EFFECTIVENESS OF HOME CLEANING METHODS ON SELECTED TUFTED CARPETS

by

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INTRODUCTION

Home cleaning of carpets has become increasingly significant as soft floor coverings of some type have come to be used by most economic groups. The demand for soft floor coverings has reached a new peak, reflected by an increase in consumption from 2.4 yards per family in 1958 to an expected 2.7 yards per family in 1960 (Winterer, 32). These figures indicate that carpets can be purchased in price ranges that fit into more family budgets, making it possible for the average American family to possess a rug or carpet of some type earlier in the family cycle with younger children still in the home. Living in the living room rather than using it as a parlor, the increased popularity of pets, and the growing trend of serving family meals in the living room have all subjected the average carpet to more severe wear than previously. The problem of carpet care and maintenance has accordingly become more acute.

The conventional solution of sending carpeting to commercial cleaners is no longer always practical as many young families cannot bear the financial burden of the more frequent cleaning necessitated by the obvious rate of soiling of man-made and cotton fibers compared to wool, and the more severe wear patterns that carpets are subjected to in today's homes. Cleaning and spot cleaning by home methods have been increasingly resorted to in an effort to defray expenses. As the use of various home cleaning methods has been augmented, it is desirable that the homemaker learn which, if any, home cleaning method is superior to others.

Few studies have compared the effectiveness of available shampoos applied by home methods.

The purpose of this study was to compare the effectiveness of soil removal by two readily available detergent solutions, Bissell and Blue Luster, each shampoo being applied by the same home method to selected man-made and natural fibers of nylon, nylon 501, Acrilan acrylic, Verel modacrylic, rayon, cotton, and two qualities of wool. It was hoped that the study would also reveal any significant differences in the effectiveness of cleaning of the different fibers as used in tufted carpeting, and the degree of acceptability of the carpets after cleaning.

REVIEW OF LITERATURE

Carpets are exposed to more severe soiling conditions during use than any other textile. Good cleanability is therefore an essential prerequisite of a carpet fiber. Even though a carpet may be satisfactory in almost all respects but does not clean well, it will be judged as unsatisfactory.

Few studies have been reported that compare the effectiveness of soil removal by available home cleaning methods. When undertaking such a study, the complexity of the soiling of the carpets must be considered. The carpet and backing construction, type of fiber, color and structure of yarn, and type of soil are some of the variables that determine the soiling and cleaning properties of any specific carpet in use.

Development of Tufted Carpeting

Directly related to the unprecedented demand for carpeting and the new interest in home cleaning methods has been the introduction of tufting, a relatively new carpet construction method that has largely replaced the traditional carpet weaving methods (Winterer, 32).

The tufting industry was first introduced in the United States as a hand craft by the early American colonists. It was revived at the beginning of the twentieth century in the vicinity of Dalton, Georgia. Heavy plied yarns were punched through sheeting by hand with a needle in a continuous line on a previously stenciled pattern (Press, 17). It was not until shortly after 1930 that tufting machinery was placed in use, encouraging the phenomenal growth of tufted products and particularly of bedspreads.

Tufting may be described as the process by which thousands of needles speedily punch tufts of yarn of any fiber through a cloth backing of jute or cotton that has been previously woven. Most carpets are tufted with an average of seven or eight stitches per inch, with less than 4 or over 14 stitches per inch being impractical (10).

Prior to 1950, cotton bath mats and sets were the only floor coverings produced by the tufting process, and total yardage was relatively low, being only five per cent of the total carpet yardage. The tufting process was made more practical by the discovery that a latex backing stiffened the rug and locked the

tufts. The use of scrim, a loosely woven fabric of either the plain or leno weave and constructed of paper, cotton, or jute, was also added to the back of the carpet by some manufacturers in a further attempt to impart dimensional stability to tufted carpeting.

When machines producing broadloom tufted carpeting were introduced in 1950 and 1951, the carpet industry was revolutionized. Tremendous strides were made during the rest of that decade as new processes and developments improved tufted products. Fibers other than cotton began to be used for tufted carpets including rayon, acetate, nylon, solution-dyed rayon, and wool. By late 1957, full-dull and dull-luster nylon carpet yarns were available. In early 1958, high denier, lofted solution dyed yarns, and continuous filament yarns came into use (11).

Production of tufted carpeting rose from 9 per cent of the total carpet yardage in 1951 to 59 per cent in 1959. The 60 per cent mark was reached in February, 1960, with sales still increasing rapidly. It has been predicted that 70 per cent of all soft floor coverings produced in the United States in 1960 will be of tufted construction (27). As tufted sales have soared, markets for carpets of traditional construction have diminished accordingly. The Axminster carpet, of traditional weaving construction and previously a popular buy, declined from 54 per cent of total sales 20 years ago to 17 per cent in 1958 (2).

The rapid growth of the tufted industry may be partially attributed to the lessened world supply of traditional carpet

materials as consumer demand attained a new level. As the scarcity of natural fibers was alleviated by the introduction of the man-made fibers to the carpet industry, the tufting process was found to adapt particularly well to the use of the new man-made fibers, with rates of production proving to be 10 to 20 times faster than the conventional weaving methods. Lower equipment investments and higher productivity per dollar investment also helped to make possible carpet prices that were 25 per cent lower than comparable woven goods (Press, 17). The development of successful texturizing methods has promoted the use of texturized yarns in the carpet industry.

Significant changes in consumer demand have also contributed to the advance of the tufted industry. New attitudes toward color, texture, and other style features have developed. Preference for solid colors and simple textured effects has replaced the demand for bordered and fringed rugs, commonly woven by traditional methods. Increased demand for wall-to-wall carpeting in contemporary homes has been a recent trend. The desire to redecorate more often and the frequent moving of families of today have dictated carpet construction that is less expensive but still reasonably durable. Excellent quality and many years' service are not the criteria for selection that they used to be (Wingate, 31).

A tufted carpet that possesses good pile height and density is preferable. A three- or four-ply yarn helps to contribute to the thickness of the tuft and therefore to the wearing qualities

and luxuriousness of the carpet. The number of tufts per inch, controlled by the number of backing yarns, also affects pile density with closeness of rows of tufts contributing to a dense pile and increasing the overall carpet performance. A good carpet has a maximum amount of fiber per square inch of carpeting with no obvious exposure of the backing yarns when the carpet is bent back upon itself (30).

Latex is the usual backing compound used to lock tufts to the carpet backing, the particular compound chosen being determined by desired properties as resiliency, hand, weight, and flexibility. An even and sparing application of latex will prevent unwanted stiffness. Brawner (3) recommended that only enough backing compound should be added to wall-to-wall carpeting to prevent wrinkling. Application of the latex to the carpet backing may be accomplished by spraying, roller coating, or the knife blade method. After application, the latex is vulcanized to the carpet at high temperatures.

Scrim is available in different weights and qualities and if it is applied to the carpet backing it should be specifically selected for each carpet or rug. Application of an excessive amount causes unnatural stiffness and can give the carpeting a better appearance and hand than its true quality warrants (19).

Fiber Performance Characteristics

Nylon. Nylon can be defined as a long chain polyamide made from coal, water, and air. This fiber gives satisfactory service

if the yarns are sufficiently twist-set to insure even texture and dyeability (28). However, if the twist is reduced to gain greater covering power, the dye does not take well and gives a streaked effect.

In the early use of nylon as a carpet fiber, yarns of low denier were adapted that had originally been designed for the garment industry. Carpeting of this nylon behaved poorly when subjected to cleaning, with color and texture changes often accompanying the cleaning process (Press, 17). In order to increase consumer satisfaction with nylon carpeting, carpet fibers of high denier have been developed with texturizing methods being used extensively. Even though these highly desirable carpet yarns are available to carpet manufacturers, the industry is alarmed about the quantities of unsuitable garment nylon being used in its place.

Performance tests by Schappel (21) revealed that although nylon has relatively low soil pick-up, apparent soilability is moderately high, attributable to the smooth, round fiber. Progress was made when duPont developed nylon 501, a crimped filament yarn possessing bulk, hand, smoothness, and recovery in addition to the advantages of spun nylon. A tri-lobular cross section was developed, giving the fiber a degree of opaqueness and thus permitting the carpet to retain its luster while hiding dirt more effectively (5). Other progress was made when Chemstrand announced the development of a texturized nylon filament yarn under the trade name, Cumuloft. Built-in crimp, rounded corners,

and a semi-dull luster are claimed (16). DuPont has recommended the use of 15 denier per filament carpet nylon because of its excellent coverage in loop pile carpets, superior hand and texture retention, and resistance to soiling and matting (28).

Press (17) stated that the use of textured nylon carpeting presents cleaning difficulties as the soil settles into the depressions of the pile requiring extra cleaning, and with cleaning being less effectively done.

Acrilan. Acrilan is an acrylic fiber in which the fiber-forming substance is any long chain synthetic polymer composed of at least 85 per cent by weight of acrylonitrile units. Acrilan acrylic is equal to or superior to wool as a carpet fiber, possessing excellent resilience. Other performance characteristics include excellent stain resistance and ease of spot removal, good soil resistance, and cleanability (14). Claimed also are superior colorfastness to sunlight, gas fading, and vigorous cleanings.

Verel. A modacrylic, the fiber-forming substance of Verel is any long chain synthetic polymer consisting of less than 85 per cent but at least 35 per cent by weight of acrylonitrile units. Produced by Tennessee Eastman, Verel modacrylic is softer than most acrylic fibers and quite similar to wool. Langstaff et al. (12) lauded the superior crush resistance and resilience of Verel modacrylic compared to wool. Verel modacrylic also retains its strength when wet, has superior soil resistance to wool, and good cleanability.

Rayon. Rayon is a manufactured fiber composed of regenerated cellulose. Economical in price, its service qualities are generally inferior to wool. Rayon's resistance to soilability has been found to vary extensively, depending on the smoothness or dullness of the carpet yarn, showing less soil in general on the dulled yarns. An investigation by Leonard and Schwarz (13) revealed that viscose fabric showed more soiling than any of the other fibers studied, its irregular contour effecting the greater soilability. Comparable soiling patterns were found for acetate, similar in contour to viscose. However, wear and soil tests of the new improved Avisco rayon used in Super L fabric have demonstrated that it is only slightly below good quality wool (Press, 17).

Cotton. Cotton is a natural fiber and the least expensive of the raw carpet fibers. Possessing excellent abrasion resistance, its resiliency is low, and soiling shows more quickly than on wool carpet. During a 112-day wear period, Hensley and Fletcher (7) found little evidence of wear on selected cotton broadloom carpeting, the most notable change occurring in color. Abrams et al. (1) reported that if cotton was treated with resin to improve its resiliency, the treated yarns became more soiled than the untreated yarns.

Wool. Wool, the traditional carpet material, is a natural fiber obtained from the native, unimproved sheep of less industrialized areas of the world including Syria, Iraq, Argentina, and formerly, China. The coarse wools from these sources have been

particularly suitable for carpet fiber, with excellent resiliency, abrasion resistance, and cleanability.

The lessening of the supplies of coarse wools, as the wool producing areas have become progressively civilized and as international policy has demanded a severing of trade relations with China, has caused the finer, softer wools to be resorted to at times. Carpets of inferior quality have resulted when inappropriate finer wool yarns have been substituted for carpet wool. Lacking the wear and appearance characteristics of carpet wool, their use as a carpet fiber is not desirable. Schappel (21) noted that service tests showed high soil retention by wool carpet fibers but no equivalent gain in apparent soil, accounted for by the hiding of soil under the scale tips. Wool was found to be easy to clean by home or professional methods.

Soiling of Carpets

Soil as related to textiles refers to all types of foreign matter accumulated by fabrics during use. Morris and Wilsey (15) stated that soil may be deposited by foot traffic or it may be air-borne. Soiling results from mechanical entrapment of particles of soil in pits and crevices in the fiber surface and in the inter-yarn and inter-fiber space, according to Hart and Compton (6). Salsbury et al. (20) stressed the importance of the very small particles, stating that although only 17 per cent of the weight of the soil particles was less than one micron in diameter, this 17 per cent contributed 77 per cent of the total

surface and of the potential soiling capacity of the soil.

The oily, greasy constituents of carpet dirt serve as soiling agents, since they bind the dirt particles together and cause them to cling tenaciously to pile yarns and to the yarns forming the carpet backing. They also effect a dulling of color, as a film forms over the surface of the fabric. In an attempt to analyze the greasy constituent of carpet soil it was revealed that a high percentage of the dirt consisted of animal and vegetable oils volatilized from household cooking, in one instance amounting to 87 per cent of the total greasy material (23).

In addition to soiling caused by household oils and grease, the amount of oil present in the carpet pile, due either to inefficient scouring or to migration of oil from the jute backing, is a serious cause of soiling. Some fibers are more prone to oil wicking than others. Those fibers with smooth, round cross-sections tend to resist oil penetration and subsequent ready soiling. A non-waxy finishing agent may also be applied to reduce the amount of soiling (26). Sudnik (25) listed still another possible cause of soil retention, namely the attraction by electrical static. However, his findings did not support this theory.

The diameter of the fiber is another factor upon which the soiling properties of both man-made and natural fibers are dependent. Carpet fibers of low deniers retain more soil than fibers of higher deniers, because of exposure of greater surface area. Ths use of carpet yarns constructed of 15 denier per

filament yarn has helped to increase soil resistance. Less soil is retained by use of a smooth circular filament than by the use of an irregular or serrated cross sectional filament, according to Weatherburn and Bayley (29), although they concluded that the chemical make-up of the fiber may have a greater influence on soil retention than the physical shape of the filament.

Schappel (21) has defined soil resistance as the ability of a fiber to release street or household oils brought into contact with the fiber in service. Adding twist to the yarn improves soil resistance of a carpet fabric. Although soil retention does increase rapidly at lower values of twisting, as sufficient twist is added, the soil becomes inaccessible to the crevices and pits.

As the visual degree of soiling of carpet fibers increases, lower reflectance readings are recorded on the reflectometer, a device employed to record wave lengths indicative of color and color changes. However, studies of soil retention by Weatherburn and Bayley (29) indicated that there is not a linear relationship between the reflectance readings and the weight of soil, accounted for by the fact that aside from the weight of soil that lowers reflectances, the effects of two other variables are apparent.

One variable that is independent of the amount of soil is the light absorbing properties of the soil. Even if two fibers have the same initial reflectance but differing scattering coefficients, as soiling proceeds, the fiber having the higher scattering coefficient will appear to be less heavily soiled.

Delustering of fibers controls this to some extent. The visual appearance is not, then, necessarily a reliable indication of the soil content.

The second variable independent of the amount of soil is the reflective properties of the fiber. The relationship of soiling properties to the reflective properties is evidenced by the assuming of a darker or a shady appearance due to the difference in light reflectance. There may appear to be a radical difference in appearance between bright and dulled fibers, according to reflectance readings. The length and density of the pile, and the cut or loop pile construction also affect visual appearance, with a close short loop pile of matt fiber or the high twist yarns showing relatively less unevenness of shades.

Soil Removal from Carpets

In an attempt to develop carpet fibers having increased resistance to soiling, both actual and simulated soiling methods have been used on experimental carpets and results studied. Weatherburn and Bayley (29) suggested that while actual wear tests serve as a useful guide in evaluating soiling qualities, that for fundamental studies it is frequently preferable to use artificial soiling methods so that test conditions will be as uniform and reproducible as possible. Sturley and Westhead (24) reported good correlation of results from the artificial and actual wear tests.

Resistance to soiling embodies the principle that a desirable carpet should allow the removal of soil from the fiber by

mechanical and suction devices. An impartial organization concerned with the development of carpets enumerated three common cleaning devices including the broom, carpet sweeper, and vacuum cleaner (9). While the broom redistributes and embeds the soil, the carpet sweeper picks up surface dirt and lint only. It is left for the vacuum cleaner to reach deeply embedded soil by suction and agitation.

Even with proper care, a gradual accumulation of soil eventually causes the fibers to become dull and drab, with bright pastels becoming more obviously soiled sooner than darker colors. Some type of remedial cleaning becomes necessary to brighten the surface. If only a surface brightening process is needed, home cleaners are available in three different forms including detergent solutions, solvents, and absorbent powders. The detergent solution is suitable for all types of carpets; the solvent type is particularly recommended for wool or man-made fibers but excluding cotton, while the absorbent powders are generally used successfully on most carpet types with some reservations. Since all home cleaners lack the ability to remove deeply embedded soil, their use as a brightener only has been emphasized (4).

A study by Hensley and Fletcher (7) revealed the ready home cleaning of 12 cotton broadloom carpets including six woven and six tufted specimens, washed under controlled laboratory conditions with a neutral soap jelly. During each of the seven wear periods the rugs were considerably soiled, with the most significant color changes occurring within the first wear period and

washing. The rate of soiling was as great for the new as the washed rugs when no finish had been applied. Apparent soiling was approximately as great at the end of four days as at the end of the 16-day wear period. This study also revealed that only one-third of the rugs were colorfast to cleaning, indicating the need for improved colorfastness to cleaning methods.

In a comparison of rug cleaning methods conducted by Herrick and Cooper (8) that included four home and two commercial cleaners, results indicated that soap was the least effective of all cleaners. Those carpets treated with soap resoiled to a greater degree than with other methods. Soap as a cleaner is not recommended because the free alkali present has been shown to cause dyestuffs to run and in some cases, to damage the carpet fibers. Contrary to the finding of Hensley and Fletcher, Herrick and Cooper discovered that the cotton sample could not be satisfactorily cleaned by a home method, particularly after the sand and grit had become ground into the fabric. A professional cleaning was recommended for cotton carpeting.

A recommended procedure for the safe use of home cleaners included the pretesting of a small, unnoticeable area on the rug for any undesirable effects before continuing with the entire cleaning process (4). This study showed a residue of detergent left in the carpets after repeated home cleanings that eventually led to rapid resoiling and loss of fresh appearance. The rapidity with which resoiling progresses is partially dependent upon the degree of neutrality of the detergent applied. Once rapid

resoiling of carpets is obvious, professional cleaning becomes the only alternative.

Manufacturers of liquid detergent shampoos recommend the sparing use of the home cleaner chosen, gently applying the solution until a small amount of lather has been gained. A back-and-forth motion with strokes overlapping a small portion of the area previously cleaned is preferable, leaving the pile as desired with the last stroke. Wetting of carpet fibers more than one-half inch is cautioned against as the application of excessive water does great harm. The detergent used should be applied sparingly since it not only cleans well but is a good wetting agent, rapidly causing the entire area of the carpet to become wetted. Once the carpet backing is excessively wet, long drying periods, shrinkage, and the tendency to mildew result. The use of forced air drying and the placing of furniture only when the carpet is completely dry are advisable procedures to follow after the cleaning process has been completed (9). The home cleaning process is completed by vacuuming of carpets to remove the detergent and loosened soil particles.

METHOD OF PROCEDURE

Carpets included in this study were of low loop pile, tufted construction, and were the same lots used for Project 556 at Kansas State University. Eight natural and man-made fibers in the low to medium price range were included. Two lots from each carpet type were represented, beige and rose-beige in color.

Lots A and B designated the lighter and darker carpets, respectively, and will be used to identify the two lots of each carpet fiber throughout the discussion.

Carpet fibers studied were nylon, nylon 501, Acrilan acrylic, Verel modacrylic, rayon, cotton, and two qualities of wool designated as wool I and wool II. The nylon, cotton, rayon, and wool I carpets were selected from the low price range while nylon 501, Acrilan acrylic, Verel modacrylic, and wool II carpets were from the moderate price range. The nylon carpet included was of low pile height and since it was not labeled carpet nylon, it was assumed that garment nylon had been misappropriately used as a substitution for carpet nylon. Nylon 501, a crimped filament yarn and specifically designed as a carpet fiber, was characterized by a definite texturized appearance with alternating depressed and raised areas. It possessed good pile height in comparison to the other nylon carpet. Acrilan acrylic carpets were of good pile height; Verel modacrylic carpets had an all-over textured effect with good pile height. The cotton and rayon carpets possessed relatively low pile height with the color of rayon-Lob B, being darker than the average of the other carpets in Lot B. The fiber used for both wool carpets appeared to be relatively fine, with wool II having a particularly porous carpet backing.

There did not seem to be any particular pattern for the type of backing used. Although latex was added to lock the tufts in all instances, it was added in varying amounts and was the only

finish used for cotton, rayon, nylon, Acrilan acrylic, and wool II. In addition to the use of latex, nylon 501 carpeting had a woven jute backing while scrim was applied to wool I and Verel modacrylic.

Portions 30 inches by 18 inches were prepared for home shampooing by the finishing of carpet edges with iron-on tape using a moderately hot iron. The direction of the pile was marked on the carpet backing.

Treatment of Carpets

The two shampoos selected for home cleaning were Bissell and Blue Luster detergent solutions. Two portions of each carpet lot were used for treatment with Bissell shampoo and two other portions for similar treatment with Blue Luster shampoo. Portions of the carpets were subjected to treatments that included 1) not-soiled-not-shampooed--vacuumed and reflectance readings taken, 2) not-soiled-but-cleaned--vacuumed and reflectance readings taken, and then shampooed, vacuumed, and reflectance readings taken, and 3) soiled-and-cleaned--vacuumed, and reflectance readings taken, then soiled, vacuumed, and reflectance readings taken, and then cleaned, vacuumed, and reflectance readings taken. The reflectance readings taken after each soiling and after each cleaning were compared to determine any variation in wave lengths between the two treatments.

Carpets were not-soiled-but-cleaned and soiled-and-cleaned weekly for three weeks on a rotation system. Methods of procedure used for application of the two shampoos were the same,

the only variable being the shampoo itself. After each shampooing, five panel members compared the treated carpets to the not-soiled-not-cleaned portions that served as a standard. Their observations were recorded on a visual evaluation sheet (Appendix).

Dimensional Stability

To determine the amount of shrinkage of each carpet type, a 10-inch square, drawn in with indelible ink, was centered on each carpet backing. After each of the three cleanings, the filling and warp dimensions of the square were measured at three positions with a ruler calibrated to one-fiftieth of an inch.

Soiling of Carpets

A composite soil that has gained wide acceptance was chosen for the accelerated soiling. It was prepared during the pilot study work for Project 556 with the assistance of the chemistry laboratory (18).

The approximate amount of soil needed was placed in heat-proof glass dishes and dried in an oven for 24 hours, at a temperature of 105-110 degrees Centigrade, then allowed to cool. Next, it was sieved through nylon marquisette having a mesh of 23 x 23 yarns; the large particles remaining were placed in a mortar and ground, then thoroughly mixed with the previously sieved soil. Ten grams of the soil were measured into the desired number of jars in readiness for carpet soiling. The soil

was returned to the oven and dried for 24 hours, until ready for use. Rubber mats were placed under the carpets during the soiling process to retain any soil passing to the carpet back and to serve as a substitute for carpet padding.

A 40 x 40 mesh brass screen was securely placed over the jar containing the soil to be applied to the carpet. The jar was placed upside down and the dirt evenly distributed to each specimen by means of a gentle, uniform tap on the back of the container. The soiling began in the upper left-hand corner proceeding lengthwise of the carpet, followed by crosswise soiling. At the end of the soiling process, a small plastic brush was used to force any remaining particles through the screen. A clean screen was used for each jar.

There were three steps in the embedding of soil into the carpets including an initial tamping with a metal rod, rolling, and a second tamping process with palmyra brushes. The initial embedding of the soil into the carpet was accomplished by a metal rod, one-fourth inch in diameter and 19.5 inches in length. Tamping was spaced at one-fourth inch intervals for a total of three cycles lengthwise of the carpet, first on the upper half and then on the lower half. A cycle consisted of a forward stroke and one back. Upon conclusion of the first tamping process, a lawn roller was used to continue the simulation of wear. The roller was passed forward and backward for 25 cycles lengthwise on one-half of the carpet and repeated on the second half in similar manner. The same procedure was followed for the crosswise of the carpet.

Timed by a metronome, each lengthwise stroke consisted of seven seconds and each crosswise stroke was four seconds in duration. A counter placed on the 40-pound roller aided the operator in keeping accurate count of the cycles rolled.

Soil was further embedded into the carpets by means of a second tamping process. A palmyra brush 18 inches in width was used for the lengthwise of the carpet and one 14 inches in width for the crosswise. As tamping proceeded, the brush was held at such an angle that the bristles were perpendicular to the floor. The brush was lifted three inches from the carpet, then dropped at each stroke of the metronome set at 60 strokes per minute. Because of the shortness of the brush, half of the lengthwise of the carpet was tamped with the 18-inch brush, followed by tamping of the other half in like manner. This was repeated for a total of four cycles. The entire area was once again tamped similarly, except that tamping was begun one-half the width of the brush from the original starting point. The crosswise of the carpet was tamped in the same manner as the lengthwise of the carpet.

After soiling and embedding processes were completed, the carpets were set aside for 24 hours. They were then rerolled and retamped with the palmyra brushes as previously, omitting the first tamping with a metal rod for the initial embedding of the loose surface soil.

Cleaning of Carpets

Vacuuming. A Hoover motor-driven upright agitator vacuum sweeper was used for all vacuuming. To obtain maximum cleaning efficiency, the paper bag was removed, the sweeper cleaned, and a clean bag inserted after the vacuuming of each series of carpets.

The carpets, as purchased, were vacuumed so that the last stroke was in the direction of the pile. A cycle is defined here as a stroke forward and one back; each stroke was 8 seconds in duration. Each area of the carpet was vacuumed two cycles before moving on to the next place on the carpet. The complete process was repeated to make a total of four cycles vacuumed on each place of the carpet. A metronome set at 60 strokes per minute timed the operator.

Vacuuming of carpets after soiling and after cleaning was similar in procedure to carpets vacuumed, as purchased, except that ten cycles rather than four cycles were used to vacuum the lengthwise of the carpet in a path the width of the brushes.

Shampooing. The two neutral detergents selected, Blue Luster and Bissell, were applied using the Bissell Shampoo Master. The Bissell applicator is a device having two stiff bristle brushes and a sponge roller on a long handle, with a tank made of plastic which permits the releasing of shampoo in a flow regulated as desired by pressing a trigger on the handle.

The shampoo solutions were prepared according to directions of the manufacturers. Prior to shampooing of the first carpet of

each series, the roller was saturated with a small amount of solution to insure equal wetting of the first carpet shampooed. In preparation for each carpet, one cup of the solution was placed in the applicator. The solution was released near the edge of the carpet closest to the operator at area one, and at areas equidistant including areas two, three, four, and five, in consecutive order and on odd cycles only. A cycle is a stroke forward and one back. During the first stroke of the first cycle the shampoo was released at area one; on the first stroke of the third cycle it was released at the second area, etc. The shampoo was thus released in progressive steps and each area was shampooed ten cycles. The procedure for shampooing of the second half of the carpet was the same, with a small portion of the area previously cleaned being overlapped. The last stroke was in the direction of the pile. After a 24-hour drying period, the carpets were vacuumed, an essential part of the home cleaning process. The purpose of vacuuming was to remove the detergent and loose soil particles. Ten cycles were vacuumed on the lengthwise of the carpet in a path the width of the brushes.

Evaluation of Cleaning

Subjective Evaluation. After each cleaning, both not-soiled-but-cleaned, and soiled-and-cleaned carpets were compared with carpets, as purchased, or the standard. Evaluation of 1) color change, 2) texture change, and 3) effectiveness of cleaning was made by a panel of five impartial persons using a five-point

rating scale. The carpets were placed on a table and a daylight lamp was used during evaluation. All other lights were turned off. No indication of the fibers or the method of cleaning used was given to the panel.

Ratings for color and texture were: no change, slight change, moderate change, more change than acceptable, and excessive change. Ratings for the effectiveness of cleaning were: highly effective, very effective, effective, slightly effective, and ineffective.

A five-point rating scale was assigned to each rating as follows: no change and highly effective, 5; slight change and very effective, 4; moderate change and effective, 3; more change than acceptable and slightly effective, 2; and excessive change and ineffective, 1. After the third and final shampooing of carpets, the ratings given by the panel were averaged. Each of the 16 carpets was then ranked in numerical order according to its degree of satisfaction as judged by the panel, with scores ranging from first place ranking of 1 to the lowest ranking of 16.

The not-soiled-not-cleaned carpets were included in the study in an attempt to determine whether variation in color and texture of cleaned carpets was caused by the deposition of soil or was the result of the cleaning process itself.

Objective Evaluation. Reflectance readings of the carpets were taken using the Bausch-Lomb Spectronic 20 Colorimeter with Reflectance Attachment to serve as an objective comparison of

the effectiveness of soil removal by Blue Luster and Bissell detergent solutions.

Carpets were prepared for reflectance readings by the drawing of ten circles two inches in diameter on the carpet backing. A pattern of selected areas to be reflected was arrived at so that the same area of the carpet was not repeated in the readings, either horizontally or vertically. Throughout the marking process, the same pattern was used so that uniform results could be obtained.

Reflectance readings were taken of carpets, as purchased, at wave lengths including 430, 495, 557, 615, and 670 millimicrons each on ten areas. After soiling and vacuuming, and shampooing and vacuuming processes, reflectance readings were taken at wave lengths of 430, 495, 615, and 670 millimicrons on three areas. In addition, the fifth wave length, 557 millimicrons, was recorded at 10 areas on each specimen. Recognizing the texture variations of the carpets, a weight was placed on each carpet as readings were taken to keep the pressure as uniform as possible and prevent slippage.

An analysis of variance (Snedecor, 22) was done on the reflectance readings taken of carpets, as purchased, after each vacuuming and soiling, and after each vacuuming and cleaning process to determine any significant variation of wave lengths; a lowering of readings being indicative of progressive soiling and lessened effectiveness of cleaning.

FINDINGS AND DISCUSSION

The effectiveness of two home cleaning methods on selected carpets has been determined through subjective and objective analysis of carpets at the end of each cleaning. The results of these analyses will be used as an indication of the degree of fiber and carpet acceptability when cleaned by the home shampoos.

General Appearance of Carpets

The nylon carpet lots soiled unevenly during all soilings and became dirty in appearance. Of low pile height and with a latex backing, the carpets progressively lost body and became limp as cleaned.

The multifilament carpet nylon 501 lots displayed excessive and noticeably uneven soiling during the first soiling process with the raised areas becoming much more soiled than the depressed areas. Vacuuming failed to improve the appearance. The second soiling process revealed that the soil appeared to distribute into the carpet pile more uniformly although vacuuming increased the spottiness of the carpets. The third soiling process revealed a further improvement in distribution of soil.

Soil was generally well distributed on the Acrilan acrylic lots although soil seemed to be more apparent after vacuuming than immediately following the soiling process. An electrostatic quality was evident.

Both Verel modacrylic lots developed smudges, showing an uneven distribution of soil. There was evidence of electric static

when the carpets were removed from the mat, with an excessive amount of soil on the roller after the completion of that process. By the end of the second cleaning process, both Verel modacrylic lots were quite fuzzy in appearance with vacuuming improving the appearance to some extent. After the third soiling of the Verel modacrylic carpets, less soil was evident on the roller than after the second soiling.

The rayon carpets, and particularly Lot B which was a darker color than the average carpet included in the study, showed little obvious soiling.

Cotton carpets showed some obvious soil particles that the fiber did not hide although the soil seemed fairly well distributed. During vacuuming, depressed areas were left from the path of the vacuum sweeper and the pile did not recover to its original state.

All lots of the wool carpets showed even distribution of soil with little actual evidence of the amount of soil applied. The extremely porous backing of wool II allowed an excessive amount of soil to pass through onto the mat. Because of this factor, the same mat was kept under the carpets during all stages of the soiling and cleaning processes.

Home cleaning indicated adequate lathering on the majority of the carpets although rayon carpets failed to show suds on the surface and did not appear to be uniformly wetted. Cotton also failed to show an adequate lather although the fibers were evenly wetted. A slightly better lather was obtained with Blue Luster

than with Bissell.

Dimensional Stability

Data for dimensional change are recorded in Table 1. The dimensional stability of most of the carpets was acceptable with wool II lots showing the most change in the warp yarns while cotton stretched slightly in the filling yarns. Next to wool II lots, nylon 501-Lot A had the most change of warp yarns with cotton-Lot A following closely in amount of shrinkage that occurred. The least shrinkage of warp yarns of the carpets was shown by cotton-Lot B.

The filling yarns of both wool II lots changed less than 0.1 per cent, showing the least shrinkage of the carpets studied, with wool I-Lot A showing the next least change. There was the greatest shrinkage of filling yarns of nylon-Lot B. However, dimensional changes of the filling yarns were generally small and could be disregarded. Aside from wool II, Acrilan acrylic showed the greatest total shrinkage of both warp and filling yarns for both lots of all cleanings while rayon showed the least total shrinkage aside from cotton.

In general, there was more shrinkage of warp yarns than of filling yarns with both showing gradual loss with progressive cleanings.

Table 1. Dimensional change, in per cent, of carpets after 1, 2, and 3 cleanings.[1]

Carpet	Number of cleanings					
	1		2		3	
	Lot A	Lot B	Lot A	Lot B	Lot A	Lot B
			Warp			
Nylon	1.3	1.0	1.2	1.1	1.3	1.3
Nylon 501	1.7	1.3	1.8	1.2	1.9	1.4
Acrilan (acrylic)	1.3	1.2	1.4	1.3	1.5	1.3
Verel (modacrylic)	1.2	0.9	1.2	1.0	1.3	1.1
Rayon	0.9	1.0	1.1	1.0	1.3	1.1
Cotton	1.9	1.0	1.5	0.9	1.9	1.0
Wool I	1.2	1.0	1.4	1.0	1.5	1.2
Wool II	2.4	2.1	2.5	2.3	2.8	2.5
			Filling			
Nylon	1.1	1.1	1.1	1.2	1.4	1.5
Nylon 501	0.9	0.8	1.1	0.8	1.2	0.7
Acrilan (acrylic)	1.3	1.0	1.3	1.1	1.6	1.2
Verel (modacrylic)	1.0	1.0	1.1	1.0	1.1	1.2
Rayon	1.0	0.9	0.9	0.9	1.3	1.0
Cotton	0.1*	1.0*	0.0	0.7	1.0*	0.5*
Wool I	0.6	0.8	0.6	0.9	0.8	1.0
Wool II	0.4	0.3	0.3	0.2	0.1	0.2

[1] Figures indicate percentage loss from carpets as purchased except when followed by an asterisk (*) which indicates percentage gain.

Subjective Evaluation of Carpets

Color. Subjective evaluation of the color of the soiled-and-cleaned carpets shampooed by the two detergents revealed comparable results with ratings for Bissell cleaned carpets being slightly but consistently higher than for Blue Luster cleaned carpets. In general, there were progressive color changes after each cleaning by the two methods with the darker color, Lot B, appearing to show less change than Lot A in nearly all instances.

The carpet that ranked the highest of soiled-and-Bissell-cleaned carpets was rayon, with a numerical score indicating only a slight color change. Although rated as having a moderate color change, cotton-Lot B, nylon 501-Lot B, and rayon-Lot A ranked close behind according to their numerical scores. Nearly all of the carpets showed a varying degree of moderate color change with Verel modacrylic-Lot A, and wool II-Lot B, approaching more change than was acceptable. Wool I-Lot A, nylon-Lot B, and wool II-Lot A were grouped in the upper half of more change than acceptable whereas nylon-Lot A ranked in the upper half of the excessive change position (Table 2).

The soiled-and-Blue Luster-cleaned carpet rankings showed the same carpets, rayon-Lot B and nylon-Lot A, having first and last rankings, respectively, as for Bissell cleaned carpets. Other carpets showed a change of position, with a general lowering of numerical scores. The rankings for Verel modacrylic-Lots A and B, improved when cleaned with Blue Luster. Those for nylon 501-Lots A and B dropped from the upper third, when Bissell cleaned, to the

Table 2. Subjective ranking of the carpets for color change after three cleanings.

Soiled-and-cleaned carpets							
Bissell				Blue Luster			
Rank	Numerical score	Fiber	Lot	Rank	Numerical score	Fiber	Lot
1.0	4.2	Rayon	B	1.0	3.9	Rayon	B
2.5	3.9	Cotton	B	2.0	3.8	Verel[1]	B
2.5	3.9	Nylon 501	B	3.0	3.7	Acrilan[1]	B
4.0	3.8	Rayon	A	4.0	3.5	Rayon	A
5.5	3.5	Nylon 501	A	5.5	3.3	Acrilan[1]	A
5.5	3.5	Verel[1]	B	5.5	3.3	Verel[1]	A
7.5	3.3	Acrilan[1]	A	7.0	3.2	Nylon 501	B
7.5	3.3	Acrilan[1]	B	8.5	3.1	Wool I	A
9.0	3.2	Wool I	B	8.5	3.1	Wool I	B
10.0	3.1	Cotton	A	10.0	3.0	Cotton	B
11.5	3.0	Verel[1]	A	11.0	2.8	Wool II	B
11.5	3.0	Wool II	B	12.0	2.7	Nylon 501	A
13.0	2.8	Wool I	A	13.0	2.5	Cotton	A
14.0	2.7	Nylon	B	14.0	2.2	Wool II	A
15.0	2.5	Wool II	A	15.0	2.0	Nylon	B
16.0	1.8	Nylon	A	16.0	1.5	Nylon	A
Not-soiled-but-cleaned carpets							
1.5	4.7	Nylon 501	A	1.5	4.6	Nylon 501	A
1.5	4.7	Nylon 501	B	1.5	4.6	Acrilan[1]	A
3.5	4.6	Acrilan[1]	A	3.0	4.5	Nylon 501	B
3.5	4.6	Verel[1]	B	4.0	4.4	Verel[1]	B
5.5	4.5	Acrilan[1]	B	5.5	4.3	Nylon	B
5.5	4.5	Rayon	A	5.5	4.3	Rayon	A
7.0	4.4	Cotton	A	7.5	4.2	Rayon	B
8.5	4.3	Rayon	B	7.5	4.2	Verel[1]	A
8.5	4.3	Nylon	A	10.0	4.1	Nylon	A
10.0	4.2	Verel[1]	A	10.0	4.1	Cotton	A
12.0	4.1	Nylon	B	10.0	4.1	Cotton	B
12.0	4.1	Wool I	A	12.0	4.0	Acrilan[1]	B
12.0	4.1	Wool II	A	13.5	3.9	Wool I	A
15.0	4.0	Cotton	B	13.5	3.9	Wool II	A
15.0	4.0	Wool I	B	15.0	3.8	Wool II	B
15.0	4.0	Wool II	B	16.0	3.7	Wool I	B

[1] Acrilan acrylic and Verel modacrylic were used as Acrilan and Verel, respectively, in the table above.

bottom half of the scale. Higher ratings were given nylon 501 lots after the third cleaning than had been given after previous cleanings. In general, and making no allowance for varying degrees of change within a rating, ten of the carpets shampooed by Blue Luster were rated as having a moderate color change, five were rated as having more change than acceptable, and one as having excessive change. No carpet rated above moderate change although rayon-Lot B, Verel modacrylic-Lot B, and Acrilan acrylic-Lot B showed little more than slight change.

All the cleaned-but-not-soiled carpets shampooed with either detergent solution were judged as changing only slightly in color with the exception of the two qualities of wool which were cleaned with Blue Luster. For these, a moderate rating was given although numerical scores indicated that their ratings approached the slight change position. The nylon 501 carpets ranked first for retention of color when cleaned by both methods, nearly approached the no change position while the rayon carpets dropped from first place ranking for soiled-and-cleaned carpets to a position about one-third to one-half of the way down the scale. There was an improvement in the ranking of nylon, denoting increased satisfaction with the carpet when the soiling process was omitted, and indicating that there was a relationship between soiling and color change of particular importance for this specific carpet. Wool II-Lot B and Bissell cleaned, and wool I-Lot B and Blue Luster cleaned, were ranked lowest of the carpets in regard to color changes. The relatively high rankings assigned to the

majority of the cleaned-but-not-soiled carpets would suggest that the soiling process was more of a primary cause of color change than cleaning. Wool carpets were the least color fast to cleaning methods employed showing a moderate change.

Texture. The subjective evaluation of the texture of the soiled-and-cleaned carpets shampooed by the two home methods showed comparable results. Conversely to color data for the same treatment, Lot B carpets did not rank consistently higher than Lot A carpets (Table 3).

The nylon 501 lots showed the least texture change among soiled-and-Bissell-cleaned carpets with rayon-Lot B ranking third. Moderate changes of texture occurred for the cotton lots with Lot A approaching more change than acceptable. Acceptability of Verel modacrylic carpets ranked comparatively low, being rated as having more change than acceptable although nearly approaching moderate change. Bissell cleaned Verel modacrylic lots indicated moderate to more change than acceptable even after the first shampooing process in the form of fuzziness, with ratings improving to moderate texture change for Blue Luster cleaned carpets.

All of the wool carpets and the nylon lots interchangeably held the last six rankings when shampooed by either Bissell or Blue Luster, with more change than acceptable to excessive change of texture being indicated.

Of the not-soiled-but-cleaned carpets cleaned by either detergent, only nylon 501 and Acrilan acrylic carpets indicated a slight texture change. The remainder showed varying amounts of

Table 3. Subjective ranking of the carpets for texture change after three cleanings.

Soiled-and-cleaned carpets							
Bissell				Blue Luster			
Rank	Numerical score	Fiber	Lot	Rank	Numerical score	Fiber	Lot
1.5	4.1	Nylon 501	A	1.0	4.0	Acrilan[1]	A
1.5	4.1	Nylon 501	B	2.0	3.9	Nylon 501	A
3.0	3.9	Rayon	B	3.5	3.7	Nylon 501	B
4.5	3.7	Acrilan[1]	A	3.5	3.7	Acrilan[1]	B
4.5	3.7	Acrilan[1]	B	5.0	3.4	Rayon	B
6.5	3.6	Rayon	A	7.0	3.3	Verel[1]	A
6.5	3.6	Cotton	B	7.0	3.3	Verel[1]	B
8.0	3.1	Cotton	A	7.0	3.3	Cotton	B
9.0	2.9	Verel[1]	A	9.0	3.1	Cotton	A
10.5	2.7	Verel[1]	B	10.0	2.9	Rayon	A
10.5	2.7	Wool I	B	11.5	2.4	Wool I	A
12.0	2.6	Wool II	A	11.5	2.4	Wool I	B
13.5	2.5	Wool II	B	13.0	2.2	Nylon	B
13.5	2.5	Wool I	A	14.0	2.1	Wool II	A
15.0	2.3	Nylon	B	15.0	2.0	Nylon	A
16.0	2.2	Nylon	A	16.0	1.7	Wool II	B
Not-soiled-but-cleaned carpets							
2.0	4.5	Nylon 501	A	1.5	4.3	Nylon 501	A
2.0	4.5	Nylon 501	B	1.5	4.3	Acrilan[1]	A
2.0	4.5	Acrilan[1]	A	3.0	4.2	Nylon 501	B
4.0	4.4	Acrilan[1]	B	4.0	4.1	Acrilan[1]	B
5.5	3.9	Rayon	A	5.0	3.8	Verel[1]	B
5.5	3.9	Rayon	B	7.5	3.5	Verel[1]	A
9.5	3.5	Nylon	A	7.5	3.5	Rayon	A
9.5	3.5	Nylon	B	7.5	3.5	Cotton	A
9.5	3.5	Verel[1]	A	7.5	3.5	Cotton	B
9.5	3.5	Verel[1]	B	10.0	3.2	Rayon	B
9.5	3.5	Cotton	A	11.0	3.1	Nylon	B
9.5	3.5	Cotton	B	12.5	3.0	Nylon	A
13.0	2.9	Wool II	A	12.5	3.0	Wool I	A
14.5	2.7	Wool I	B	14.0	2.9	Wool I	B
14.5	2.7	Wool II	B	15.0	2.7	Wool II	A
16.0	2.6	Wool I	A	16.0	2.5	Wool II	B

[1] Acrilan acrylic and Verel modacrylic were used as Acrilan and Verel, respectively, in the table above.

moderate change, except for all of the wool carpets but one for which more change than acceptable was shown.

In general, the texture rankings of cleaned-but-not-soiled carpets and soiled-and-cleaned carpets followed a similar pattern except for a change in position of the nylon lots from a ranking of 13 or lower for the soiled-and-cleaned treatment and with a rating of more change than acceptable, to a rating that indicated only moderate changes of texture. A relationship of soiling to texture changes is assumed for this particular carpet.

Further comparison of the soiled-and-cleaned carpets to the not-soiled-but-cleaned carpets would indicate that although the soiling and embedding processes influenced the texture changes that resulted, the shampooing process was also a significant factor in causing progressive changes.

Effectiveness of Cleaning. The rayon carpets were ranked first and second in degree of effectiveness of cleaning of the soiled-and-cleaned carpets cleaned by both methods except for one lot, although only an effective rating was given. There was no particular agreement of rank between carpets of the same fiber, Lot B ranking much higher than Lot A in some instances. Nylon carpets were judged to have been ineffectively cleaned except for one instance and wool II-Lot A also received a rating of being ineffectively cleaned, ranking fifteenth (Table 4).

Contrary to general soiling patterns, nylon 501 carpets appeared to become progressively cleaner with each soiling and cleaning process, but even so ranked tenth or below in cleaning

Table 4. Subjective ranking of effectiveness of cleaning after three cleanings.

Soiled-and-cleaned carpets							
Bissell				Blue Luster			
Rank	Numerical score	Fiber	Lot	Rank	Numerical score	Fiber	Lot
1.0	3.7	Rayon	B	1.0	3.4	Rayon	B
2.0	3.6	Rayon	A	2.5	3.2	Verel[1]	B
3.0	3.5	Cotton	B	2.5	3.2	Acrilan[1]	B
4.5	3.1	Nylon 501	B	4.5	3.1	Acrilan[1]	A
4.5	3.1	Acrilan[1]	B	4.5	3.1	Rayon	A
6.0	3.0	Wool I	B	6.0	2.8	Verel[1]	A
8.0	2.9	Acrilan[1]	A	7.5	2.7	Cotton	B
8.0	2.9	Verel[1]	B	7.5	2.7	Wool I	A
8.0	2.9	Cotton	A	9.0	2.5	Wool I	B
10.0	2.7	Nylon 501	A	10.0	2.3	Nylon 501	B
10.0	2.7	Wool I	A	11.0	2.1	Wool II	B
10.0	2.7	Wool II	B	12.5	2.0	Cotton	A
13.5	2.3	Wool II	A	12.5	2.0	Nylon 501	A
13.5	2.3	Verel[1]	A	14.0	1.7	Wool II	A
15.0	2.0	Nylon	B	15.0	1.3	Nylon	B
16.0	1.2	Nylon	A	16.0	1.0	Nylon	A
Not-soiled-but-cleaned carpets							
1.0	4.7	Acrilan[1]	A	2.0	4.5	Nylon 501	A
2.0	4.5	Nylon 501	A	2.0	4.5	Nylon 501	B
3.0	4.4	Nylon 501	B	2.0	4.5	Acrilan[1]	A
5.5	4.3	Acrilan[1]	B	4.0	4.4	Acrilan[1]	B
5.5	4.3	Rayon	A	5.5	4.3	Rayon	A
5.5	4.3	Cotton	A	5.5	4.3	Rayon	B
5.5	4.3	Cotton	B	10.0	4.1	Nylon	A
8.0	4.2	Rayon	B	10.0	4.1	Nylon	B
11.5	4.1	Nylon	A	10.0	4.1	Verel[1]	A
11.5	4.1	Nylon	B	10.0	4.1	Verel[1]	B
11.5	4.1	Verel[1]	A	10.0	4.1	Cotton	A
11.5	4.1	Verel[1]	B	10.0	4.1	Cotton	B
11.5	4.1	Wool I	A	10.0	4.1	Wool I	A
11.5	4.1	Wool I	B	14.0	4.0	Wool I	B
15.5	3.9	Wool II	A	15.5	3.8	Wool II	A
15.5	3.9	Wool II	B	15.5	3.8	Wool II	B

[1] Acrilan acrylic and Verel modacrylic were used as Acrilan and Verel, respectively, in the table above.

effectiveness, with one exception. None of the soiled-and-cleaned carpets was given a higher rating than effective, with numerical scores indicating that cleaning methods used were only slightly effective or ineffective for approximately two-thirds of the carpets in regard to removal of soil.

All not-soiled-but-cleaned carpets shampooed by both methods indicated that only a slight change in cleaning effectiveness had occurred except for wool II lots. The Acrilan acrylic and nylon 501 carpets interchangeably ranked the highest. The decrease in satisfaction of the wool carpets may have been related to excessive texture and color changes, indicating that the panel members closely associated cleaning with color and texture.

Objective Evaluation of Carpets

Trial analysis of variance was done with first soiling data, using the sums of squares as an estimator of variance in an effort to determine any meaningful differences in the wave lengths of the soiled carpets. A pattern could not be established so a second trial analysis of variance was done with carpets, as purchased, in another attempt to find a base from which to begin comparisons. Since the reflectance readings of carpets, as purchased, were lower than for soiled-and-cleaned carpets, these data were also discarded.

A third analysis of variance was done, using sums of differences of the three cleanings by the two methods. This procedure was followed to determine any significant difference in the cleaning

effectiveness of the two shampoos. It was found that the method of cleaning was significant at the 0.1 per cent level except for Verel in which case the method of cleaning was significant at the 5.0 per cent level (Table 5). In general, Bissell cleaned carpets had higher reflectance readings, implying more effective cleaning than with Blue Luster.

Cleanings and the interaction, method times wave length, also showed particular significance.

Negative numbers were obtained in some instances when arriving at differences between the soilings and the cleanings for Blue Luster cleaned carpets, indicating that the soiled carpets were cleaner than the shampooed carpets. It was found that appreciable negative readings were obtained after the first cleaning but that they were less negative after the second cleaning. However, the reflectance readings again reversed after the third cleaning, and negative readings were obtained that approached those of the first cleaning. These variables are unexplained.

SUMMARY AND CONCLUSIONS

The purpose of this study was to compare the effectiveness of two home cleaning methods on selected carpets of tufted loop pile construction in regard to color, texture, and effectiveness of cleaning, and to obtain, if possible, a positive correlation between the objective and subjective evaluation in an attempt to define desirable service qualities of carpeting.

Table 5. Analysis of variance among carpets, using the Bausch-Lomb spectronic 20 colorimeter with reflectance attachment.

Source of variation	Degrees of freedom	Mean squares: Nylon	Nylon 501	Acrilan	Verel	Rayon	Cotton	Wool I	Wool II
		Lot A							
Method of cleaning	1	295.211***	629.378***	513.611***	115.600*	346.100***	332.544***	608.400***	453.378***
Cleanings	2	160.345***	247.078***	259.878***	43.477	145.278***	477.300***	840.700***	239.078***
Wave length	4	19.872	37.734*	24.905	10.844	1.317	12.539	29.622	22.488
M x C	2	95.279**	150.345***	88.077*	8.100	135.900***	15.321*	79.300*	159.345***
M x WL	4	4.461	28.711	43.972	44.322	1.572	116.405*	14.288	36.045
C x WL	8	10.081	10.050	33.363	17.769	5.625	8.397	11.005	13.772
Remainder	8	16.920	14.749	18.291	28.003	9.657	33.552	18.875	26.669
		Lot B							
Method of cleaning	1	624.100***	892.500***	774.400***	90.000*	798.044***	810.000***	953.878***	385.155***
Cleanings	2	106.900**	410.700***	145.678**	44.433	338.033***	1040.434***	336.678***	256.678***
Wave length	4	28.361*	2.983	15.489	17.489	1.972	26.183	5.628	4.431
M x C	2	298.434***	330.900***	132.700***	14.700	125.411***	257.433***	185.478***	3.256
M x WL	4	7.906	35.528***	15.678	13.888	23.239***	16.195	4.850	17.625
C x WL	8	9.595	9.283	21.997	19.030	1.047	35.225	6.844	16.718
Remainder	8	10.028	3.090	19.336	15.873	2.527	29.873	9.406	17.336

* Significant at P = 0.05
** Significant at P = 0.01
*** Significant at P = 0.001

Included in the study were carpet fibers of nylon, nylon 501, rayon, cotton, Acrilan acrylic, Verel modacrylic, and two qualities of wool. Two lots of each carpet type were purchased.

The treatment of the carpets was as follows: 1) not-soiled-not-cleaned to serve as a standard, 2) soiled-and-cleaned, and 3) not-soiled-but-cleaned. Carpets were subjected to these treatments for a three-week period, with both objective and subjective evaluations made at the end of each period in the forms of reflectance readings and ratings by a panel, respectively.

The results of the study showed that the panel evaluated the soiled-and-cleaned carpets shampooed with Bissell and Blue Luster as being cleaned with nearly equal effectiveness. However, Bissell shampooed carpets seemed to be slightly more satisfactory than those cleaned by Blue Luster. The darker colored lot appeared to be more effectively cleaned than the light lot in almost all instances.

The texture of the soiled-and-cleaned carpets was only moderately satisfactory or less, except for the two nylon 501 lots, Bissell cleaned, and for Acrilan acrylic-Lot A, Blue Luster cleaned, that showed only a slight change in texture. Already after the first cleaning, moderate to more change than acceptable were the ratings given to all lots of Verel modacrylic carpets because of the fuzzy surface appearance. Except for nylon 501 carpets and Acrilan acrylic-Lot B, the carpets showed moderate change to more change than acceptable. Wool II-Lot B and Blue Luster cleaned showed excessive texture change. The not-soiled-but-

cleaned carpets followed a similar texture pattern, although to a somewhat lesser extent, that would suggest that the soiling and embedding processes were influential in effecting the texture changes, but that the shampooing process was also a significant cause. The poorest in performance of the soiled carpets, nylon increased in satisfaction after cleaned-and-not-soiled treatment, indicating that soiling was perhaps a factor in causing texture changes for that particular carpet.

Panel members were the best satisfied with the color of rayon-Lot B, after the repeated shampooings of soiled-and-cleaned carpets by Bissell detergent, giving it a rating of only slight change. All other carpets indicated moderate change or more even though cotton-Lot B, nylon 501-Lot B, rayon-Lot A, Verel modacrylic-Lot B, and Acrilan acrylic-Lot B nearly reached the numerical score assigned to rayon-Lot B. The most dissatisfaction was shown with nylon-Lot A, which was ranked as showing the most color change of all the cleaned-and-soiled carpets. All carpets not-soiled-but-cleaned were judged as changing only slightly in color except for both lots of wool I and II cleaned by Blue Luster. A comparison of color changes of soiled-and-cleaned and cleaned-but-not-soiled carpets would suggest that although soiling is an important cause of color changes, that the cleaning process is also a significant factor, in this case having particular bearing on the colorfastness of the wool carpets included in the study.

With no exceptions, the cleaning of the soiled-and-cleaned carpets by both methods was given an intermediate rating of

effective or less after the first cleaning. Thereafter, the carpets remained about the same or became progressively more soiled after each cleaning, with the exception of nylon 501 which showed a higher degree of apparent soiling after the first cleaning than after the third cleaning. The darker lot of rayon was ranked the highest, being rated by the panel as cleaned effectively, while cleaning of nylon was ineffective, possibly accounted for by the use of a fiber that is of low denier and probably designed for apparel use. All of the cleaned-but-not-soiled carpets were rated as being very effectively cleaned with the exception of both lots of wool II, for which effective cleaning was indicated. Since no soil had been applied it could be assumed that the decrease in satisfaction of the effectiveness of cleaning of the not-soiled-but-cleaned carpets was perhaps related to texture or color changes. Subjective evaluation of the effectiveness of cleaning also indicated that home shampoos act as a surface brightener only rather than as a cleaner.

An analysis of variance on the objective data obtained from reflectance readings found differences at the 0.1 per cent level between the cleaning effectiveness of Bissell and Blue Luster cleaning methods, with Bissell repeatedly appearing to clean the carpets more effectively than Blue Luster.

The lack of agreement between the subjective and objective data would indicate that there are some unexplained variables. Possibly the brighteher used in Blue Luster detergent could cause a difference in reflectance readings. The seemingly slightly

better sudsing on carpets subjected to Blue Luster shampooing might indicate a greater amount of residue left in the carpet after vacuuming, thus effecting a dulled appearance and subsequent lower reflectance readings. The ratings given by the panel might also indicate that there was not an accurate subjective measurement of the soiling of carpets.

On the basis of the highly varying data obtained, no conclusions were drawn. Further studies to investigate any similar or dissimilar cleaning abilities of home shampoos would be helpful.

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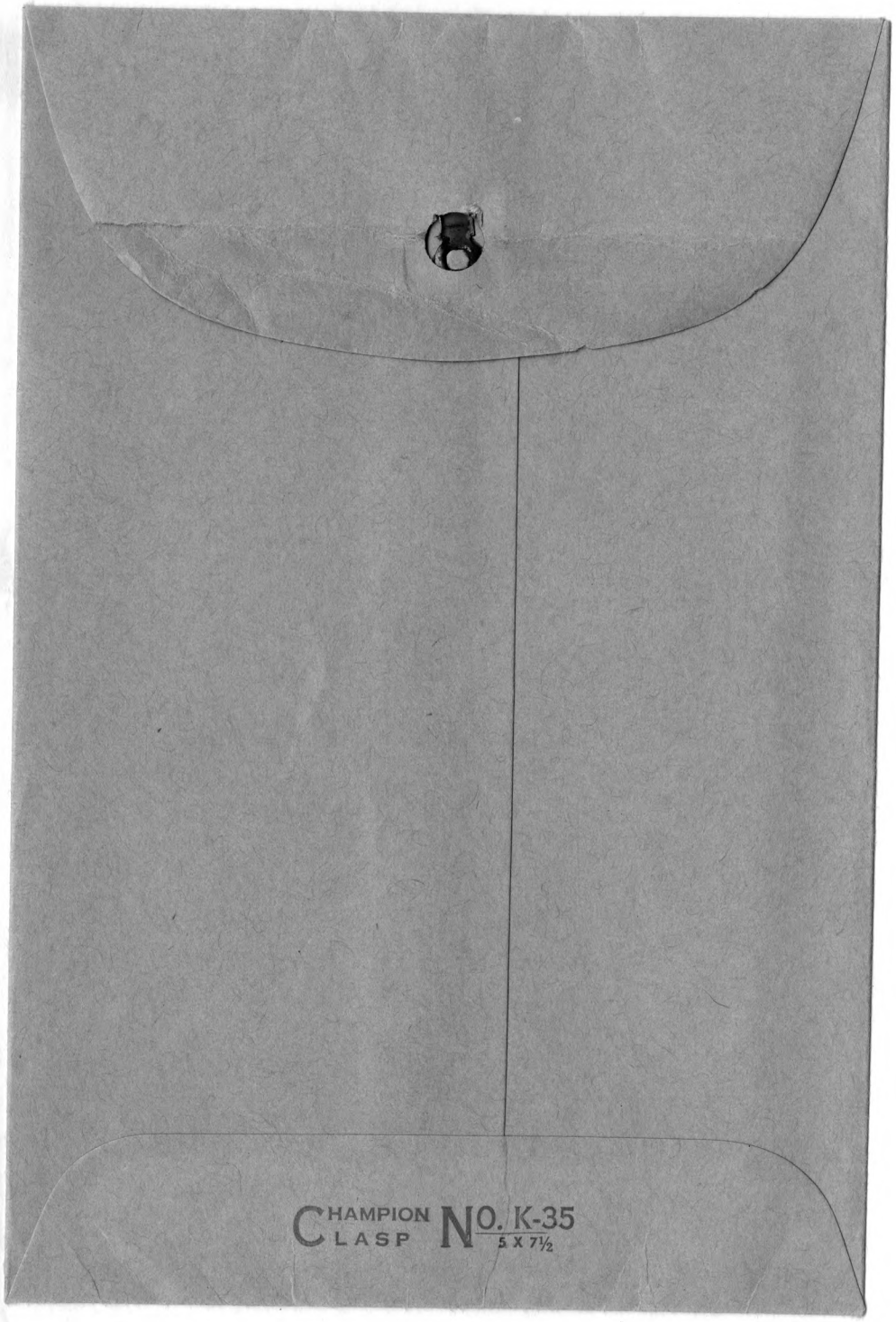
APPENDIX



The ratings for the color, texture, and effectiveness of cleaning of the carpets were recorded on this subjective evaluation form.

VISUAL EVALUATION OF CARPETS

Date_____ Cleaning No. _____

Evaluator_____

Evaluate the carpets for color change, change in texture, and effectiveness of cleaning. Check in one of the columns below the terms which best describe your evaluation.

Evaluation for Color Change

	No Change	Slight Change	Moderate Change	More Change than Acceptable	Excessive Change
Position 1					
Position 2					
Position 3					
Position 4					
Position 5					
Position 6					
Position 7					
Position 8					

Evaluation for Change in Texture

	No Change	Slight Change	Moderate Change	More Change than Acceptable	Excessive Change
Position 1					
Position 2					
Position 3					
Position 4					
Position 5					
Position 6					
Position 7					
Position 8					

Evaluation for Effectiveness of Cleaning

	Highly Effective	Very Effective	Effective	Slightly Effective	Ineffective
Position 1					
Position 2					
Position 3					
Position 4					
Position 5					
Position 6					
Position 7					
Position 8					

EFFECTIVENESS OF HOME CLEANING METHODS ON SELECTED TUFTED CARPETS

by

ALLENE LYDIA WENGER

B. S., Kansas State University, 1954

AN ABSTRACT OF A THESIS

submitted in partial fulfillment of the

requirements for the degree

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1960

Home cleaning of carpets has become increasingly important as soft floor coverings of some type have come to be used by most economic groups. The purpose of this study was to compare the effectiveness of two home methods of cleaning on tufted carpets made of selected natural and man-made fibers, and to compare the effectiveness of cleaning of the different fibers.

The carpets included in this study were made of nylon, nylon 501, Acrilan acrylic, Verel modacrylic, rayon, cotton, and two qualities of wool designated as wool I and wool II. Two colors, beige and rose beige, were purchased for each carpet type and will be identified as Lot A and Lot B.

A synthetic soil was used in this study. The two shampoos selected for cleaning were Bissell and Blue Luster. Portions of the carpets were subjected to treatments that included 1) not-soiled-not-shampooed--vacuumed and reflectance readings taken (to serve as a standard), 2) not-soiled-but-cleaned--vacuumed and reflectance readings taken, and then shampooed, vacuumed, and reflectance readings taken, and 3) soiled-and-cleaned--vacuumed, and reflectance readings taken, then soiled, vacuumed, and reflectance readings taken, and then cleaned, vacuumed, and reflectance readings taken. After each shampooing, a group of five panel members subjectively evaluated the carpets for color change, texture change, and effectiveness of cleaning. Reflectance readings were taken using a Bausch-Lomb Spectronic 20 Colorimeter with Reflectance Attachment to serve as an objective evaluation of soiling. Dimensional stability measurements were taken after each of

the three cleanings.

The dimensional stability of the carpets was generally acceptable with wool II lots showing the most change of the warp yarns while cotton stretched slightly in the filling yarns. Evaluation by the panel indicated that with few exceptions, the cleaning method used for soiled-and-cleaned carpets was non-significant, with ratings for carpets cleaned with Bissell detergent usually ranking only slightly higher than carpets shampooed by Blue Luster, in regard to color, texture, and effectiveness of cleaning. Numerical scores indicated that the rayon carpets showed the least color change, nylon-Lot A showed excessive change, and all other carpets showed varying degrees of moderate change or more. The nylon 501 carpets showed the least texture change with Acrilan acrylic showing slightly greater change. More texture change than acceptable was indicated for Verel modacrylic, wool I, wool II, and nylon carpets. The ratings for effectiveness of cleaning demonstrated that even after the first soiled-and-cleaned process a moderate change had occurred. Progressive soiling was generally indicated with the exception of nylon 501 lots which showed a higher degree of apparent soiling after the first than after the third cleaning.

The not-soiled-but-cleaned carpets followed a similar pattern to that of the soiled-and-cleaned carpets but with higher numerical scores and higher ratings. There was little evidence of important color changes caused by the cleaning process except for wool I-Lot B, and wool II-Lot B, for which moderate changes were

listed. The cleaning process apparently effected texture changes of a moderate degree, with only nylon 501 and Acrilan acrylic showing slight changes. Wool II-Lot B was judged unacceptable.

The nylon 501, Acrilan acrylic, and rayon carpets were judged to be most acceptable in overall appearance with nylon, wool I, and wool II interchangeably and consistently being least acceptable.

An analysis of variance of the objective data showed significant differences at the 0.1 per cent level between the effectiveness of the two shampoos with Bissell consistently showing more effective cleaning than Blue Luster.

The lack of agreement between subjective and objective data would imply that there are some unexplained variables. A study of the cleaning effectiveness of other carpet shampoos would be helpful.