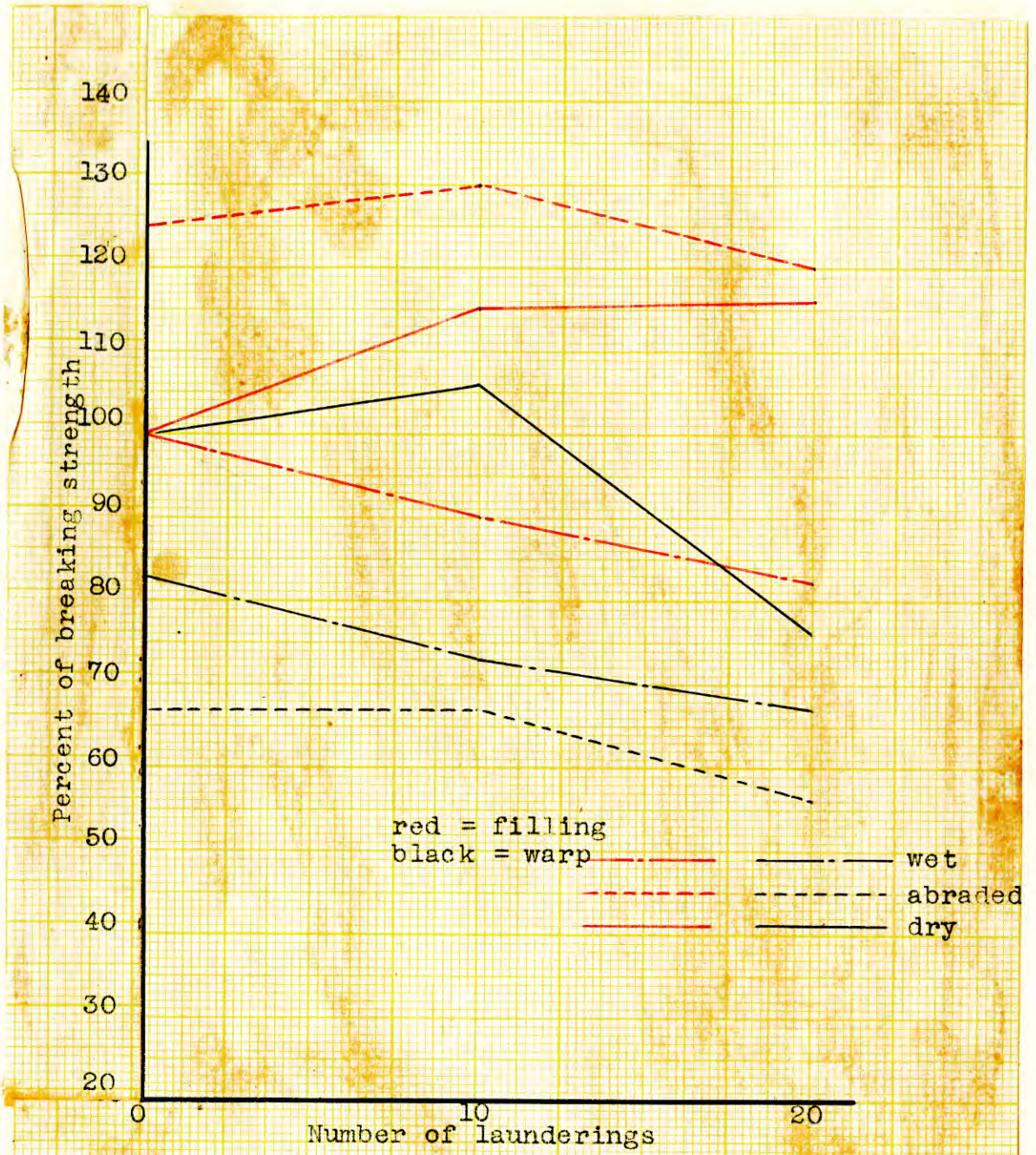

Fig. 25. Dry, wet, and abraded breaking strengths before and after laundering in percentage of the control of satin A.

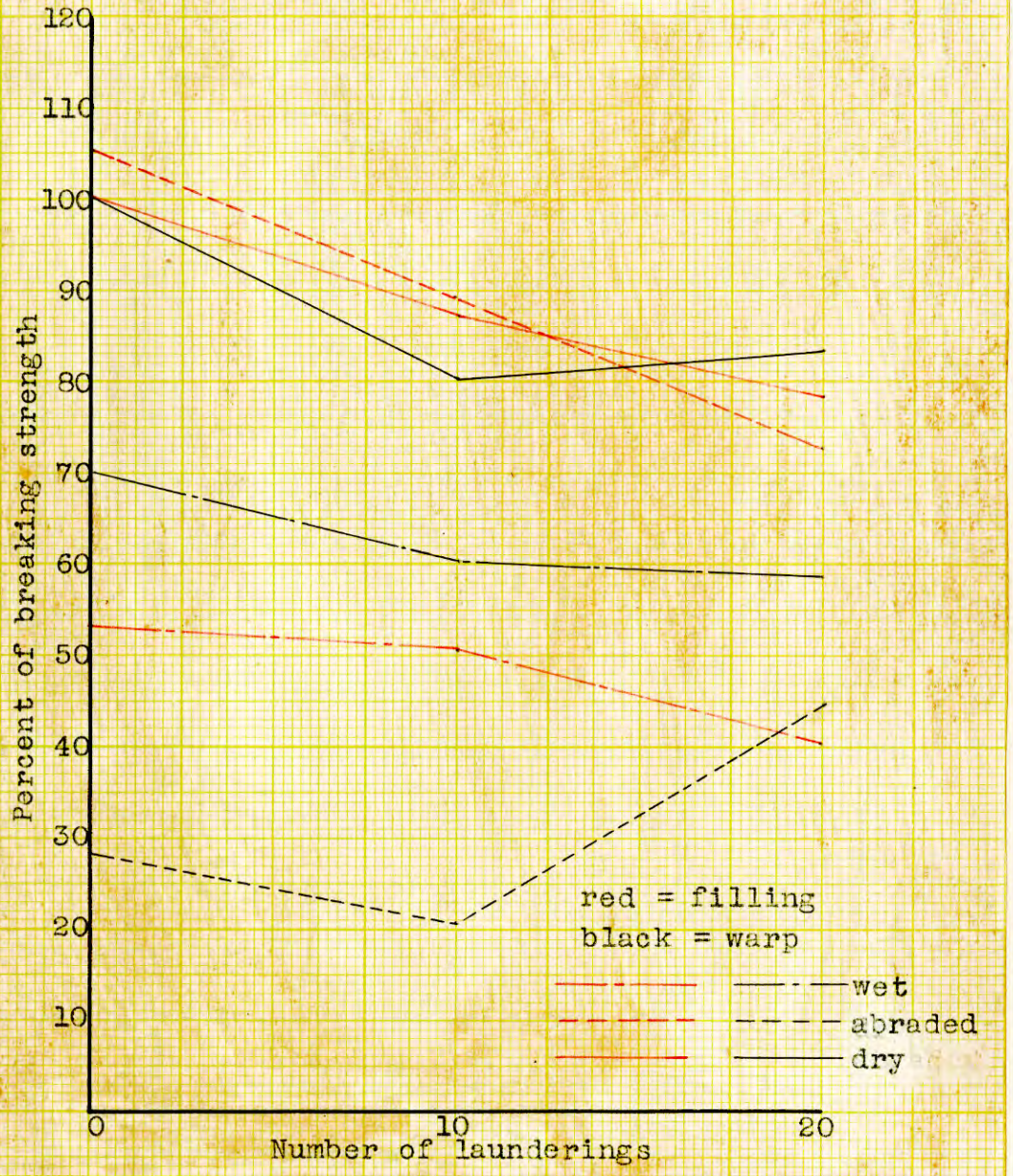

Fig. 26. Dry, wet, and abraded breaking strengths before and after laundering in percentage of the control of satin B.

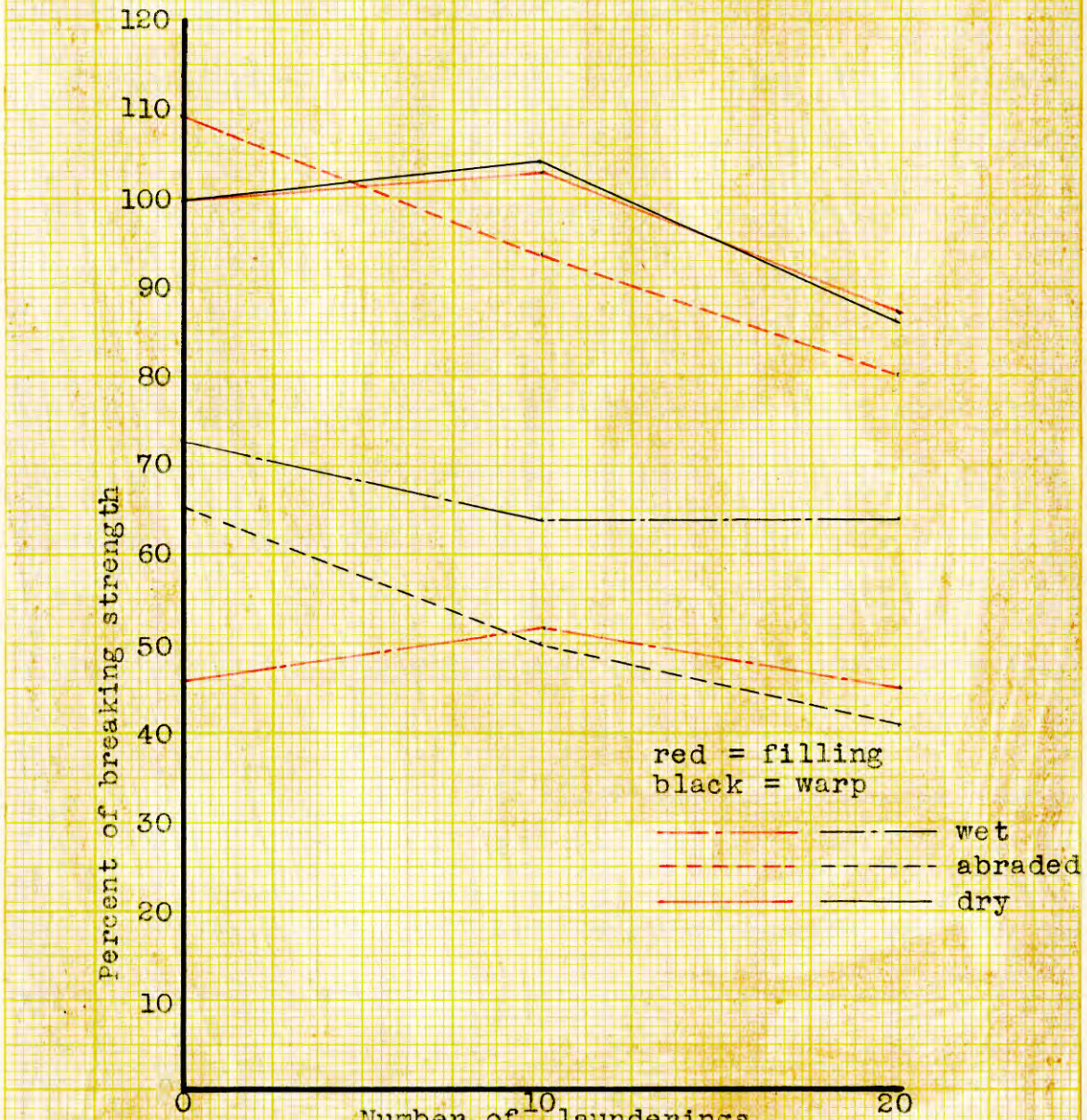

Fig. 27. Dry, wet, and abraded breaking strengths before and after laundering in percentage of the control of Satin C.

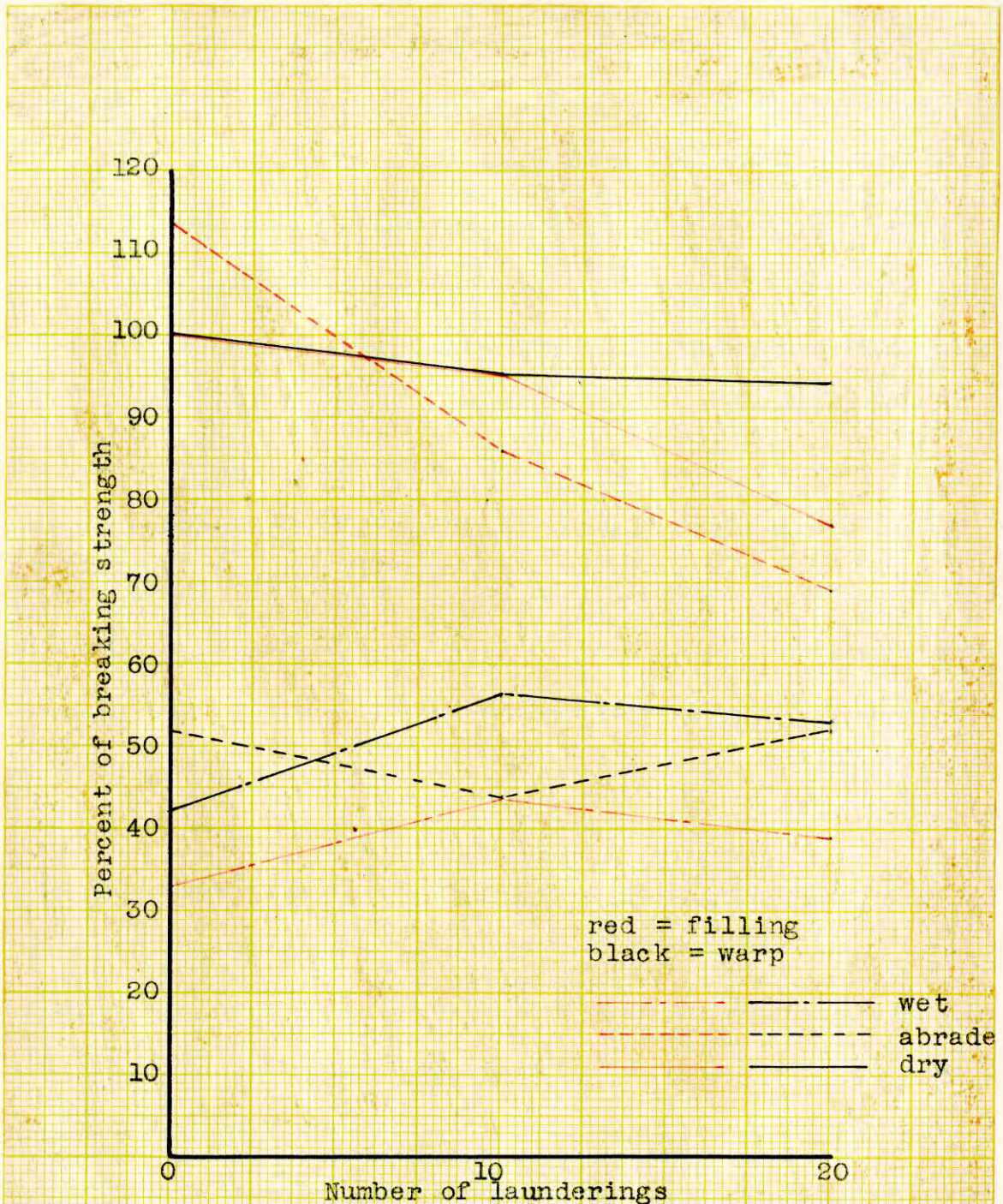

Fig. 28. Dry, wet, and abraded breaking strengths before and after laundering in percentage of the control of satin D.

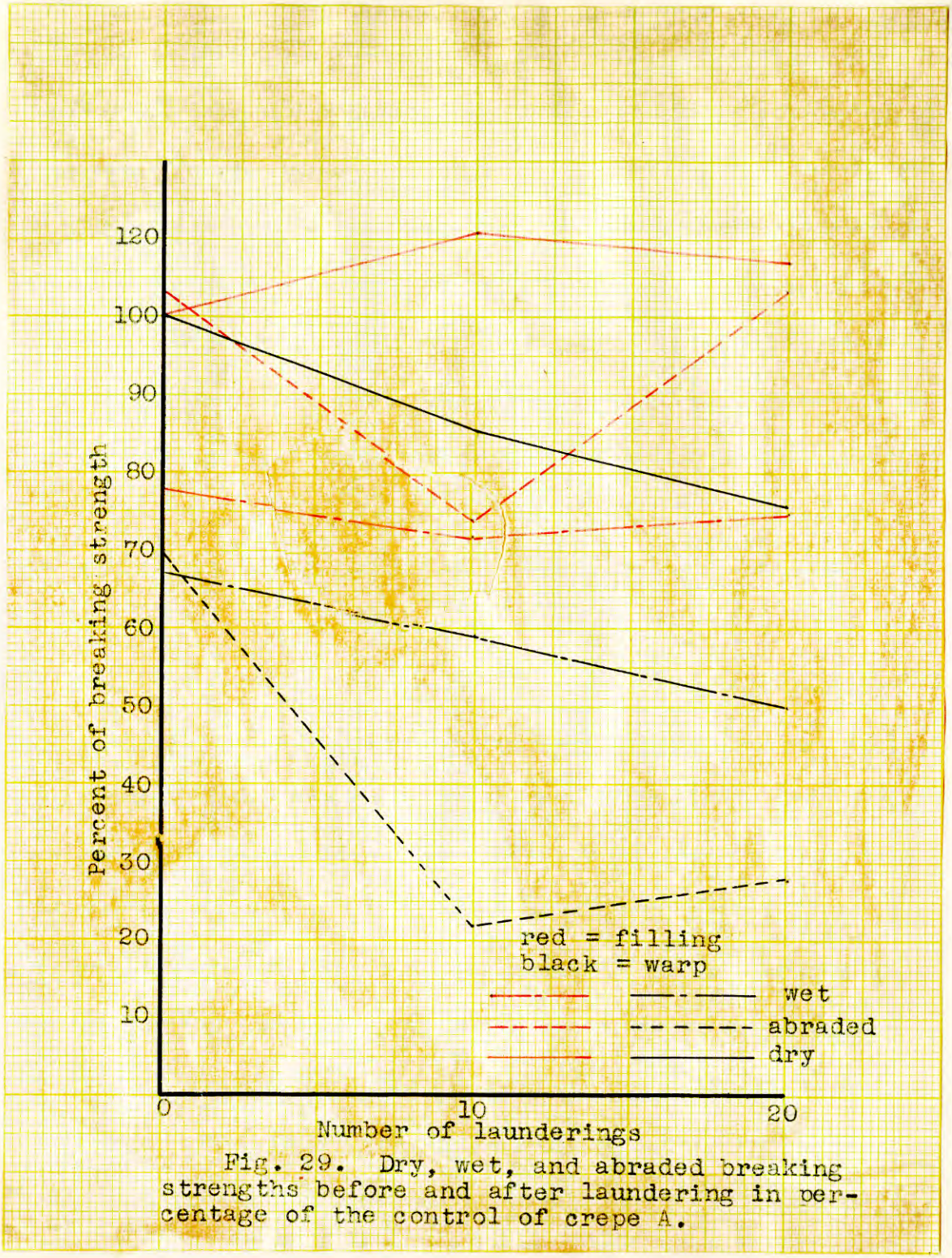

Fig. 29. Dry, wet, and abraded breaking strengths before and after laundering in percentage of the control of crepe A.

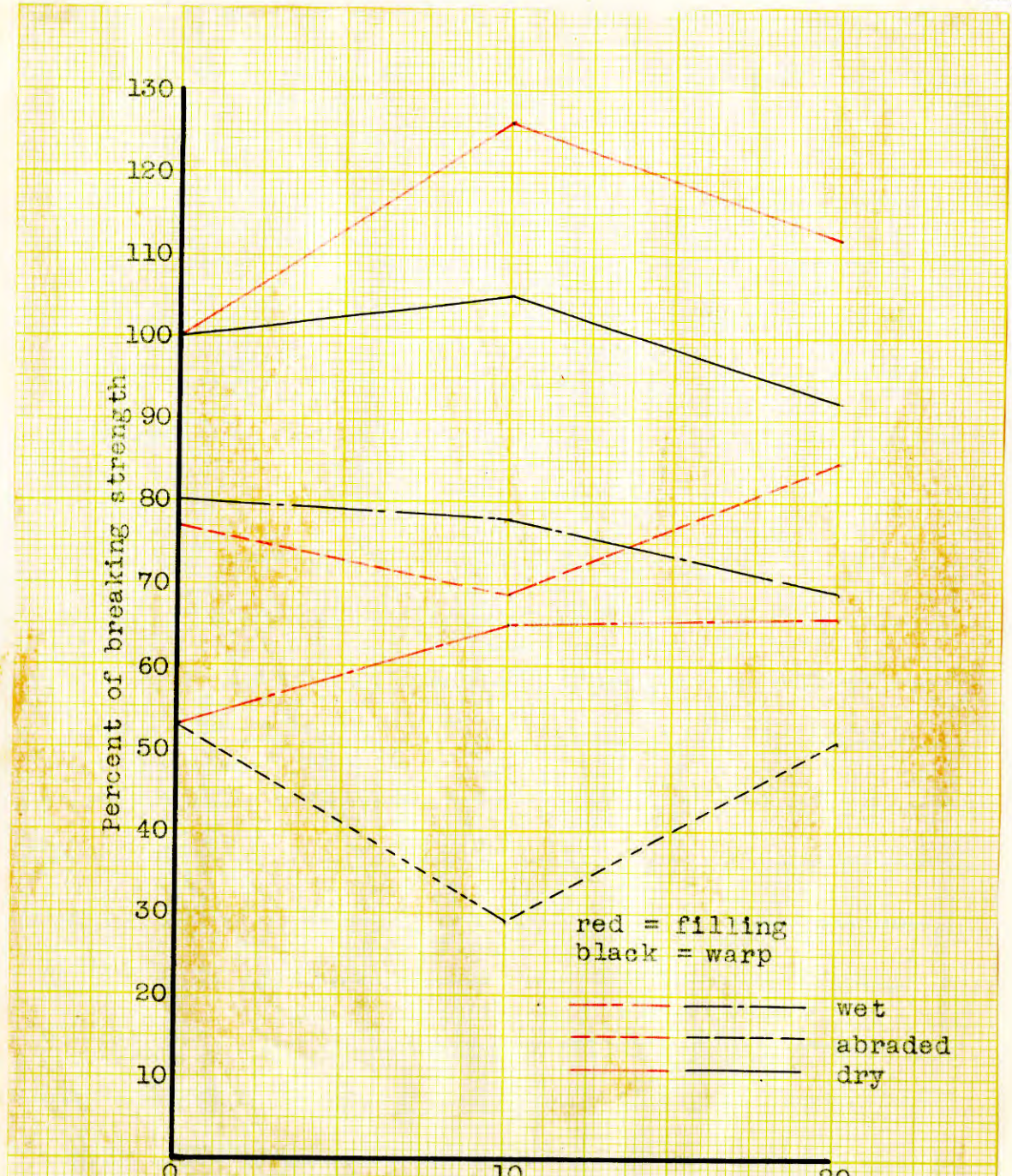

Fig. 30. Dry, wet, and abraded breaking strengths before and after laundering in percentage of the control of crepe B.

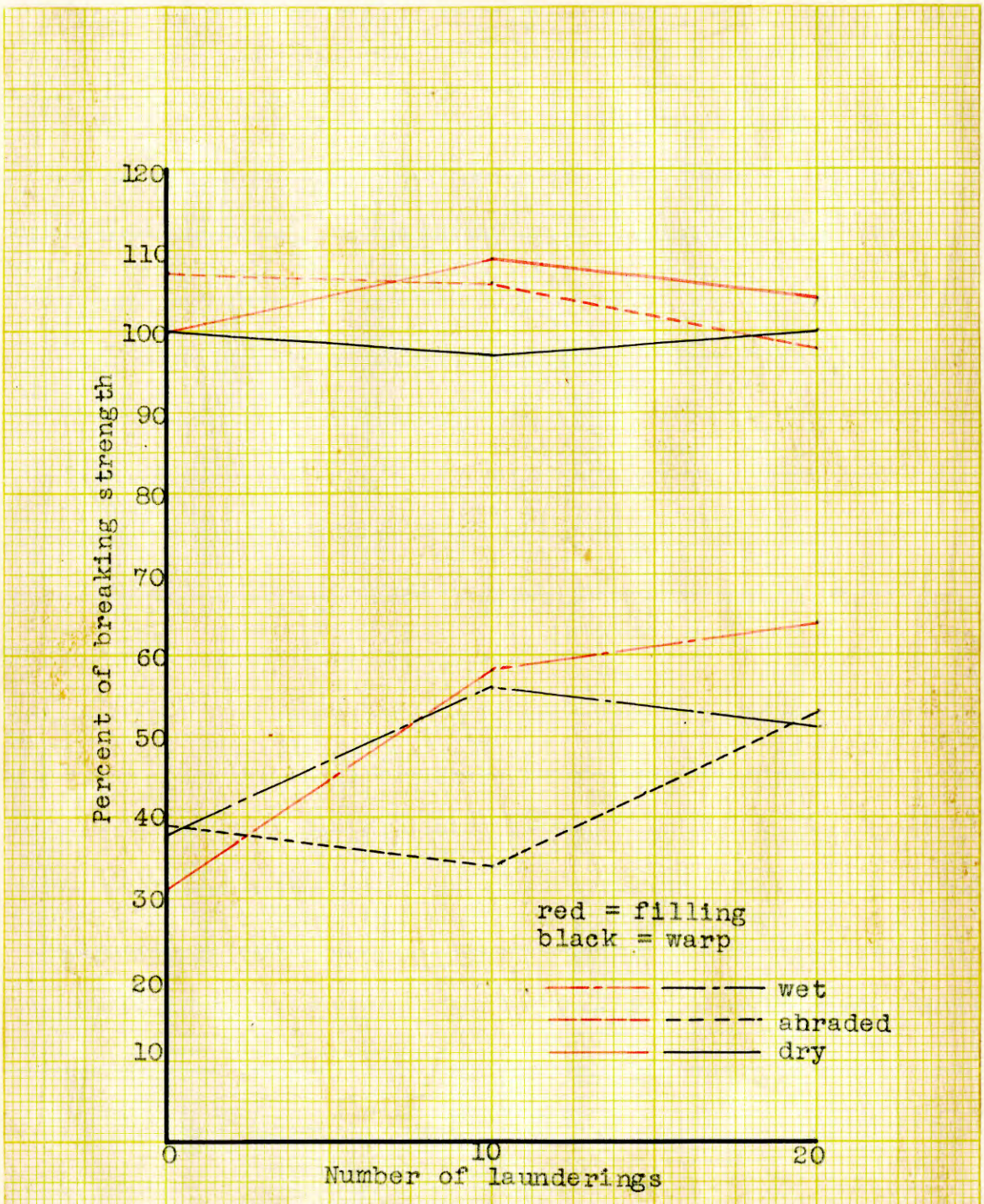

Fig. 31. Dry, wet, and abraded breaking strengths before and after laundering in percentage of the control of crepe C.

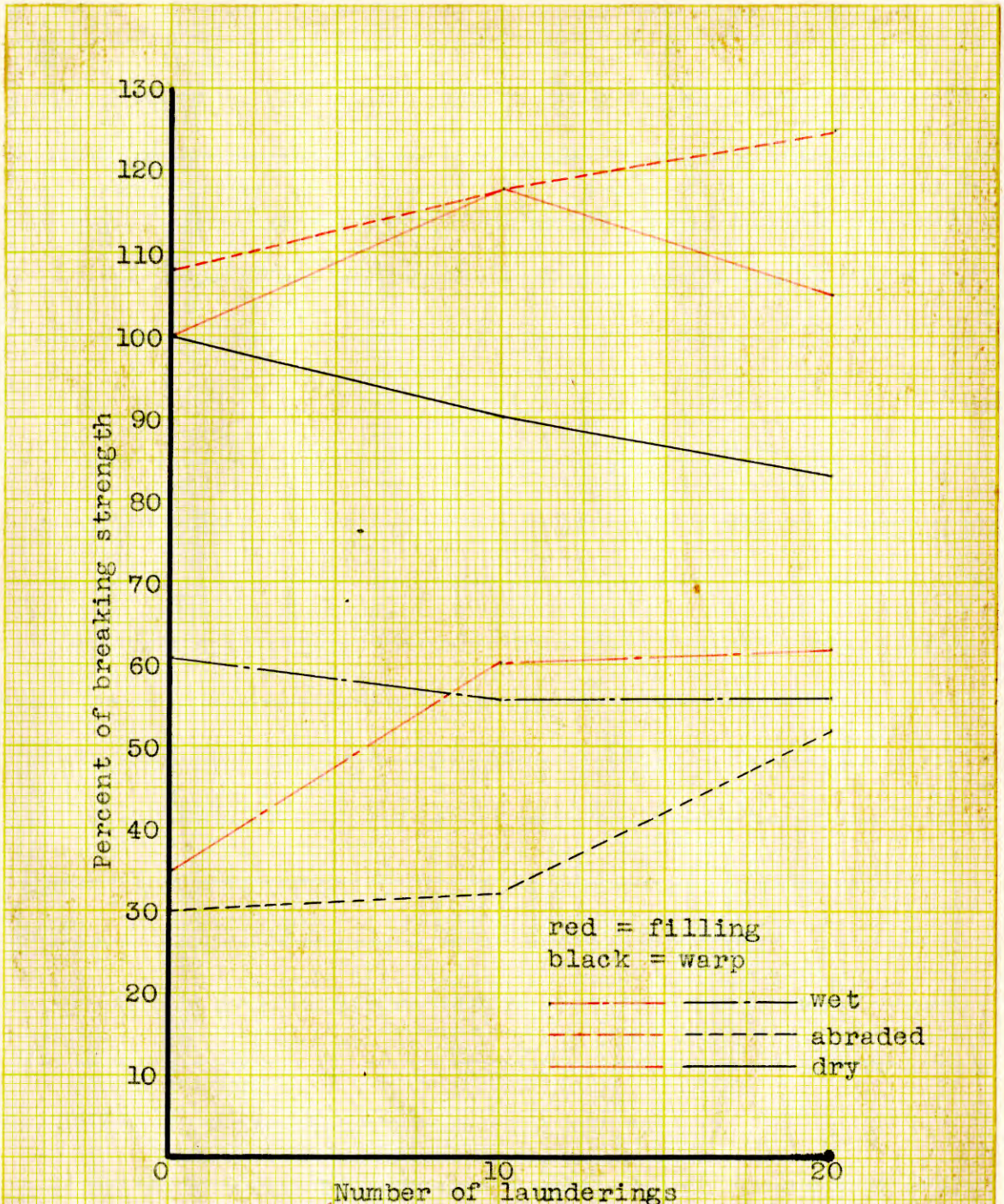

Fig. 32. Dry, wet, and abraded breaking strengths before and after laundering in percentage of the control of crepe D.

ation in the fiber content and construction of the materials studied, a divergence of results was obtained.

The breaking strengths of the dry fillings increased after the first 10 launderings for every material except satins C and D, which showed a slight decrease. After 20 launderings the filling breaking strengths showed a tendency to decrease, except in satin A. Here the silk filling showed no evidence of being weakened.

The breaking strengths of the warps of satins A and B and crepe B when dry were the only ones that increased after 10 launderings. These three showed a definite decrease in strength after 20 launderings. The other warps when dry, showed a tendency to decrease in strength with the number of launderings except for crepe C.

The breaking strengths of the wet samples for both warp and filling were below those of the dry. For satins A, B, and C and crepes A and B, all of which had a silk warp, the warp breaking strength decreased 30 percent or less when wet. The remaining warps, all of which were rayon, decreased much more than this when broken wet, the decrease varying from 40 to 60 percent. This study was too limited to show any superiority in strength of wet acetate over that of other wet rayons, as shown by Smith's study (10).

The fillings for satin A and crepe A, both of which were silk, lost only 20 percent in strength when wet. The other fillings, all of which were rayon, lost from 50 percent to 70 percent in strength when wet.

After abrasion, the breaking strengths for the warp and filling samples showed wide divergence. The abraded warps showed loss of strength greater than the loss which occurred in the wet warps, except in crepe A and satin D. Here the abraded warps decreased less in breaking strength in the controls, but they showed a sharp decrease in strength when abraded after the launderings. The filling strengths of the abraded samples before laundering remained high, and in seven of the eight fabrics, even exceeded the strength of the dry control samples.

A comparison of the warp breaking strength, in pounds, of the eight fabrics studied (Fig. 33) showed the silk warps definitely stronger than the rayon. A similar comparison of the eight fillings (Fig. 34) showed little variation in their breaking strength. However, this comparison of the filling yarns showed the superior wet breaking strength of the two silk fillings.

The warps of the materials studied had a higher breaking strength than the fillings, probably because of the higher thread count of the warp. A comparison of warp and

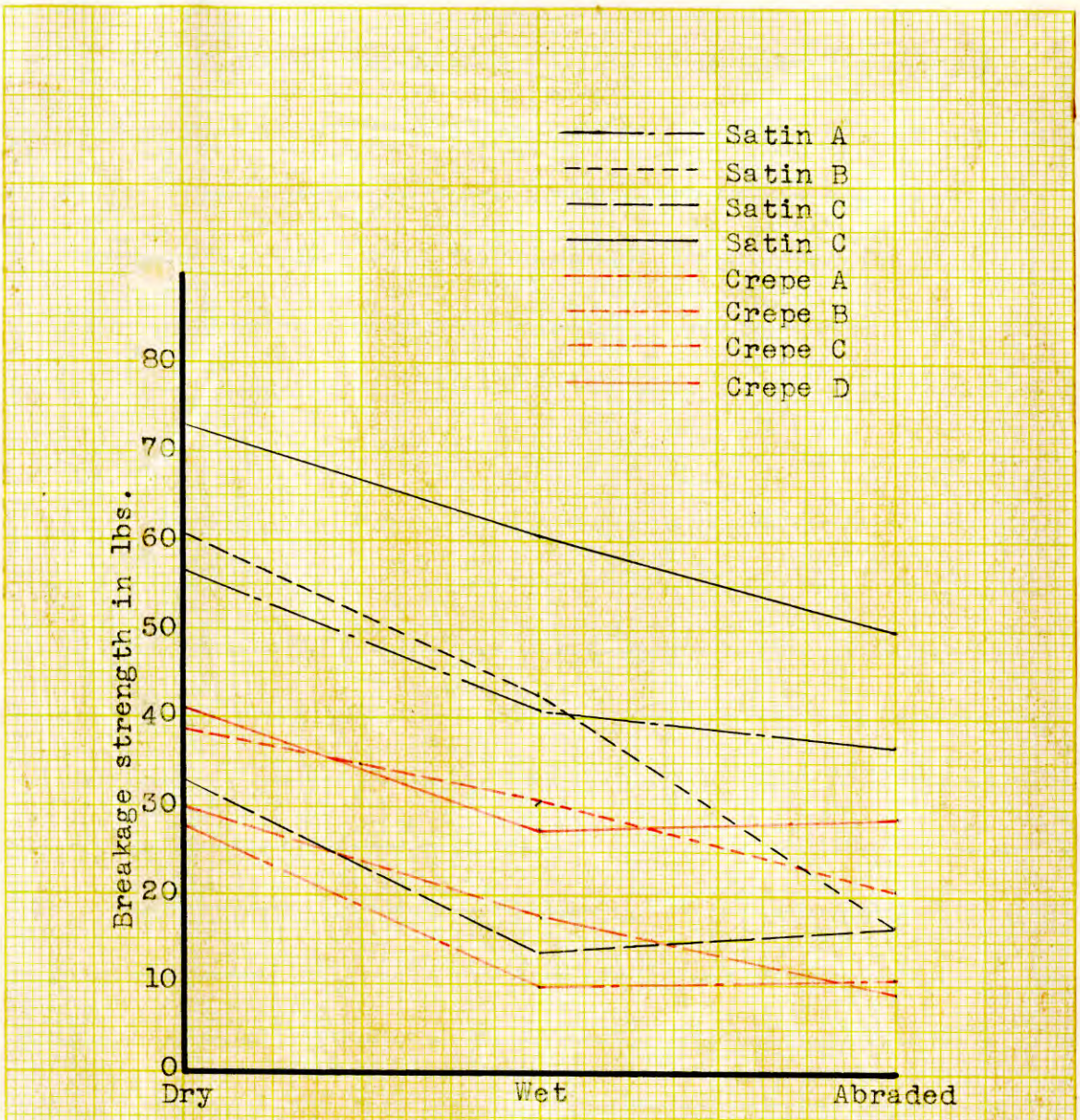

Fig. 33. Dry, wet, and abraded breaking strengths in pounds of the warp controls of the eight fabrics tested.

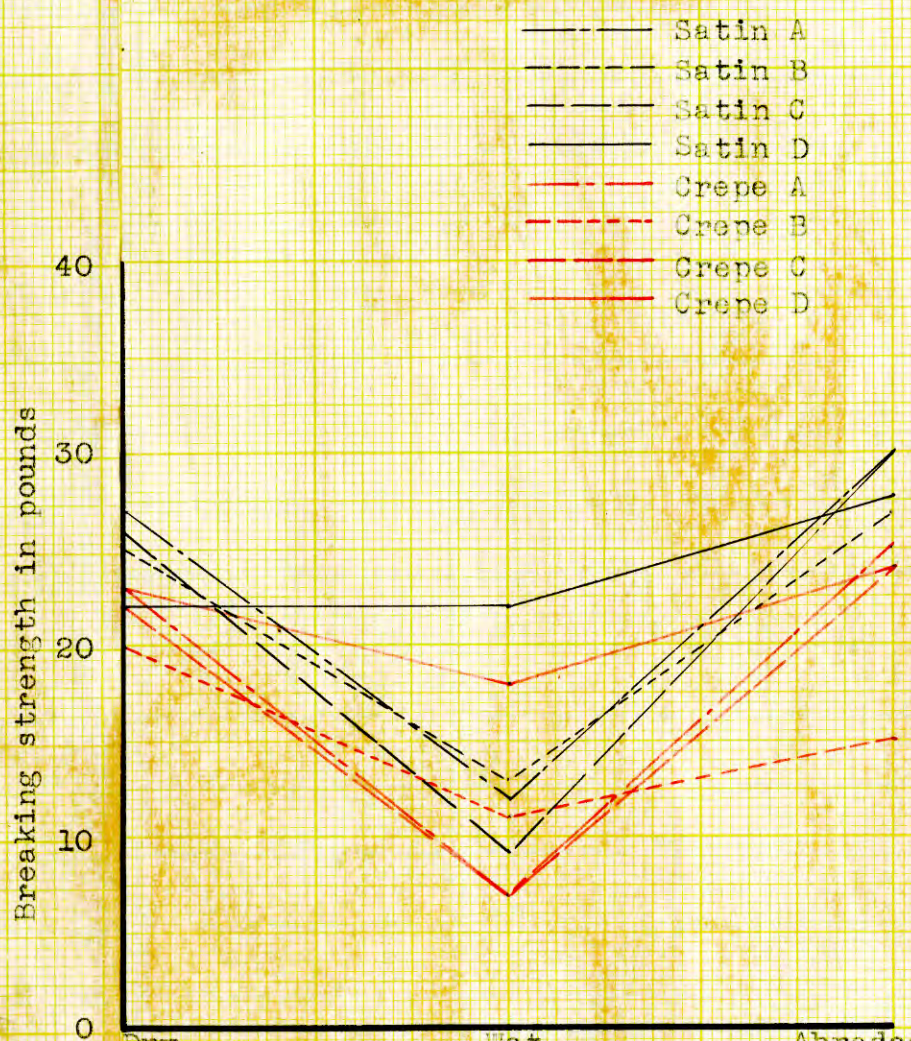

Fig. 34. Dry, wet, and abraded breaking strengths in pounds of the filling controls of the eight fabrics tested.

filling breaking strengths of the dry controls in relation to the thread counts (Fig. 35) showed an increase of breaking strength in proportion to the thread count. A single exception to this relationship was the warp of satin D, the cuprammonium satin. This warp broke much lower than the other warps of similar thread count, all of which were silk.

Elongations for the warp and filling yarns were recorded in Table 5. The percentage of elongation was calculated by dividing the stretch in inches by the gauge length of the sample, which was three inches, and multiplying by 100. The percentages also were recorded in Table 5. The range of elongations was similar for all fabrics, except satin D, (Figs. 36 to 43) the highest elongations varying from 27 to 35 percent and the lowest from 4 to 16 percent. For satin D the range was lower, occurring between 4 percent and 16 percent. In every fabric the wet warp showed the greatest elongation, and the abraded warp showed the lowest. The silk fillings of satin A and crepe A showed a greater elongation when wet than did the rayon fillings in the six remaining fabrics.

The appearance and handle of the fabrics showed a change after 10 launderings and even greater change after 20 launderings (Plates I to IV). The all-silk satin showed only a slight loss of color, while the all- or part-rayon

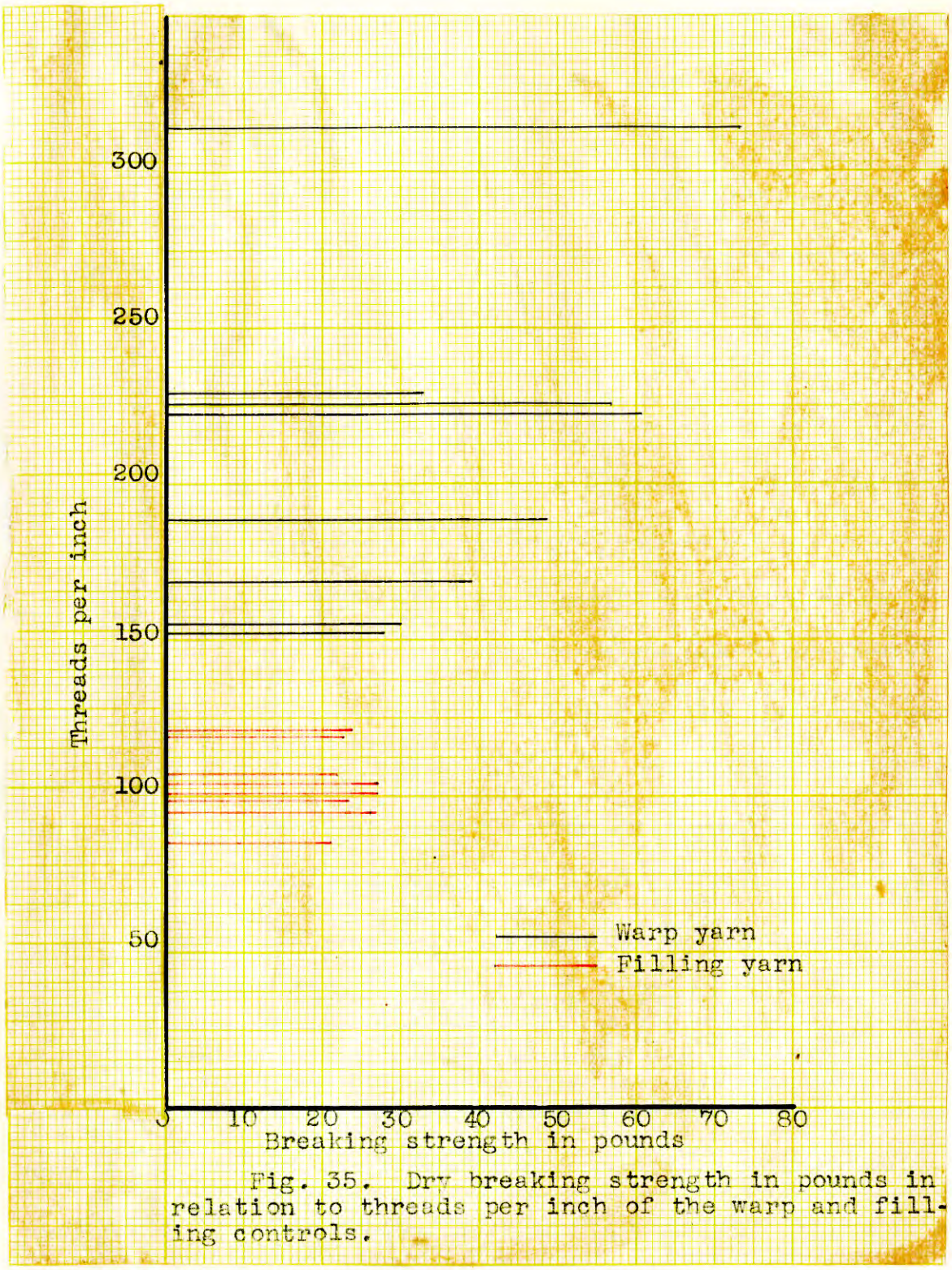

Fig. 35. Dry breaking strength in pounds in relation to threads per inch of the warp and filling controls.

Table 5. Elongations in inches and percentages for warps and fillings of the eight fabrics tested.

Fabric	No. of launderings	Warp elongations						Filling elongations					
		Inches			Percentages			Inches			Percentages		
		Dry	Wet	Abraded	Dry	Wet	Abraded	Dry	Wet	Abraded	Dry	Wet	Abraded
Satin A	0	.69 ± .01	.96 ± .03	.36 ± .01	23.0	32.0	12.0	.74 ± .01	.94 ± .02	.65 ± .01	24.7	31.3	21.7
	10	.69 ∓ .01	.96 ∓ .01	.47 ∓ .03	23.0	32.0	15.7	.76 ∓ .02	.90 ∓ .02	.67 ∓ .01	25.3	30.0	22.3
	20	.59 ∓ .03	.88 ∓ .01	.57 ∓ .01	19.7	29.3	19.0	.69 ∓ .01	.84 ∓ .01	.73 ∓ .02	23.0	28.0	24.3
Satin B	0	.59 ± .02	.86 ± .01	.10 ± .01	19.7	28.7	3.3	.43 ± .01	.51 ± .01	.34 ± .01	14.3	17.0	11.3
	10	.62 ∓ .02	.76 ∓ .01	.12 ∓ .01	20.7	25.3	4.0	.36 ∓ .01	.38 ∓ .01	.30 ∓ .00	12.0	12.7	10.0
	20	.56 ∓ .01	.71 ∓ .01	.35 ∓ .01	18.7	23.7	11.7	.25 ∓ .00	.26 ∓ .01	.30 ∓ .01	8.3	8.7	10.0
Satin C	0	.60 ± .01	.86 ± .01	.27 ± .01	20.0	28.7	9.0	.30 ± .01	.42 ± .01	.35 ± .01	10.0	14.0	11.7
	10	.57 ∓ .01	.80 ∓ .02	.18 ∓ .01	19.0	26.7	6.0	.47 ∓ .01	.40 ∓ .01	.32 ∓ .00	15.7	13.3	10.7
	20	.62 ∓ .01	.77 ∓ .01	.24 ∓ .04	20.7	25.7	8.0	.29 ∓ .00	.28 ∓ .00	.32 ∓ .01	9.7	9.3	10.7
Satin D	0	.43 ± .01	.49 ± .01	.16 ± .01	14.3	16.3	5.3	.38 ± .00	.35 ± .01	.34 ± .00	12.7	11.7	11.3
	10	.46 ∓ .00	.48 ∓ .01	.14 ∓ .01	15.3	16.0	4.7	.43 ∓ .02	.27 ∓ .01	.30 ∓ .01	14.3	9.0	10.0
	20	.42 ∓ .01	.40 ∓ .01	.27 ∓ .01	14.0	13.3	9.0	.31 ∓ .01	.21 ∓ .01	.33 ∓ .01	10.3	7.0	11.0
Crepe A	0	.77 ± .01	.82 ± .03	.48 ± .01	25.7	27.3	16.0	.65 ± .01	.78 ± .01	.51 ± .02	21.7	26.0	17.0
	10	.69 ∓ .01	.80 ∓ .03	.27 ∓ .01	23.0	26.3	9.0	.75 ∓ .01	.76 ∓ .02	.47 ∓ .01	25.0	25.3	15.7
	20	.59 ∓ .01	.65 ∓ .01	.34 ∓ .01	17.7	21.7	11.3	.72 ∓ .01	.77 ∓ .01	.58 ∓ .01	24.0	25.7	19.3
Crepe B	0	.60 ± .01	.84 ± .02	.29 ± .01	20.0	28.0	9.7	.37 ± .01	.46 ± .01	.32 ± .01	12.3	15.3	10.7
	10	.62 ∓ .01	.95 ∓ .01	.26 ∓ .01	20.7	31.7	8.7	.34 ∓ .01	.44 ∓ .01	.85 ∓ .01	11.3	14.7	8.3
	20	.66 ∓ .01	.73 ∓ .03	.51 ∓ .02	22.0	24.3	17.0	.30 ∓ .00	.38 ∓ .00	.34 ∓ .01	10.0	12.7	11.3
Crepe C	0	.61 ± .01	.81 ± .02	.37 ± .01	20.3	27.0	12.3	.77 ± .01	.65 ± .02	.82 ± .01	25.7	21.7	27.3
	10	.81 ∓ .01	.89 ∓ .04	.34 ∓ .02	27.0	29.7	11.3	.80 ∓ .01	.89 ∓ .01	.79 ∓ .01	26.7	29.7	26.3
	20	.88 ∓ .01	.80 ∓ .04	.74 ∓ .02	29.3	26.7	24.7	.72 ∓ .01	.98 ∓ .01	.79 ∓ .01	24.0	32.7	26.3
Crepe D	0	.89 ± .01	1.06 ± .04	.41 ± .01	29.7	35.3	13.7	.57 ± .00	.44 ± .01	.60 ± .01	19.0	14.7	20.0
	10	.99 ∓ .02	.96 ∓ .05	.39 ∓ .01	33.0	32.0	13.0	.70 ∓ .01	.61 ∓ .01	.61 ∓ .01	23.3	20.3	20.3
	20	.99 ∓ .01	1.07 ∓ .04	.82 ∓ .03	33.0	35.7	27.3	.55 ∓ .01	.49 ∓ .01	.67 ∓ .01	18.3	16.3	22.3

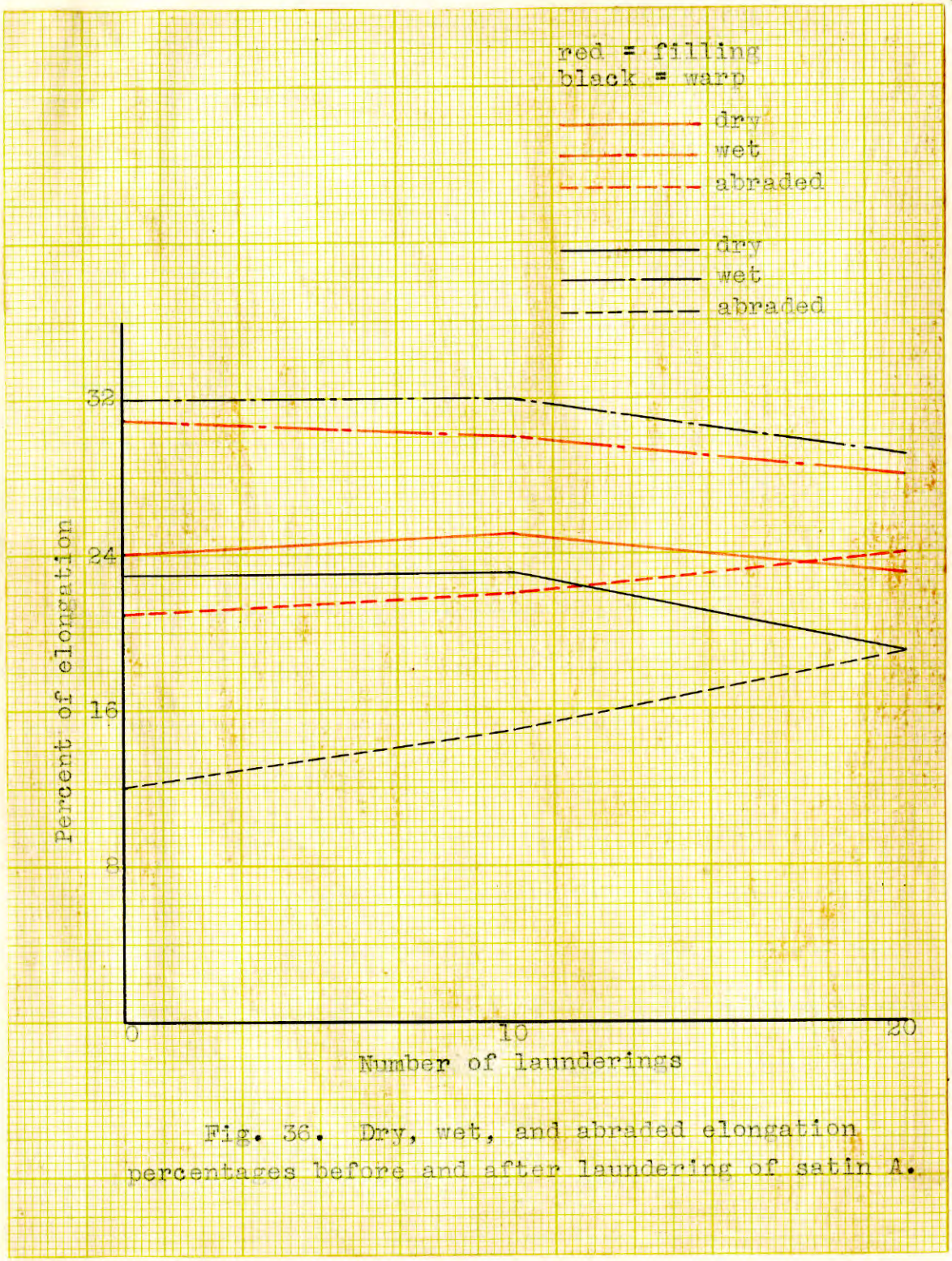

Fig. 36. Dry, wet, and abraded elongation percentages before and after laundering of satin A.

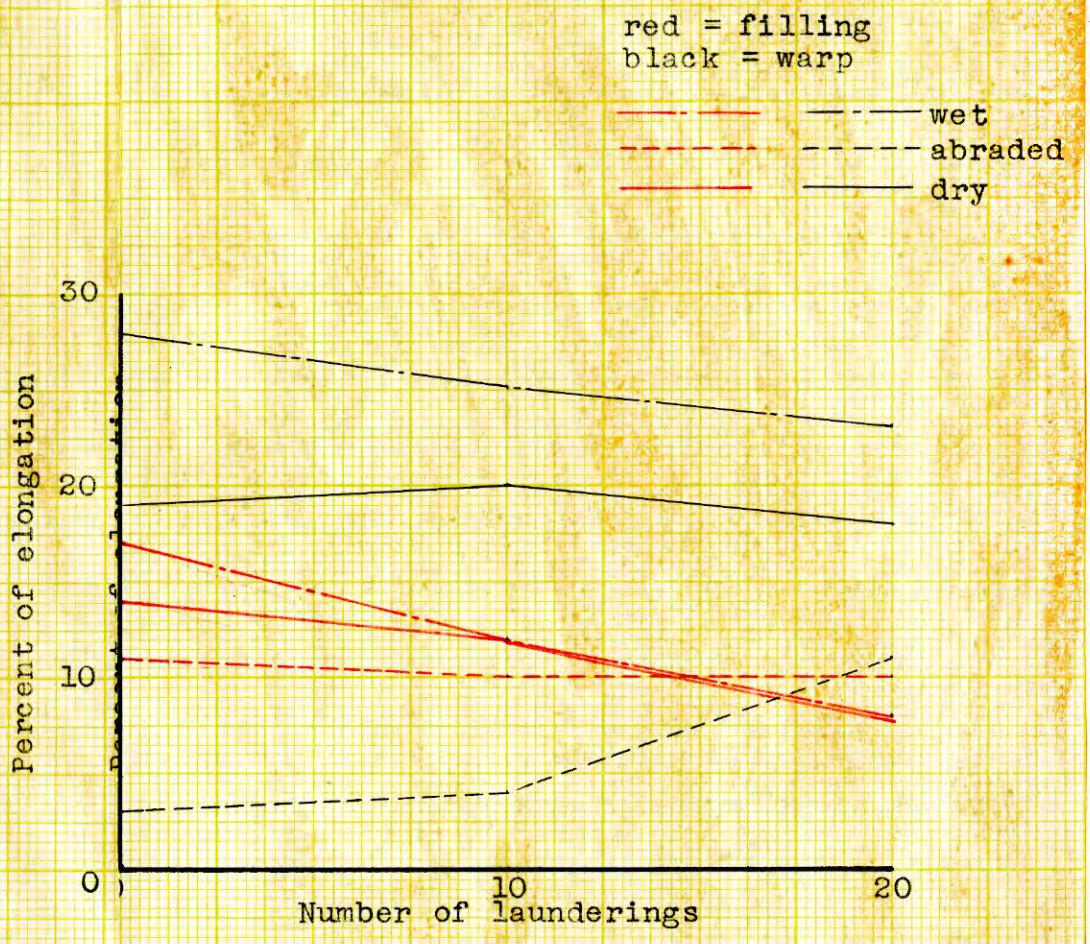

Fig. 37. Dry, wet, and abraded elongation percentages before and after laundering of satin B.

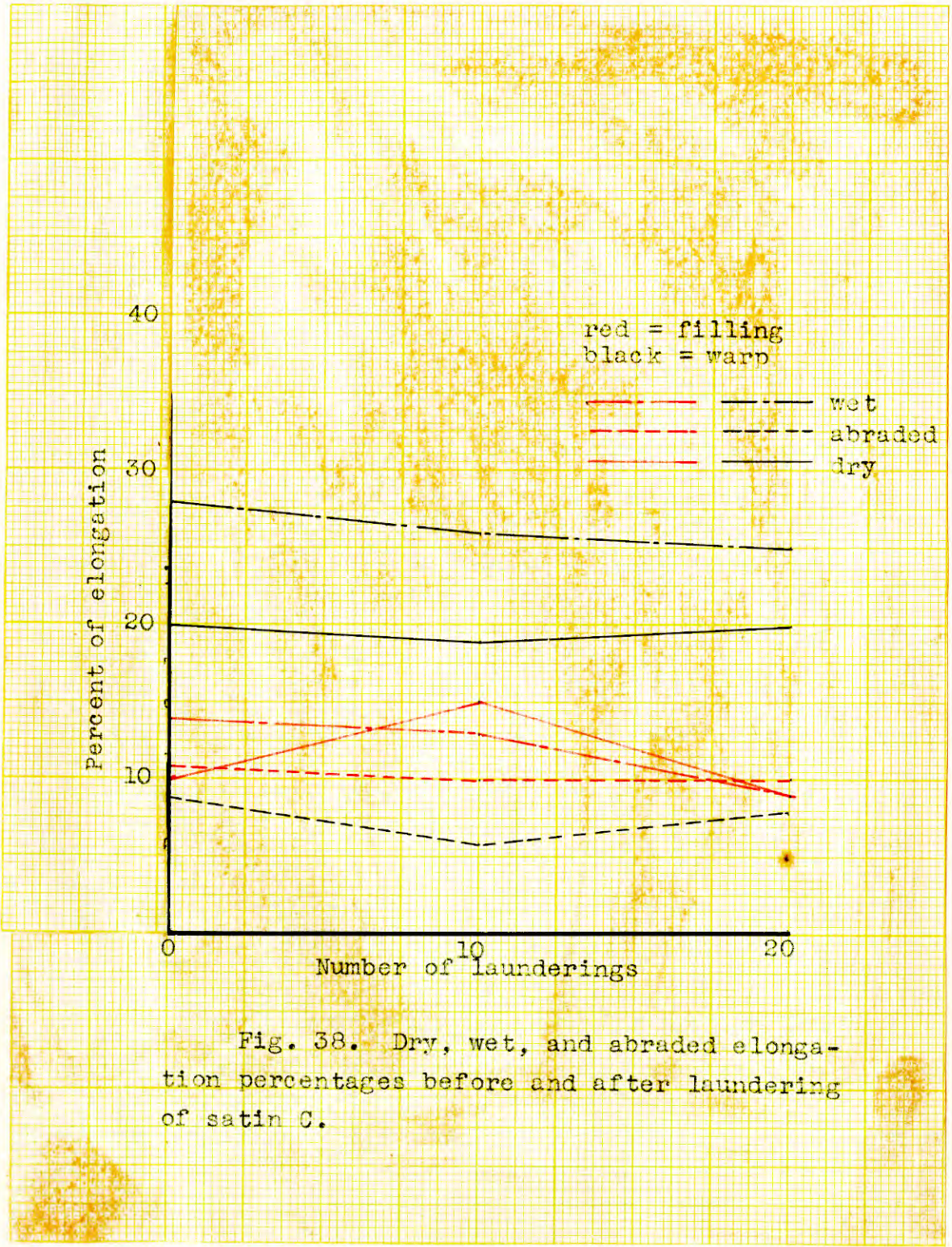

Fig. 38. Dry, wet, and abraded elongation percentages before and after laundering of satin C.

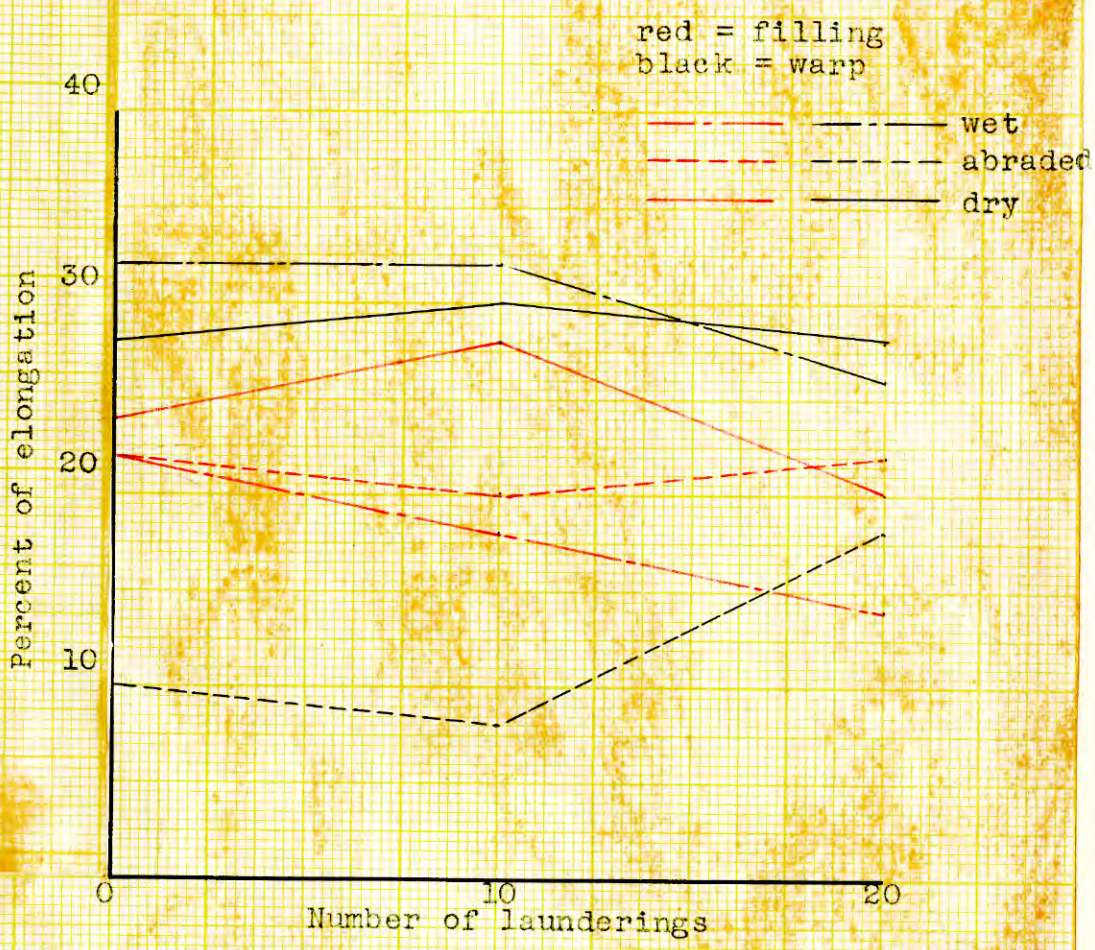

Fig. 39. Dry, wet, and abraded elongation percentages before and after laundering of satin D.

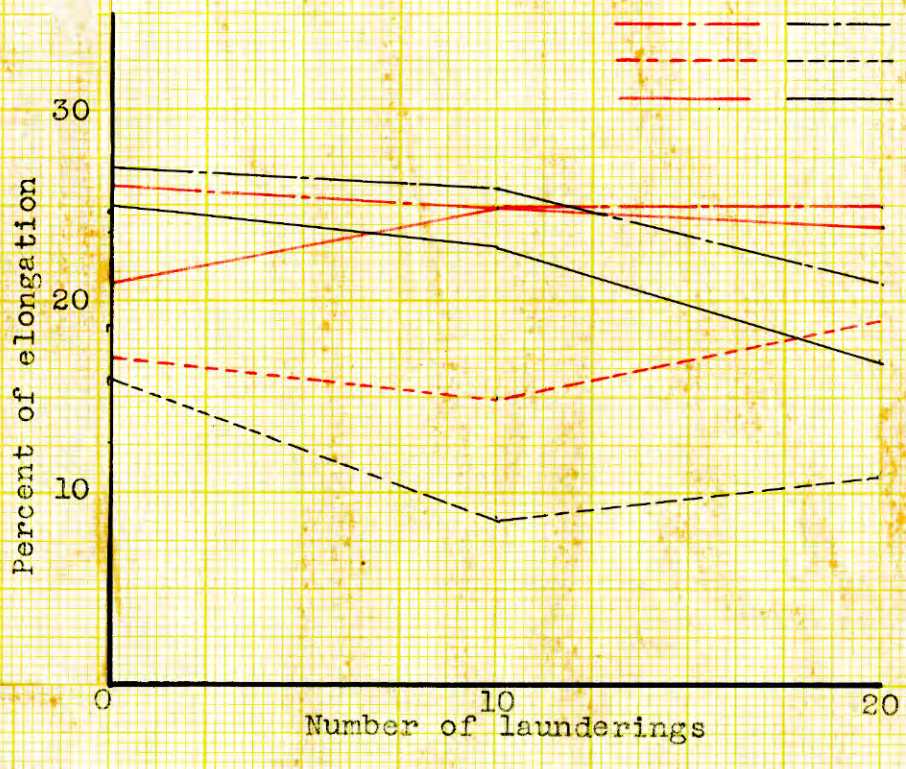

Fig. 40. Dry, wet, and abraded elongation percentages before and after laundering of crepe A.

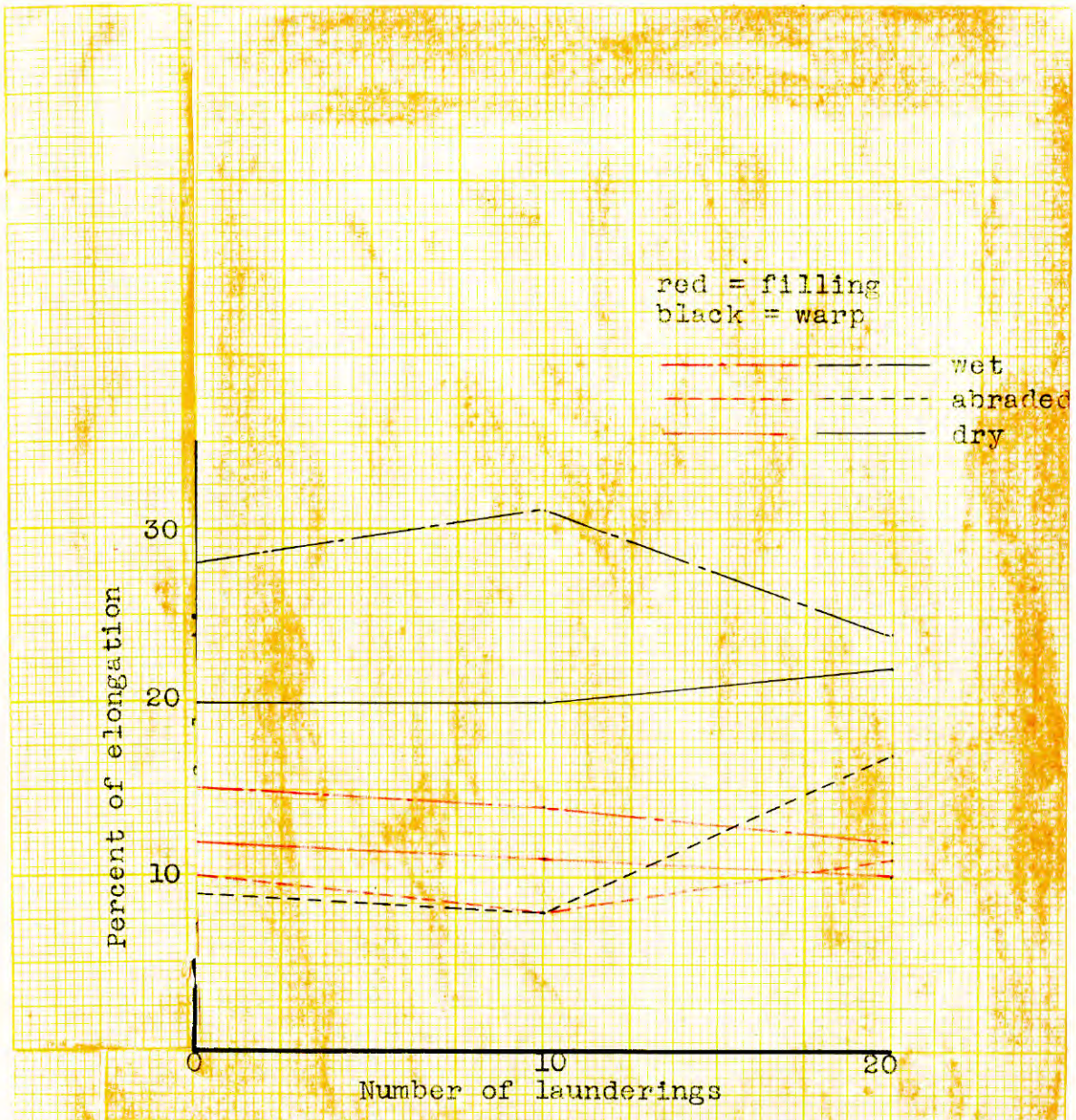

Fig. 41. Dry, wet, and abraded elongation percentages before and after laundering of crepe B.

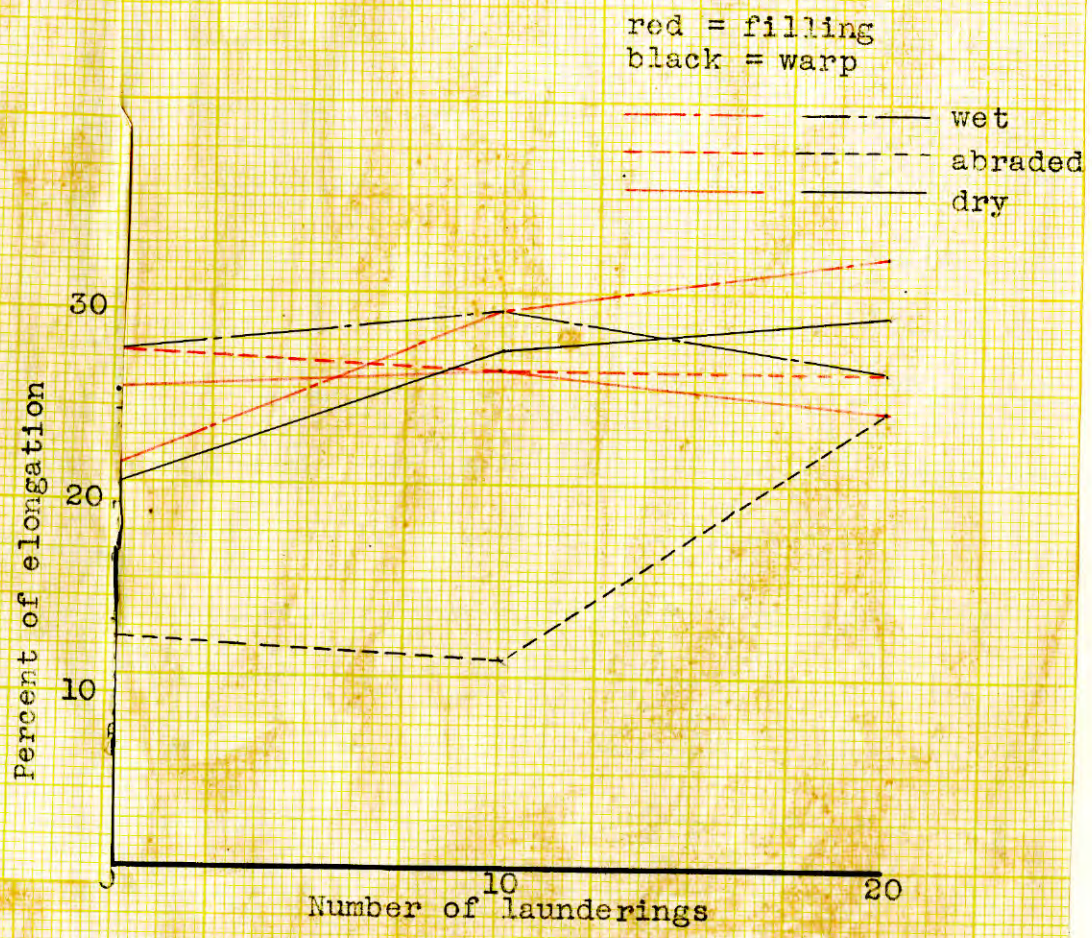

Fig. 42. Dry, wet, and abraded elongation percentages before and after laundering of crepe C.

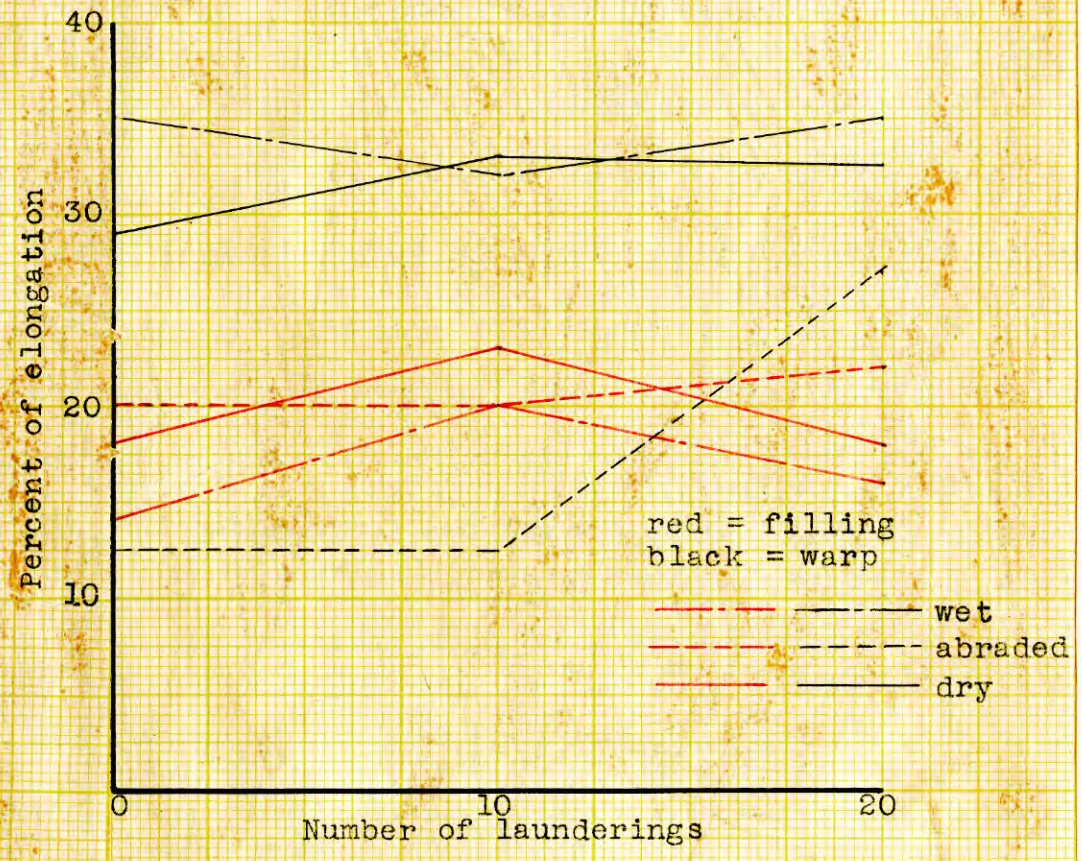

Fig. 43. Dry, wet, and abraded elongation percentages before and after laundering of crepe D.

satins and crepe faded to a marked degree. The white silk showed a tendency to turn yellow after the launderings, whereas the all-rayon crepes retained their original whiteness. The all-silk satin and crepe lost much of their body after the laundering, probably because of the loss of soluble weighting. The all- or part-rayon fabrics lost some of their softness after the launderings. The all-rayon crepes and satin acquired a harsh handle that lessened their desirability. This may have been caused by the high temperature of the steam press used on them after laundering. The all-rayon satin was the only one of the fabrics which lost its silk-like appearance. This satin became shiny and lost entirely its softness after the laundering. The silk and rayon mixed satins and crepe retained their body and pleasing handle. The only unsatisfactory change in these mixed fabrics was the loss of color.

SUMMARY

1. The breaking strengths of the fabrics tested increased in direct proportion to the number of threads per inch. The silk yarns had breaking strengths superior to those of the rayon yarns when dry, and showed less decrease in strength when wet than did the rayon yarns. There was a tendency for all yarns to have lower breaking strengths

after 10 launderings, and all breaking strengths definitely decreased after 20 launderings. After abrasion, the warps showed an even greater loss in strength than did the wet warps, but the breaking strengths of the filling yarns remained nearly constant.

2. The lowest percent of elongation occurred in the cuprammonium satin. In every fabric tested the wet warp showed the greatest elongation, and the abraded warp showed the lowest. The filling yarns of the two silk fabrics showed a greater elongation when wet than did the rayon fillings in the six other fabrics.

3. All the fabrics tested showed some shrinkage. The all-rayon crepes exhibited the greatest amount, with an area decrease of approximately 10 percent.

4. Of the eight materials studied, the two all-silk fabrics were the only ones which showed slippage.

5. The all-silk satin showed less color change than did the all- or part-rayon satins or crepes. The white silk turned yellow after laundering, whereas the white rayons retained their whiteness.

ACKNOWLEDGMENT

Appreciation is expressed to Dr. Hazel Fletcher, Assistant Professor of Clothing and Textiles, for her guidance and interest in this study.

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