

BLEACHES . . .

Whitening Effect and Fabric Strength

Mary Lapitsky

Carolyn Kyes

Mary Brown Patton



Ohio Agricultural Experiment Station

Wooster, Ohio

BLEACHES . . .

Whitening Effect and Fabric Strength

Many homemakers today consider bleaching an essential part of the laundry process. Surveys show that four of five women use a bleach in machine laundering of white clothes. One of three use it in washing colored clothes. But considerable confusion and little understanding exist as to differences between brands or types of bleach.

Ten or more years ago, the homemaker had little difficulty in selecting a bleach since only a limited number was available. Today, this number has multiplied and still more bleaches are being developed, some of which will find their way to the market shelves. Further, some of the old familiar bleaches are being displayed in new packages. Glass for bottles is being replaced by plastic as a safety measure; and premeasured packages are appearing on the market.

Confronted with the wide array of bleaches available, the homemaker may well ask, which type will do the best job of keeping or getting clothes white. Will the use of bleach week after week harm the fabric and make it wear out quickly? Also, what will happen to the wear-life of the fabric if double the amount recommended by the manufacturer is used? To help answer these questions, an investigation was conducted by the Home Economics Department of the Ohio Agricultural Experiment Station.

PROCEDURE

One phase of the study dealt with the relative whitening effect of various types of bleaches. Some examples of the many bleaches on the market or in test markets are:

Chlorine	
Liquid	Dry
Clorox	Action
Fleecy White	Beads-o'-Bleach
McCoy's	Star Dust (in test market)
Purex	
Roman	Trey
Peroxy	
Perborate	Persulfate
Dexol	
Lestare	Dri-Brite
Safety	Du-Rite
Snowy	
Thanx	

This experiment was carried out with four of the above bleaches:

- (1) liquid chlorine, (2) dry chlorine, (3) perborate and (4) persulfate.

Liquid chlorine bleaches on the market are similar in chlorine content. Dry chlorine bleaches vary in formulation and as a result differ in performance and in stability of the bleaching agent after the package is opened. The one used in this study is a derivative of cyanuric acid and tests have shown that the bleaching agent is stable in the opened package.

Perborates are sometimes referred to as "light duty" bleaches. They are reputed to be safe for all fabrics when used in recommended amounts.

The persulfates are among the newer bleach products. In fact they are not available nationally and can be found only in certain areas where they are sold on a test market basis. Some have sodium chloride added; the one used in this study does not contain sodium chloride and according to the manufacturer is different in formulation than the other persulfates.

Bleaches were used on the following test fabrics in amounts recommended by the manufacturers for heavy soil:

- a) Cotton which had been immersed in an aqueous suspension of vacuum cleaner dirt (hereafter referred to as dry soil), and
- b) Cotton and spun Dacron*, nylon and Orlon* which were printed with an oily suspension of lampblack (hereafter referred to as oily soil).¹

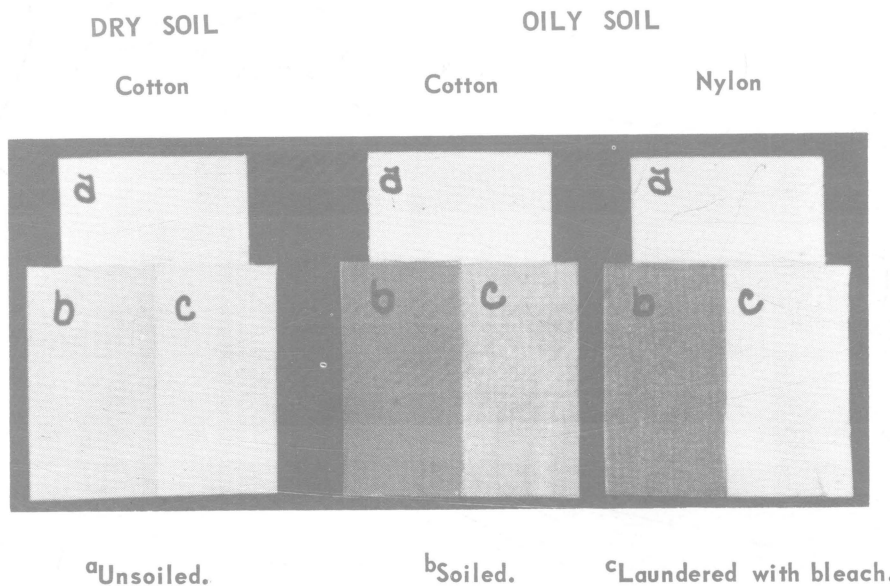
All of the above fabrics, especially the oily soil ones, were heavily soiled.

One set of these test swatches, the control group, was laundered for ten minutes in a pulsator-type washer. Hot water ($140^{\circ} \text{F} \pm 5^{\circ}$) was used with a 0.25 percent concentration of a low-sudsing type of detergent². The remaining four sets were laundered under the same conditions except that one of the four bleaches was added to the washing solution.

After the test swatches were laundered once, dried and lightly pressed, a photoelectric reflection meter was used to determine the whitening efficiency of the bleaches.

¹Due to limitations of time other soil formulae and other fabrics could not be included in this experiment.

²This concentration was used since Columbus water had an average of six grains of hardness per gallon at the time the investigation was conducted.



Examples of fabrics on which reflectance readings were made.

The second part of the investigation was concerned with the effect of the repeated use of recommended amounts of the selected bleaches (dry and liquid chlorines, perborate and persulfate) on the breaking strength of unsoiled cotton and nylon fabrics. In addition, the two chlorine bleaches were used in

amounts twice that recommended by the manufacturers for heavy soil to determine the effect of overuse of these products on cotton and nylon. Fabric strength was measured at the end of 1, 7, 13, 19 and 25 launderings by a Scott tester which records the number of pounds required to break a strip of fabric.

FINDINGS

Investigation of soil removal and the relative whitening effects of the bleaches showed that detergent alone removed approximately 60 percent of the dry soil from cotton (Fig. 1). No increase in whitening resulted when perborate bleach was used in the washing solution and less than 5 percent additional whitening (or total of 64.5 percent) occurred when persulfate was used. The addition of the chlorine bleaches gave 74 percent whitening for the dry chlorine and 75 percent for the liquid which was significantly better than detergent alone or the above two bleaches.

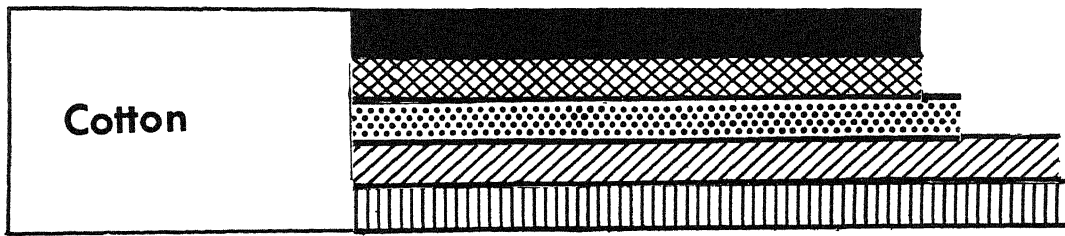
The performance of all products in removing oily soil or in producing whitening effects varied considerably with the kind of fabric. The oily soil was most difficult to remove from cotton and most easily removed from nylon. Detergent alone removed only about 27 percent of this soil from cotton and there was no significant improvement in whitening when any of the bleaches were added. With nylon, detergent alone removed 68 percent of the oily soil. Of the bleaches, only the addition of persulfate appreciably increased whitening of the nylon which was 8 to 13 percent above that of any other bleach.

Dacron* and Orlon* were approximately midway between cotton and nylon in their resistance to removal of oily soil or resultant whitening effects. with both fabrics the use of liquid chlorine resulted in greater whitening than did any of the other bleaches.

Investigation of losses in breaking strength showed that very little occurred in the cotton warp³ when the fabric was washed 25 times in detergent only (approximately 3 pounds or less than 4 percent; very little, if any, was also evidenced when the perborate or persulfate bleach was used) (Fig.2). The addition of recommended amounts of either of the chlorine bleaches resulted in greater deterioration of the cotton after only 7 launderings than was true for the above after 25. At the end of 25 launderings, about 12 pounds or 15 percent of the strength of the cotton was lost when the dry chlorine was added and approximately 18 pounds or 23 percent when liquid chlorine was used.

³Since a greater percentage of loss in breaking strength occurred in the warp than in the filling in every instance except one after 25 launderings, only data for the warp are reported here.

DRY SOIL



OILY SOIL

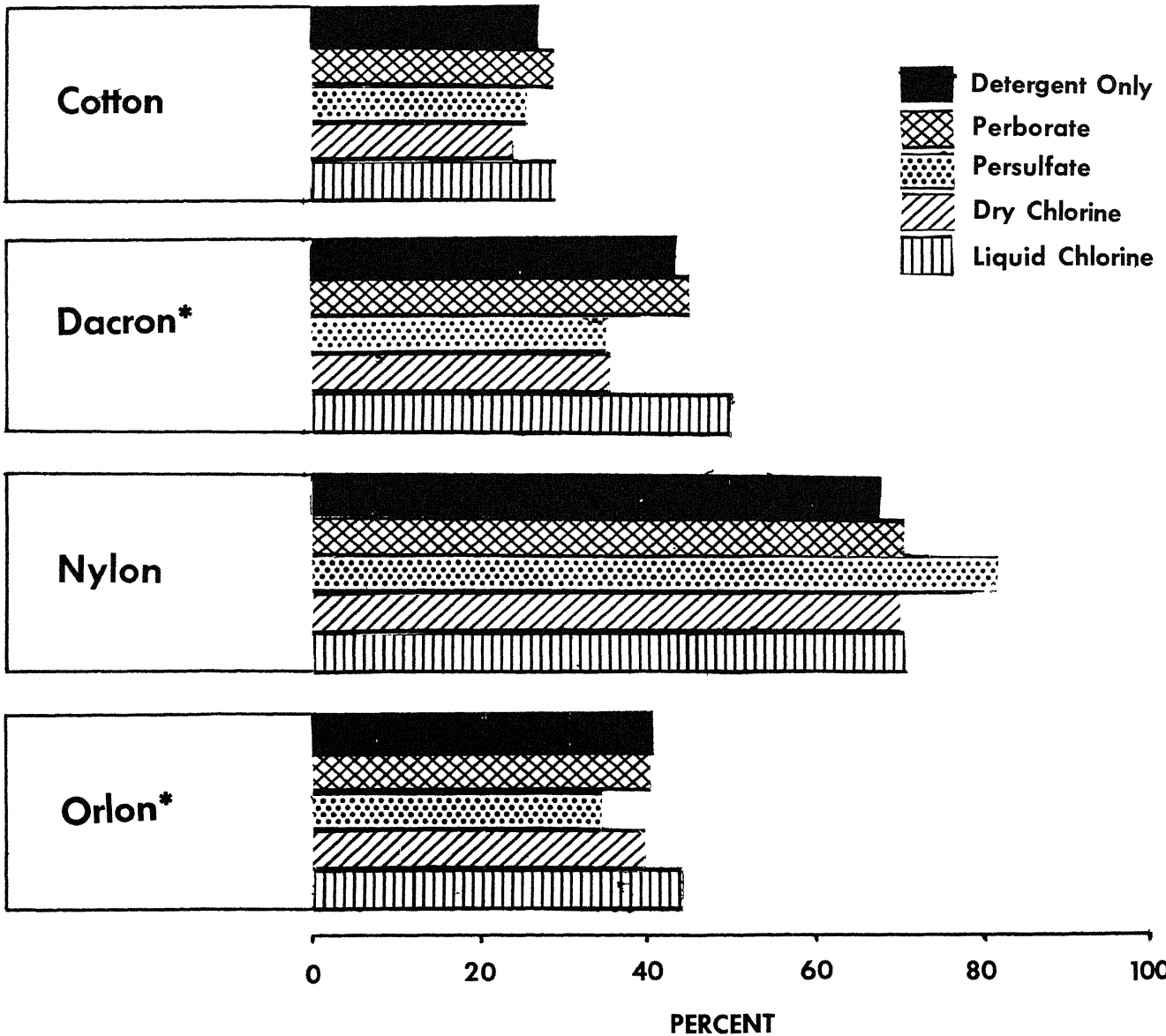


Fig. 1.—Average percentage of soil removed with detergent only and whitening effects of four different bleaches when used on soiled test materials.

*Registered Trade Name (DuPont).

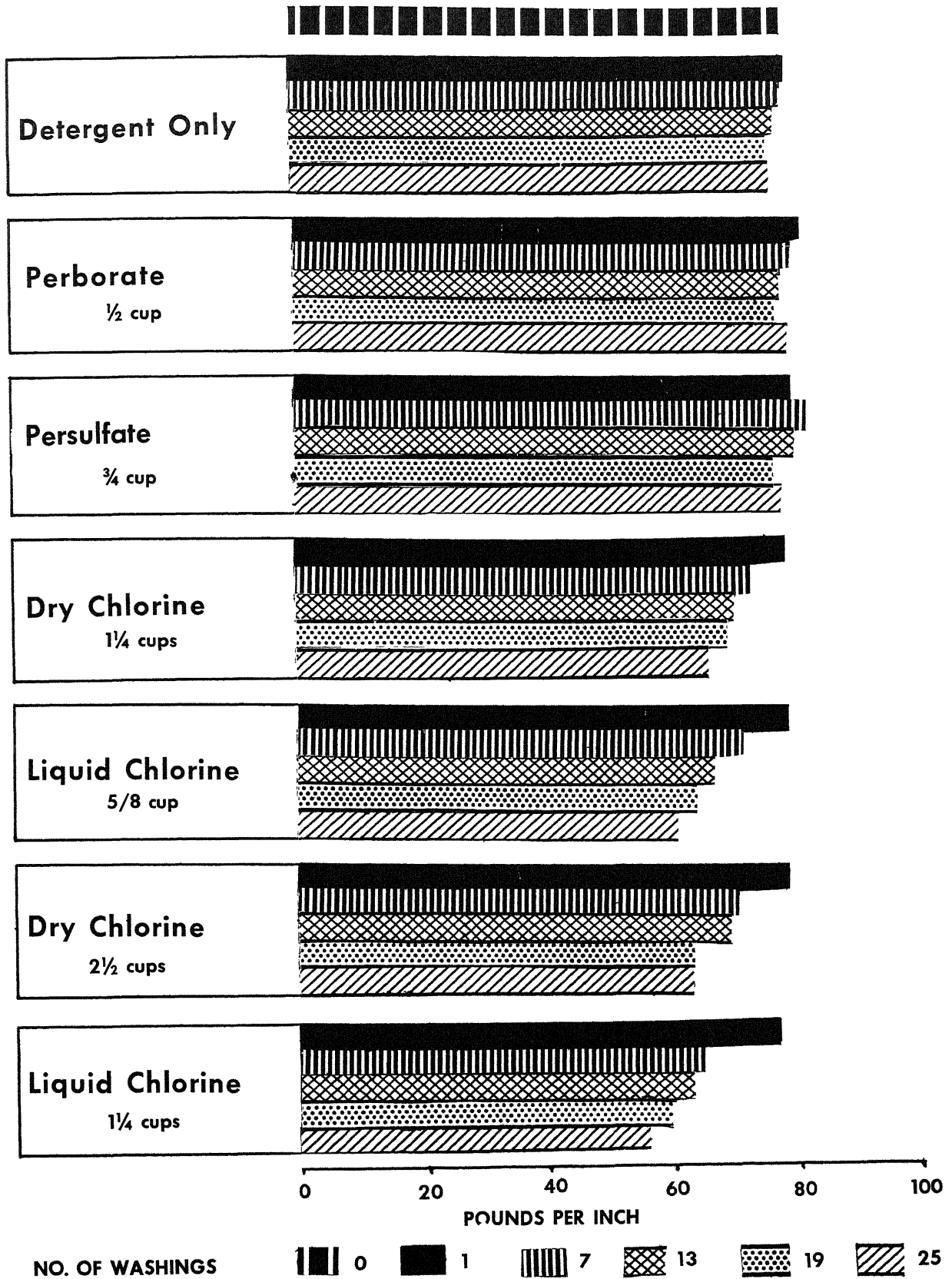


Fig. 2.—Average pounds breaking strength of cotton warp for seven different laundry treatments after equivalent numbers of washings

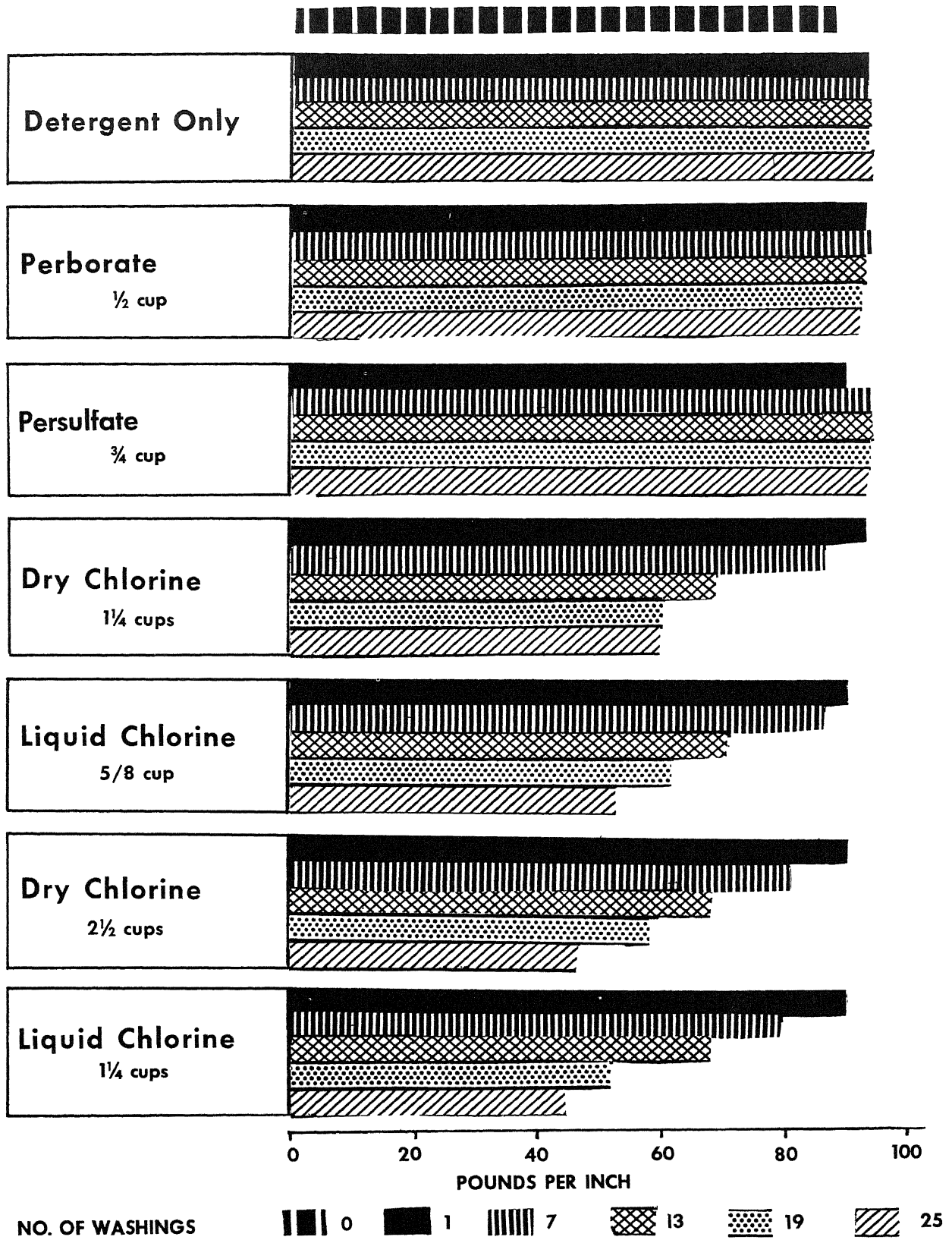


Fig. 3.—Average pounds breaking strength of nylon warp for seven different laundry treatments after equivalent numbers of washings

SUMMARY AND CONCLUSIONS

When double the manufacturers' recommended amounts of the chlorine bleaches were used, somewhat greater degradation of the cotton occurred than when recommended amounts were used. The fabric laundered with excessive amounts of these bleaches at the end of 25 washings showed reductions in strength of about 15 pounds or less than 19 percent for the dry chlorine (versus 15 percent for the recommended amount) and 23 pounds or about 29 percent for the liquid (versus 23 percent).

For the nylon fabric, repeated laundering with detergent only and with perborate or persulfate bleach added did not produce any losses in warp breaking strength (Fig. 3). In this group, the fabric was somewhat stronger after 25 washings than when new. Shrinkage may have partially accounted for this increase since the nylon shrank about 6 percent in the warp direction and 5 percent in the filling.

Continued use of either the dry or liquid chlorine bleach resulted in progressive losses in the nylon strength. Noticeable deterioration occurred in this fabric after 13 launderings with the use of recommended amounts of the chlorine bleaches--19 pounds or 22 percent for the dry chlorine and 17 pounds or 19 percent for the liquid. At the end of 25 launderings, the total losses in nylon strength were about 28 pounds or 32 percent for the dry chlorine and 34 pounds or 39 percent for the liquid chlorine.

The nylon laundered with double the manufacturers' recommended amounts of the chlorine bleaches showed greater losses in strength after 7 launderings than was true when recommended amounts were used. However, after 13 launderings, losses were approximately the same regardless of the amounts of these bleaches used. Further comparison of results obtained when the different amounts of the dry chlorine bleach were used revealed that no appreciable differences in nylon strength occurred until after 25 launderings when the fabric washed with the excessive amount of bleach was reduced about 40 pounds or 46 percent in strength (versus 32 percent for the recommended amount). For the two amounts of liquid chlorine bleach, significant differences in nylon strength were found after 19 and 25 launderings. At the latter time, the fabric laundered with an excessive amount of liquid chlorine showed a strength loss of approximately 43 pounds or 49 percent (versus 39 percent for the recommended amount).

This investigation seemed to indicate that for heavily soiled fabrics the type of bleach to be used depends somewhat on the fiber content of the fabric and the type of soil:

- 1) **DRY SOIL.** Increase in whitening effect of cotton was best accomplished with the aid of the chlorine bleaches--the dry and liquid being equally effective. Continued use of these bleaches through 25 launderings in amounts recommended by the manufacturers resulted in total losses of approximately 15 percent in cotton strength for the dry chlorine and 23 percent for the liquid chlorine. The cotton washed with perborate or persulfate showed little, if any, loss after 25 launderings.
- 2) **OILY SOIL.** The whitening effects of all bleaches were least for cotton, intermediate for Dacron* and Orlon* and greatest for nylon. For cotton no appreciable differences in resultant whitening were evident among the bleaches. Liquid chlorine performed somewhat better on Dacron* and Orlon* than did any of the other bleaches. For the nylon fabric, persulfate gave greater whitening than did the other bleaches. Further, the nylon washed with this bleach did not show any loss in breaking strength even after 25 launderings while the strength of this fabric washed with dry chlorine was reduced about 32 percent and about 39 percent with liquid chlorine after 25 launderings.

The study also showed that use of double the manufacturers' recommended amounts of the two chlorine bleaches through 25 launderings resulted in additional losses in strength of only 4 and 6 percent for the cotton and 10 and 14 percent for the nylon in comparison to losses which occurred when recommended amounts were used. Repeated use of the excessive amount of dry chlorine was found to be somewhat less destructive to cotton and nylon than when the excessive amount of liquid chlorine was used.

*Registered Trademark (DuPont).

This investigation was made possible by a grant obtained from the Purex Corp., Ltd. Other cooperators were The Frigidaire Corp. (washers and dryers), E. I. duPont de Nemours and Co. (nylon fabric), and Lever Bros. (detergent).