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## Effect of Laundering and Starching on the Serviceability of Cotton Shirts

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### SUMMARY

*Forty white broadcloth shirts were laundered 36 times by four methods at Prairie View A&M College: traditional black pot method of soak, rub, boil, rinse and dry outdoors; modern home method with starch; modern home method without starch; and in the Prairie View College commercial laundry without starch. Half of the shirts were worn 1 day between launderings; the other half were laundered but not worn.*

*The wearers thought shirts without starch did not look as well or stay fresh as long but were more comfortable than starched shirts.*

*The effect of various laundry methods on soil removal, color and strength of the shirts was determined by tests in the laboratory of the Texas Agricultural Experiment Station at College Station.*

*The black pot method was the more effective for removal of stains and soil and the shirts washed by this method were the whitest, perhaps because of bleaching by sunlight while drying outdoors. Those laundered by the modern home methods remained white throughout the study. The commercially laundered shirts soon became yellow and dingy and did not regain their whiteness.*

*Commercial laundering caused much greater loss in strength in both the worn and unworn shirts than the other methods of laundering. The black pot method caused greater loss in strength than the modern home methods.*

Three methods of laundering are in common use — commercial, home methods with modern equipment and the traditional black pot method which is still used in some areas, especially in the south.

Studies were conducted at Prairie View A&M College on the effectiveness of various laundry methods in removing soil and the effect of each method on the serviceability of cotton shirts. Laboratory work was done at College Station.

### PROCEDURE

Forty white cotton broadcloth shirts were laundered 36 times between May 1953 and June 1956. Half of the shirts were worn and half were not worn. As they were short-sleeved sport shirts they were worn only in warm seasons.

Ten shirts were laundered without starch, by the traditional or black pot method — soak, rub, boil, rinse and hang outside to dry. Ten shirts were laundered with modern home equipment consisting of an automatic washer-dryer combination, but were not starched. Ten other shirts were laundered by the same method and starched. Ten other shirts were laundered without starch in the commercial laundry of the college of Prairie View.

Five shirts were laundered by each of the four methods and distributed to 5 men who wore each shirt 1 day between launderings. The shirts were collected and laundered each week and distributed again to the wearers. The shirts were rotated each week among the wearers.

After 36 launderings the shirts were removed from service and were examined for signs of wear and tested for breaking strength by the ravelled strip method. Losses in strength from the strength of the original fabric were calculated.

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## METHODS OF LAUNDERING

### Commercial Laundry Method, without Starch

The process of the commercial laundry, as given by the foreman, follows:

The break — soak for 5 minutes with very little pensal at 130° F.

The first suds—10 minutes with pensal and amber soap flakes at 130° F.

The second suds—same as the first suds with amber soap flakes and pensal 10 minutes at 160° F.

The third suds—without soap but with 1 percent chlorine bleach for 10 minutes at 160° F.

Four hot rinses, 5 minutes for each rinse at 160° F.

The unload process.

Extracting—remove 70 percent of the water.

The four-operator pressing unit:

First operator—iron back of the shirt.

Second operator—iron collar, yoke and place on the sleeve ironer.

Third operator—iron front of the shirt.

Fourth operator—fold the shirt.

The time required to iron each shirt was 1½ minutes with steam pressure. The shirts were delivered to the inspector, folded and made ready to distribute to the wearers.

### Modern Home-laundry Method, with and without Starch

The automatic washer-dryer guide was used for the modern home-laundry process.

Soaking—for 10 minutes, very little soap powder.

First wash—for 15 minutes with added soap powder.

First rinse for 15 minutes.

Spin—for 5 minutes.

Second rinse—cold water for 10 minutes.

Third rinse—cold water for 10 minutes.

Spin—10 minutes.

Dry—15 minutes in washer-dryer.

Some of the shirts were dampened and rolled in a cloth until ready to iron. Others were starched when removed from the washer, dried in the dryer, dampened and rolled in a cloth until ready to iron.

The ironing was done with a hand electric iron and required approximately 15 minutes per shirt.

### Black Pot Laundry Method, without Starch

The process used in the black pot method was:

Soaking — for 30 minutes with very little soap powder, in 6 gallons of water at 112°

F to 115° F, and rubbing the shirts slightly in the soaking water, wrong side out.

First suds—after draining and wiping the tub out, run into the tub 6 gallons of water, dissolve soap powder and pour 2 quarts of hot water into the tub to make a good suds. Rub the shirts slightly on a washboard, giving special attention to the collar of the shirt until the shirts are fairly clean.

Boiling process—place the shirts in a pot of cool water with a little soap powder, and allow the water to boil for 10 minutes, punching down with a stick when necessary.

Second suds — remove the shirts from the pot with the clothes stick and put in a tub of warm water. Rub slightly on the washboard.

First rinse — in warm water removing as much soap as possible.

Second rinse — in cold water until free of soap.

The shirts were hung on the clothesline by the tail and left until dry.

The shirts were taken from the line and sprinkled evenly, rolled in a cloth for 1 hour, then ironed as in the earlier section.

TABLE 1. TIME SHIRTS WERE WORN

Shirt number and laundry method	Hours worn				Total
	1953 13 weeks	1954 10 weeks	1955 8 weeks	1956 5 weeks	
<b>Commercial</b>					
1	133	68	74	54	329
2	101	74	48	30	253
3	128	76	68	47	319
4	120	50	61	32	263
5	93	63	63	25	244
	575	331	314	188	1407
<b>Home, starched</b>					
1	116	64	72	48	300
2	117	69	63	14	263
3	118	64	73	37	292
4	120	58	68	35	281
5	107	65	59	40	271
	578	320	335	174	1407
<b>Home, not starched</b>					
1	116	79	68	50	313
2	104	70	66	32	272
3	131	81	75	45	332
4	120	56	73	36	285
5	110	62	70	36	278
	581	348	352	199	1480
<b>Black pot</b>					
1	126	85	75	43	329
2	100	59	64	26	249
3	120	61	73	45	299
4	113	52	60	32	257
5	103	56	59	25	243
	562	313	331	171	1377

## RESULTS AND DISCUSSION

The total number of hours the shirts were worn was 1,407 for the commercially laundered, 1,406 for the home-laundered starched shirts, 1,480 for the home-laundered unstarched shirts and 1,376 hours for those laundered by the black pot method, Table 1. The 5 shirts were rotated among the days of the week and it was expected the shirts would be worn approximately the same number of hours.

### Preferences of Wearers

For three of the four summers, the shirts washed by the black pot method were worn fewer hours than the shirts laundered by the other three methods, Table 1. The shirts home laundered without starch were worn more hours each summer than the shirts laundered by the other methods. If difference in the number of hours the shirts were worn was an unconscious expression of preference, then the wearers preferred the shirts home laundered without starch over all others, had no choice between the commercially laundered and the home-laundered starched shirts and liked those laundered by the black pot method the least.

When asked, the wearers expressed a preference for starched shirts because they looked better and did not wilt as soon as those without starch. However, they thought unstarched shirts were more comfortable. There is some evidence that in spite of their greater yellowness and more stains, some of the wearers liked the commercially laundered shirts. The men were accustomed to the kind of work done by the laundry and to the folded shirts.

### Appearance of Shirts

*Commercial laundry.* The labels on the shirts were well worn at the end of 13 launderings on both the shirts that were worn and those not worn, and a small hole appeared in one of the worn shirts.

By the end of the 36 launderings, these shirts, both worn and not worn, had broken and missing buttons, holes in the collars and stains. All shirts were decidedly yellow.

*Modern home laundry, starch.* At the end of the first 13 weeks of laundering the shirts showed frayed labels, pocket stains and faded laundry marks. By the time the shirts had been laundered 36 times, the worn shirts were visibly thin, with holes in the collars and sleeve hems. The shirts not worn were thin also, but no holes were noted. The shirts remained white.

*Modern home laundry, no starch.* After 13 launderings all labels were worn, all laundry markings were faded, and some stains and iron

rust were present. By the end of 36 launderings, the fabric was thin and the sleeves worn. The fabric was thinner in the worn shirts than in those not worn. The shirts remained white.

*Traditional home laundry, black pot.* The labels were only slightly worn in contrast with the other shirts where the labels were well worn at the end of 13 weeks of laundering. Two of the shirts (not worn) had perfect labels. After 36 launderings the collars, sleeves and backs of the shirts were worn very thin. Some holes were in the shirts that had been worn. These shirts were much whiter than any of the other shirts probably because of bleaching by sunlight when drying outdoors.

### Breaking Strength

The breaking strengths of the warp and filling of the original fabric, of the laundered shirts, and of the worn and laundered shirts were determined, Table 2.

TABLE 2. BREAKING STRENGTH OF LAUNDERED SHIRTS AND OF WORN AND LAUNDERED SHIRTS, IN POUNDS

Method of laundering	Laundered only		Worn and laundered	
	Warp <sup>1</sup>	Filling <sup>2</sup>	Warp	Filling
Commercial	31.9	12.9	20.9	11.2
Home, starched	45.7	21.6	26.7	16.7
Home, not starched	46.6	20.7	30.1	15.6
Black pot	41.9	19.7	27.6	16.9

<sup>1</sup>Original fabric warp strength, 64.4 pounds.

<sup>2</sup>Original fabric filling strength, 35.8 pounds.

For the shirts that were laundered only, commercial laundering caused much greater loss in strength in both the warp (50 percent) and in the filling (64 percent) than any of the home methods of laundering (28 to 45 percent). These findings are in agreement with previous studies.<sup>1</sup> Among the home methods, the black pot method caused greater loss than the other home methods. The significance of the differences in loss in strength among the laundry methods is given in Table 3.

The differences in warp and filling were significant beyond the 1 percent level between the commercial and all home-laundry methods. The

<sup>1</sup>Grimes, M. A. and Werman, C. A., Tex. Agri. Expt. Sta. Prog. Report 1504 (1952).

Grimes, M. A. and Werman, C. A., Modern Textiles 35, 48, 71-73 (1954).

Grimes, M. A. and Werman, C. A., Textile Research Journal 26, 112-113 (1956).

TABLE 3. SIGNIFICANCE OF DIFFERENCES IN BREAKING STRENGTH AMONG LAUNDRY METHODS OF UNWORN SHIRTS

Method of laundering	Home, starched		Home, not starched		Black pot	
	Warp	Filling	Warp	Filling	Warp	Filling
Commercial	19.151 <sup>1</sup>	26.484 <sup>1</sup>	23.403 <sup>1</sup>	21.948 <sup>1</sup>	11.679 <sup>1</sup>	14.518 <sup>1</sup>
Home, starched			1.096	2.789 <sup>2</sup>	3.699 <sup>1</sup>	4.213 <sup>1</sup>
Home, not starched					4.899 <sup>1</sup>	2.137 <sup>3</sup>

<sup>1</sup>To be significant at the 1 percent level, t must be at least 3.506.

<sup>2</sup>To be significant at the 1 percent level, t must be at least 2.678.

<sup>3</sup>To be significant at the 5 percent level, t must be at least 2.008.

loss in strength with the black pot method was significantly greater than with the other home methods. There was slightly greater loss in strength of the filling, but slightly less in the warp of the starched than in the unstarched shirts.

The shirts that were worn also lost significantly more strength when laundered in the commercial laundry than when laundered by any of the home methods, Tables 2 and 4.

The worn starched shirts lost somewhat more strength in the warp but less in the filling than those not starched. There was no significant dif-

TABLE 4. SIGNIFICANCE OF DIFFERENCES IN BREAKING STRENGTH AMONG LAUNDRY METHOD FOR WORN SHIRTS

Method of laundering	Home, starched		Home, not starched		Black pot	
	Warp	Filling	Warp	Filling	Warp	Filling
Commercial	4.314 <sup>1</sup>	11.906 <sup>1</sup>	6.560 <sup>1</sup>	9.251 <sup>1</sup>	5.652 <sup>1</sup>	13.649
Home, starched			2.416 <sup>2</sup>	2.129 <sup>2</sup>	.855	.453
Home, not starched					1.854	2.743

<sup>1</sup>To be significant at the 1 percent level, t must be at least 3.506.

<sup>2</sup>To be significant at the 5 percent level, t must be at least 2.008.

<sup>3</sup>To be significant at the 1 percent level, t must be at least 2.678.

ference between the starched and the black pot laundered shirts. There was greater loss in the filling of the shirts not starched than in those laundered by the black pot method.

From these determinations it is concluded that commercial laundering caused much greater loss in strength and more yellowing than any of the home methods used.

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