Journal of the American Oil Chemists' Society

Surfactants & Detergents

Technical

Redeposition of Natural Soils In a Home Laundry Test

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ABSTRACT

A procedure for measuring the redeposition of natural soils onto clean fabrics was developed. Laundry bundles of paired articles from typical households were divided and washed under controlled conditions in a home style washing machine. Large swatches of unsoiled fabrics were included in the laundry load. After each laundering small swatches were cut out for reflectance measurements. The large swatches were rated by panelists after every 5 cycles. Twenty cycles were run. Results demonstrated that the test discriminates between similar products. The effect seen was quite similar to the soil build-up which occurs in the Laundry Bundle Test ASTM-D-2960. However, the bundle test requires much time to complete while the test described here can be run at the rate of several cycles per day. Also, it is not necessary to purchase new clothing for each test.

INTRODUCTION

There are numerous methods which have been used on a laboratory scale for the testing and evaluation of household laundry products. Some of these methods are in widespread use in the United States and have achieved the status of ASTM standards. Examples are tests for measurement of detergency (1) and redeposition (2) properties of household laundry products. These methods are used for screening laundry detergent formulations, evaluation of ingredients, and in studying the sensitivity of performance to laundry conditions. Although they are quite useful, it is widely recognized that these laboratory methods have limited value in predicting performance under actual use conditions.

EXPERIMENTAL PROCEDURES

Depending on the speed with which we wish to do the test, we use laundry from 5 or 10 families. We choose families with a husband, wife and children. Each family supplies us with a 10- to 14-pound bundle made up of paired articles. Colorfast articles such as undergarments, towels, shirts, blouses, dish towels, bed clothes, etc., are used. Each family supplies us with soiled laundry on a weekly basis.

In our tests to date we have used 3 different clean white fabrics for soil redeposition. They are Testfabrics Cotton #400, Cotton Polyester Durable Press #7406WRL and Polyester #767. Five pieces of each fabric measuring 4 sq ft in area per swatch are included with the soiled clothes. To prevent ravelling, 3 of the edges are hemmed. After each wash-dry cycle a small swatch is cut out for measurement of reflectance. After each 5 cycles are finished, the coded large swatches are arranged for panelist evaluation. The panel consists of 5 observers who have been trained to make a forced choice between the 2 paired swatches. Panel evaluations are made under North Daylight conditions and

[1] Presented at the AOCS meeting, Chicago, May 1983.

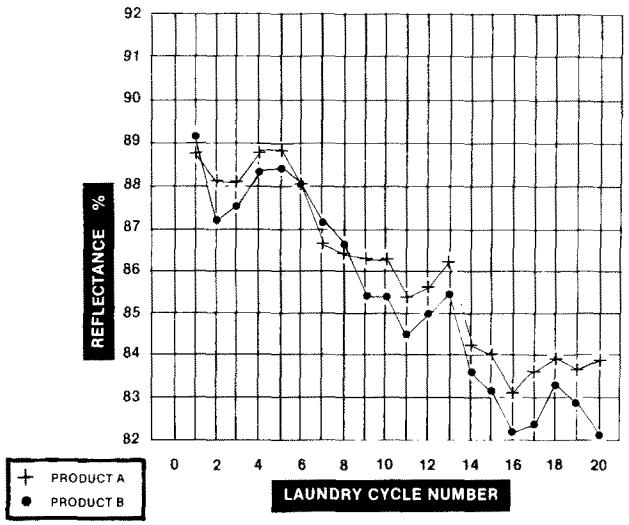

FIG. 1. Reflectance of cotton cloth vs. laundry cycle.

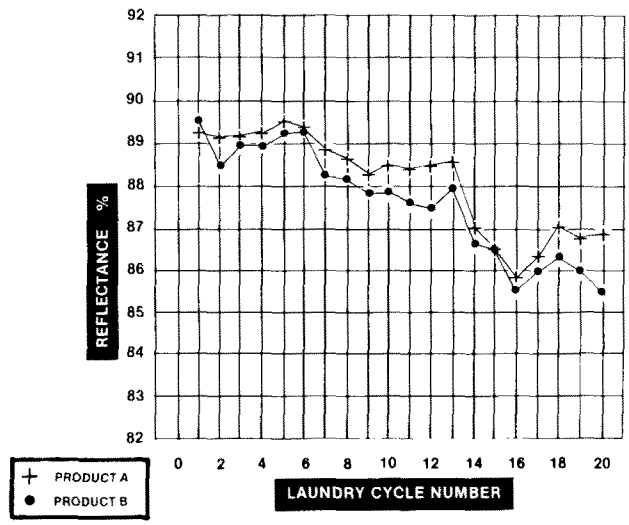

FIG. 2. Reflectance of cotton P.E. dur. press vs. laundry cycle.

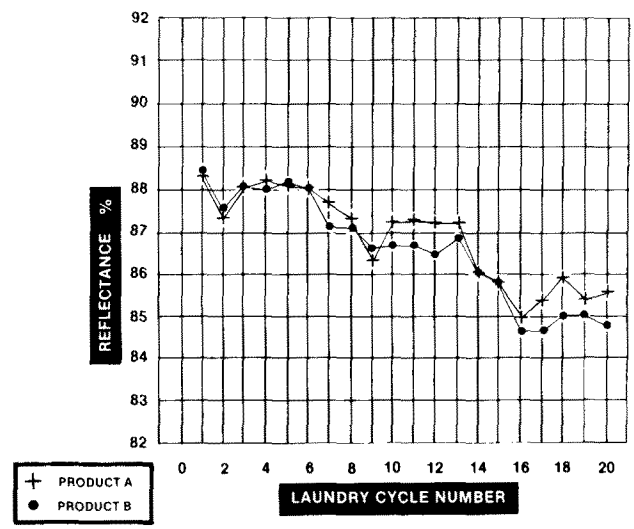

FIG. 3. Reflectance of polyester cloth vs. laundry cycle.

also under incandescent light. Equipment used for the test described in this paper consisted of: Washing machine, Whirlpool LDA 5700; tumble dryer, Whirlpool LDA 5701; reflectometer, Hunter D-25 - L scale; lighting, indirect daylight supplemented by GE F40 Chroma 75 fluorescent bulbs; frosted 100 watt incandescent bulb.

Laundry conditions used for these tests are: Water volume, 14 gallons; temperature, 105 F; normal wash cycle with warm wash and cold rinse; water hardness, 150 ppm Oakland, N.J. water diluted with deionized water; recommended level of commercial products; dry cycle, permanent press hot.

RESULTS

To illustrate the results obtained with this test, I have selected comparisons of 3 pairs of commercial products. Because the results are proprietary, I can say only that the products tested were household laundry products purchased off the supermarket shelf.

The first 3 figures show the decrease in reflectance over a 20-cycle test. Figure 1 shows that after the ninth cycle cotton cloth laundered with Product A gives consistently higher reflectances than the cotton cloth laundered with Product B. Figure 2 shows the results obtained with cotton-polyester, durable-press fabric. Product A gives better results, but the difference is smaller. Figure 3 shows that with polyester cloth there is the same degree of difference in most of the cycles.

Note that over the 20-cycle test the reflectance of the cotton swatches has decreased 6 to 7 units. Cotton-polyester has decreased approximately 3 units, and polyester also has decreased about 3 units. In our work we have noted that the casual observer can detect a difference of one reflectance unit in white fabrics. Our trained observers become much more discriminating. It should be kept in mind that the human eye sees and prefers things that do not necessarily show up on the L scale of the reflectometer.

Figures 4 and 5 show the results of panel evaluations of swatches which have been laundered with products A and B. Figure 4 is the result under incandescent light. The panel results are not exactly in line with the reflectance measurements. Panelists consistently preferred polyester cloth laundered with Product A. Only after 20 cycles did the panelists prefer cotton and cotton-polyester cloths washed with Product A with any consistency.

Figure 5 shows the results obtained under North Daylight conditions. Here a different picture emerges. Through 15 cycles the results are inconclusive because of switches in preference. Looking at the results after 20 cycles we would conclude that Product A gives better results on all 3 fabrics.

In drawing conclusions from a study such as the one we have seen in the first 5 figures, we would calculate 95% confidence limits on the individual data groups. In addition to using statistics to get an idea of experimental error, we examine the overall effect and consistency of the visual and instrumental measurements.

The next five figures present the results of a study comparing another pair of products—C and D. Figure 6 shows the decrease in reflectance of cotton fabric. Note that in this case less of a reflectance decrease is obtained over the 20 cycles than was seen in the previous test with A and B. Figure 7 shows the results with cotton-polyester, durable-press fabric. From cycles 8 through 20 Product C has a small but consistent advantage. Figure 8 shows similar results with polyester fabric. Overall, in this test Product C begins showing superiority early and it persists through the twentieth cycle.

Results of the panelists' evaluations of the fabrics washed with Products C and D are shown in Figures 9 and

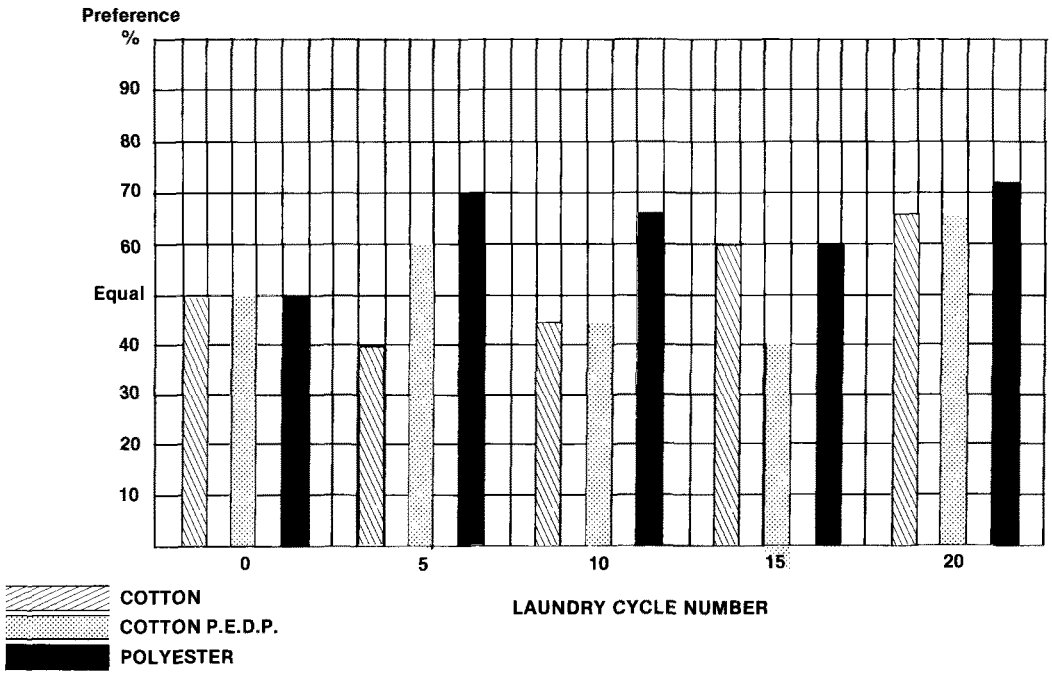

FIG. 4. Preference of panelists for product A vs. product B incandescent light.

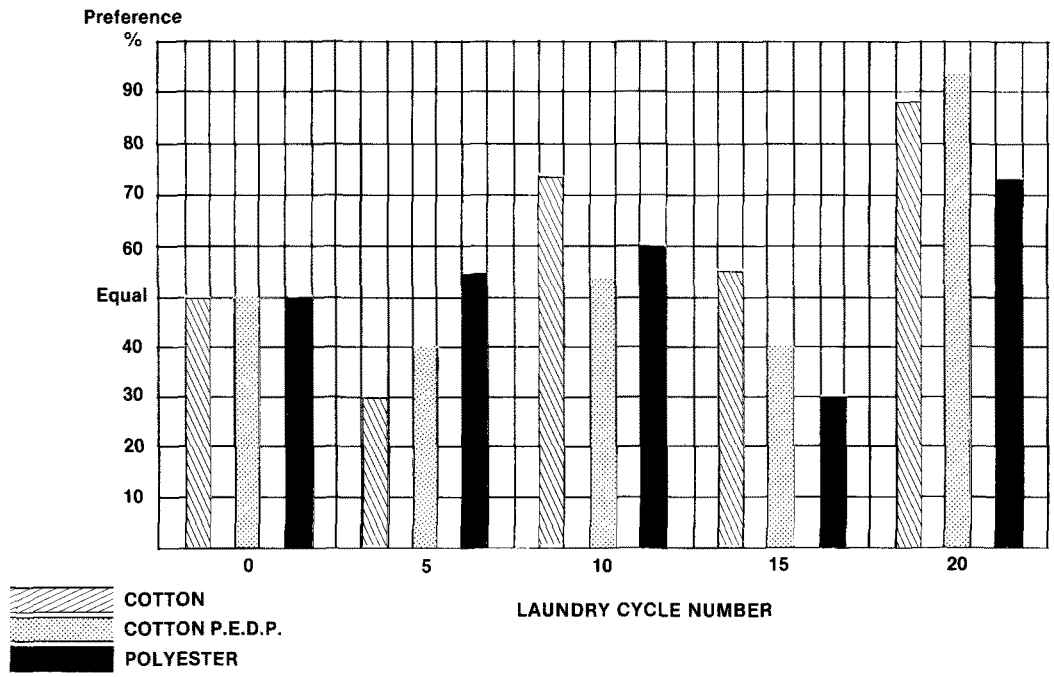

FIG. 5. Preference of panelists for product A vs. product B north daylight.

10. The preference of the panelists for Product C or D is usually the same under either kind of light. Note that Product C seems to perform better on polyester fabric than it does on cotton and cotton-polyester. It is interesting to see that after 5 cycles the panelists prefer cotton and cotton-polyester fabrics washed with Product D. However, after the tenth cycle, this preference is reversed. Another noteworthy point is the degree of preference by the panelists. In the earlier study we had larger reflectance differences than we have with Products C and D. Apparently, in spite of the smaller differences, the panelists were able to distinguish between the fabrics washed with Products C and D more consistently than they were able to with Products A and B.

The last 2 figures are selected results from a study comparing products in which we found very little or no differ-

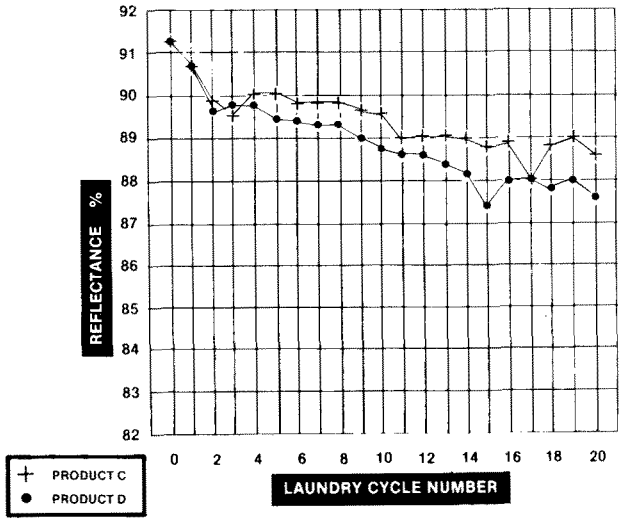

FIG. 6. Reflectance of cotton cloth vs. laundry cycle.

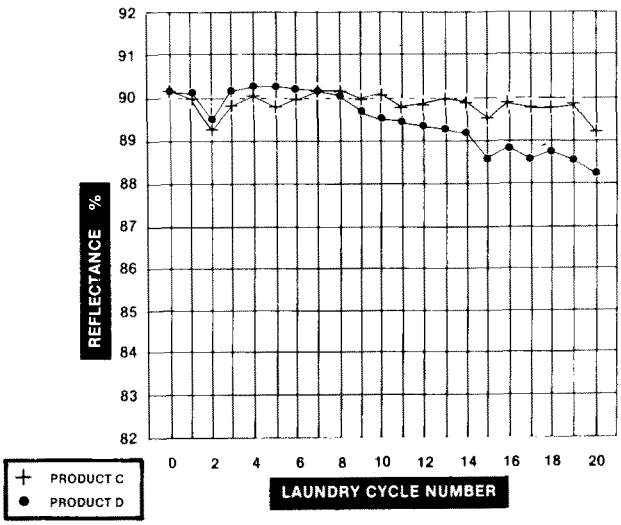

FIG. 7. Reflectance of cotton P.E. dur. press vs. laundry cycle.

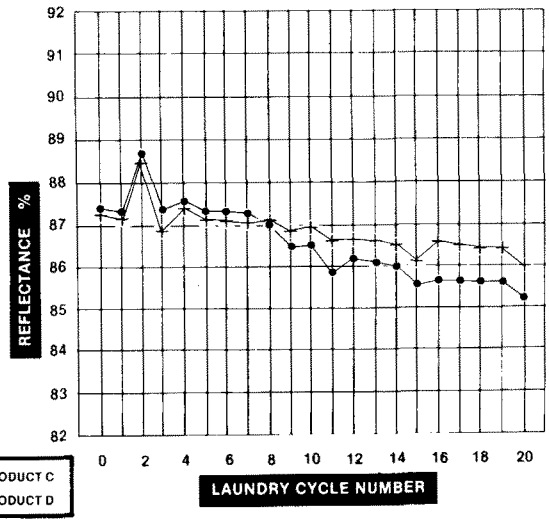

FIG. 8. Reflectance of polester cloth vs. laundry cycle.

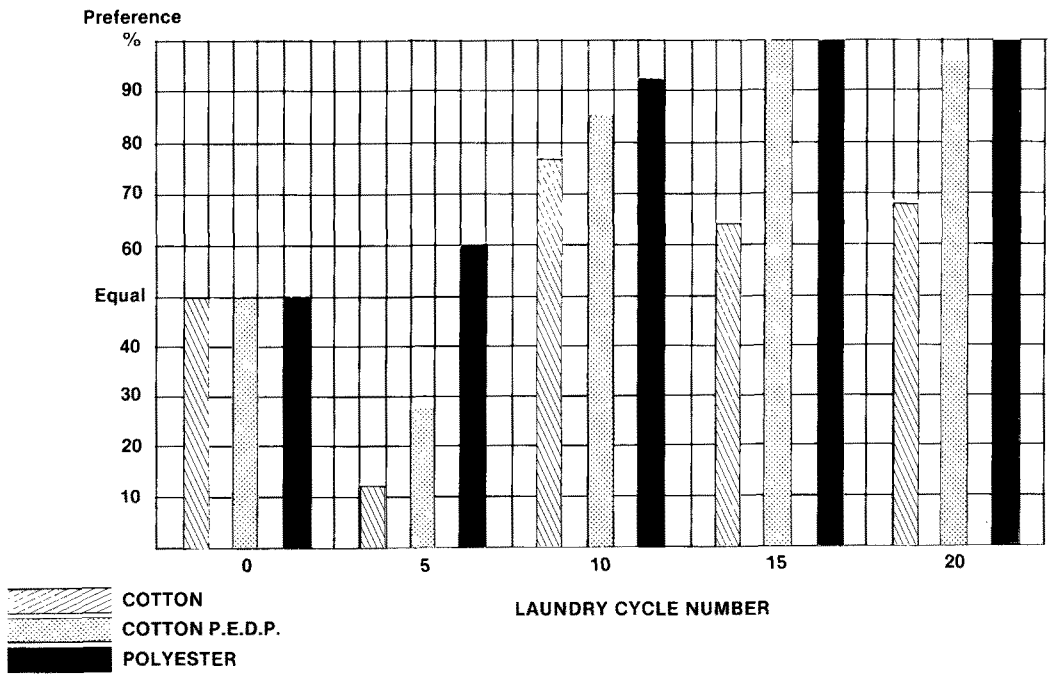

FIG. 9. Preference of panelists for product C vs. product D incandescent light.

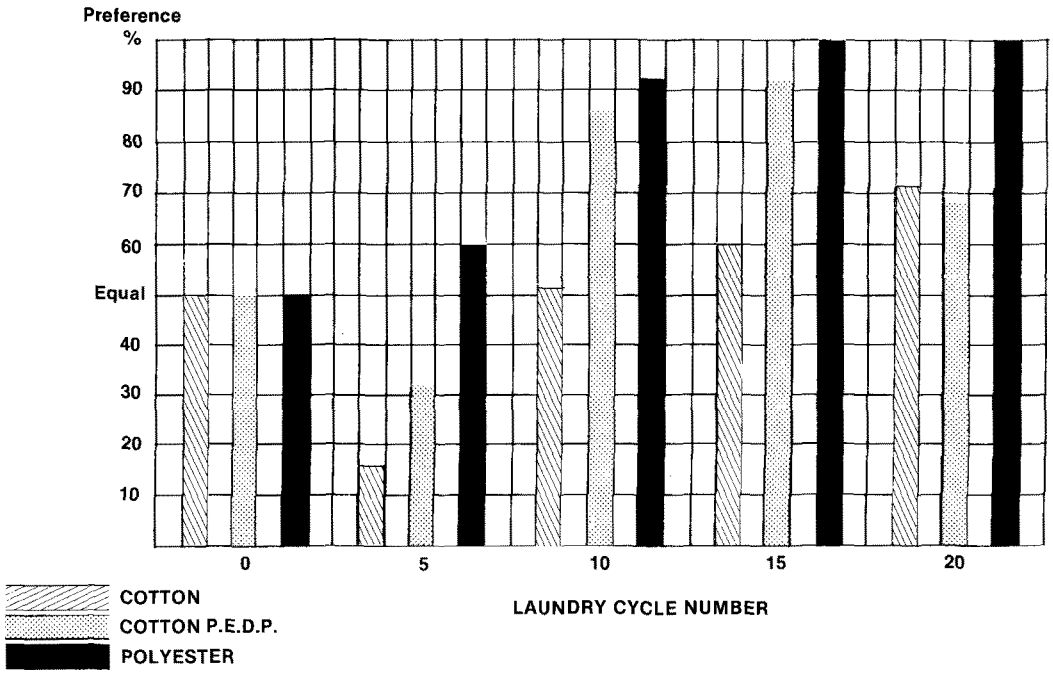

FIG. 10. Preference of panelists for product C vs. product D north daylight.

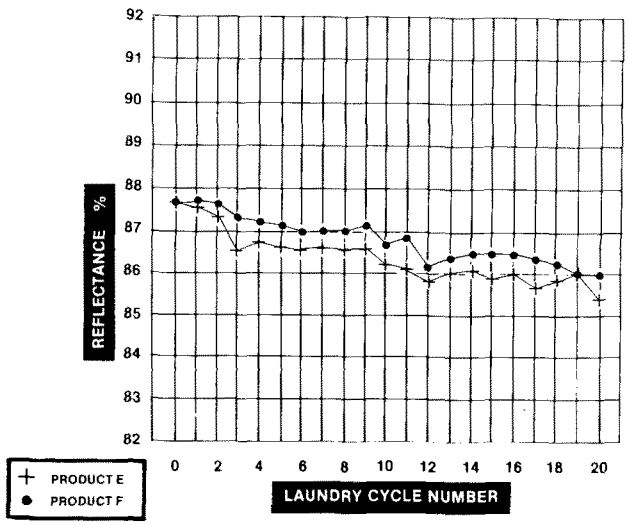

FIG. 11. Reflectance of polyester cloth vs. laundry cycle.

ence. Figure 11 is a plot of the reflectance of the polyester cloths versus laundry cycle comparing products E and F. There is a very small difference on most cycles and, in some cases, no difference whatsoever. The results with cotton and cotton-polyester, durable-press fabric are essentially identical for the 2 products.

Figure 12 shows the per cent preferences by the panelists for polyester cloth. In this graph we have plotted the results for incandescent as well as the North Daylight data. Although there is a slight preference overall for polyester cloth laundered with Product F, the magnitude is small and rather inconsistent. On the other 2 fabrics the panelist preferences were erractic and the overall difference was statistically insignificant.

DISCUSSION

The data which we have presented show that similar laundry products can be compared in a practical test using naturally soiled garments. By use of multiple determinations of soil redeposition we can quite precisely differentiate between products. Changes which would be expected to occur over a lengthy period of time in the normal use of the articles of clothing are seen. As many families as desired can be recruited to provide soiled laundry. Therefore, the time required to complete a 20-cycle test is limited only by the time needed to complete the individual sequential steps in the laboratory protocol. In the regular bundle test the completion time is limited by the need to allow a normal wear time of about a week between cycles.

The test allows us to evaluate a number of important effects. We feel that the use of both reflectance and panel evaluations to measure soil redeposition along with the repetitive nature of the test helps put the magnitude of the differences between products into perspective. We have noted differences which we attribute to soil and brightener

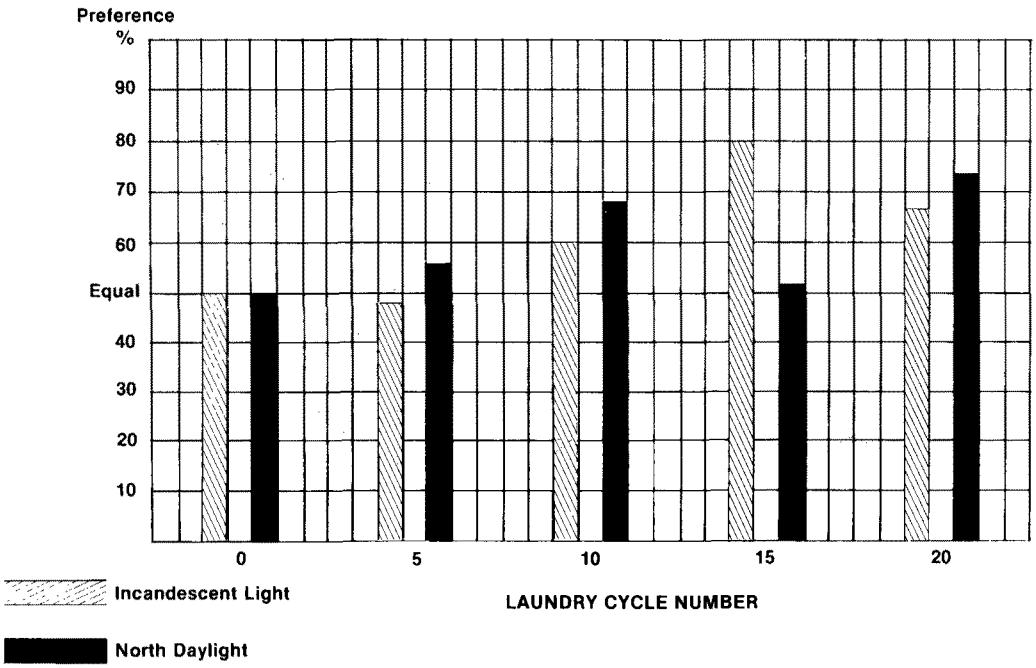

FIG. 12. Preference of panelists for product F vs. product E polyester cloth.

equilibrium effects. Our panelists are sometimes confused by the different shades of fluorescent light emitted by the various brighteners used in commercial laundry products. These measurements could be correlated with broader consumer preference studies. Panelists occasionally will switch preferences under North Daylight or incandescent light. By using 3 common fabrics we feel that we get a cross sectional view of what will be seen in the typical household.

In common with all tests which make use of subjective measurements, care must be taken in the interpretation of results. Although this test does nothing to reduce the tremendous number of variables which affect the home laundering process, we feel that it is useful in understanding and improving the products of our industry.

ACKNOWLEDGMENTS

Thanks to my clients for their support in the publication of this paper, and to the several people who did the actual laboratory work.

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3. Ibid., 1982, p. 453, Controlled Laundering Test Using Naturally Soiled Fabrics and Household Appliances.

[Received July 3, 1984]