EFFECTIVENESS OF A HOME CLEANING METHOD OF SELECTED PILE FLOOR COVERINGS MANUFACTURED FROM MAN-MADE FIBERS

by

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INTRODUCTION

The increased use of carpeting and rugs both for home and commercial purposes, the use of fibers other than wool, and the development of tufted carpeting has raised numerous questions concerning care and cleaning. The consumer is faced with problems relating to the care of these new carpetings. There has been little work reported on care of carpeting constructed of the man-made fibers that would help in solving these problems. Some work was reported on the cleaning of wool, cotton, and rayon and wool blends by various types of rug cleaners (22). Hensley and Fletcher (21) found that on laundering cotton broadloom rugs, the woven ones used in the study showed more dimensional change than the tufted rugs. Work has been reported by Fletcher and Hensley (14) on the effect of soil retardants on cotton carpeting. These workers found that carpets treated with a soil retardant after each cleaning showed less soiling and change in reflectance than those not treated before soiling or those treated only once which was before the first soiling test.

The purpose of this study was to compare the effectiveness of a home method of cleaning carpets made of different fibers in an attempt to gather information that would help the consumer with some of the problems relating to the care of carpets constructed of the man-made fibers rayon, nylon, and Verel modacrylic.

REVIEW OF LITERATURE

The serviceability of carpeting is influenced by its construction, its fiber content, its resistance to soiling, and its ease of cleaning. Carpeting is subjected to soiling by the very nature of its use.

Construction and Production of Carpets

The weaving of carpets dates back to ancient Egypt when the tapestry carpets, woven flat without pile, were used in temples and later in the palaces of the Pharaohs. The Babylonians were also known as weavers of carpets. Carpets of Egypto-Roman origin of the second and third centuries A. D. with cut-pile surfaces have been preserved. Most authorities agree that carpet weaving spread to Spain and Italy during the fourteenth century; however, some authorities report that this occurred as early as the eighth century. The weaving of cut-pile carpets was at its height in the Orient during the sixteenth century. The center of the carpet industry moved to France around 1604. After Louis XIV deprived the French Protestants of religious protection in 1685, the center of the industry moved to England, Belgium, and Germany. It was in 1791, in Philadelphia, that the first carpet mill in the United States was established. The growth of carpet weaving continued until the center of the industry was in the United States by 1839 (11). The use of soft floor coverings has grown steadily.

In 1951, the production of soft floor coverings for commercial and home use amounted to a little less than 65 million square yards. In 1958, the figure was a little less than 131 million square yards. This shows an increase in the use of soft-floor coverings of approximately 66 million square yards in this eight-year period (4).

There are various types of carpets made today. The Oriental rug is an example of the handmade type. The three most important types of machine-woven carpets are Wilton, Axminster, and velvet. Other types of machine-made carpets are tufted and knitted. Knitted carpets are one of the most recent developments in carpet manufacture and have been produced on a limited scale since 1950. Prior to 1951, woven carpets dominated the market. Since then, there has been a marked change in the manufacture of carpeting, and the use of tufted carpeting has increased (25). This study was concerned with tufted carpeting.

The tufting process is one in which a piece of yarn is pushed through a backing material with a needle. This yarn is caught by a hook, held, and then taken back through the backing thus forming a tuft. The backing fabric for carpets may be of jute or cotton duck. The tufting machine may have many needles, often more than a thousand. A strand of yarn goes to each needle which may place the tufts in the backing material at any length the manufacturer desires. Today, carpeting may be made by tufting machines which make it up to 18 feet wide (23).

The tufting industry is not a new one in this country as the process was brought from Europe during the middle of the nineteenth century. It became an industry about 1921, when a tufting machine was developed for the production of bath mats. In 1948, a tufting machine was developed that could manufacture goods in widths of 27 and 37 inches and in 1950, another machine was made that produced carpeting 12 feet wide (5). Production by the tufting process prior to World War II was estimated at not more than three million square yards. This was produced in making bath mats and sets. In 1951, the total production of tufted carpeting and rugs over four by six feet in size was 6.1 million square yards (this figure includes 13 million square yards used in the manufacture of auto and aero carpeting). In 1951, 91 per cent of the carpeting produced was woven, and only nine per cent was tufted (3). In February, 1959, nearly 60 per cent of the soft floor covering used in the United States was tufted and it was estimated that by 1960, this figure would reach 70 per cent (43).

The use of the tufting machine for making soft floor coverings represents a current trend in the methods used in manufacture. The speed by which its use has grown has been attributed to several factors. One is that it is much faster to make carpets by this method than by the woven method. Another factor is that it would cost approximately 27,000 dollars for a tufting machine and creels while the cost of looms and other necessary equipment to equal production of this tufting machine would cost approximately 350,000 dollars (23).

Changes in the fibers used have been as great as the changes in the method of manufacture and the consumption of soft floor coverings. Wool has been the major fiber used in making woven carpets since ancient days and its use in making tufted and knitted carpeting is extensive but other fibers also are being used. The wool fiber used in soft floor coverings has been imported from such countries as Syria, Iraq, Argentina, and India. Wool from China is no longer available because of the United States trade relations with that country. Domestic wool is not suitable for carpet making as it is too soft and too fine. Argentina has been the major source of carpet wool for the last 15 years (4). There is little chance that the importation of carpet wool will increase. There is more likelihood that it will become more expensive and scarce (27).

One result of the position of the carpet wool market is that the use of cotton and man-made fibers has grown rapidly. This is particularly true when speaking of tufted carpeting. Cotton is used in tufted carpeting although its use is not as great today as during the early years of tufted carpeting manufacture (4). The use of the man-made fibers has grown steadily. In 1951, one carpet firm showed lines of carpets made only of wool. Seven years later, this same company showed more than four times as many lines of carpets as they had previously and these were made of such fibers as acetate, Acrilan acrylic, nylon, rayon, and wool (27). Poundage-wise, the use of man-made fibers for carpet manufacture is nearly equal to that of wool. This is shown by estimated consumption figures for 1958 of 117 million pounds of wool as compared to 105 million pounds of man-made fibers. The 105 million pounds of man-made fibers was composed of 67 million pounds of rayon and acetate and 38 million pounds of nylon and acrylics. The estimated consumption of cotton for 1958 was 17 million pounds (4).

On examining more closely the growth of the man-made fibers, it was found that rayon was the first to make its appearance as a carpet fiber. It was reported that the use of rayon for making tufted carpeting had made a sharp rise from 22 million dollars wholesale in 1943 to 110 million dollars by 1954 (42). Most of this increase had occurred in the two previous years. By 1958, rayon had become an important fiber for use in making carpeting (27).

Saran also was used in carpet making (23). Acrilan acrylic and Dynel modacrylic carpets began to appear in early 1957 (1). The use of acetate increased during 1958 and also the use of nylon grew significantly as most all tufters and weavers of soft floor coverings were including nylon in their production plans for the immediate future (27). Verel, Eastman's modacrylic fiber, was introduced in carpeting in 1958 (27), and new high bulk Verel modacrylic was shown in January, 1960 (47).

At a home-furnishing market held in January of this year, other new fiber developments in carpeting were exhibited. Du Pont showed the first carpeting made of Orlon acrylic fiber. Carpets of textured nylon were prominent in the carpeting picture as were solution-dyed nylon tweed carpets. Creslan acrylic fiber is expected to be on the carpet market later this year (47).

The use of man-made fibers should not be considered as a substitute for wool, but as a permanent part of the raw material available for carpet manufacture. The use of these fibers fills the need left by the decreased production of carpet wool (3).

Soil

Soil on carpeting has been defined by Florio and Mersereau (15) as "any dry or able-to-be dried material that is retained on fiber surface after vacuuming or sweeping has been performed." This definition does not include stains. A stain results when the soil is held to the fabric by ionic or by hydrogen bonding (36).

Snell et al. (36) explained that soil was deposited on fabric by mechanical, chemical, and electrical forces. When soil is deposited by mechanical means it is loosely held so it can be removed by brushing or agitation. When the forces that hold soil to fabric are chemical in nature, it is attached by ionic or by hydrogen bonding. This type of soiling is difficult to remove and usually requires chemical agents. These workers postulated that soil was held to fabric by electro-static forces but Schappel (33) did not verify this finding.

Compton and Hart (10) reported that micro-occlusion was a major factor in soil retention. They defined micro-occlusion as the "entrapment of particles in the irregularities of the fiber surface." The use of the optical microscope showed that soil particles appeared to be located along the crevices and irregularities of the fiber. In later work, Hart and Compton (19) reported that there was a geometric relationship between the size and shape of the soil particles and the size and shape of the pits and crevices of the fiber.

It was found by Hart and Compton (20) that macro-occlusion was also a major factor in soil retention. Macro-occlusion was defined as the "entrapment of particles in the intrayarn and interyarn spaces" (10). Both primary and secondary soil deposition resulted from this type of soiling. Primary soil deposition increased as the weight and complexity of the structure of the fabric increased. The secondary soil deposition indicated a build-up of soil in the interyarn and interfiber spaces of fabrics (20).

Schwarz (35) concluded from a study made on fabric soiling, that carpet soiling was the result of impingement occurring by deposition and transfer, and retention by oil bonding and occlusion. This worker also suggested that the impingement of soil on carpeting occurred by transfer from contact surfaces and by being air borne. Soiling from shoe contact produced pressure and friction for embedding the soil into the fiber (32).

Snell et al. (36) suggested that loosely held soil should not be difficult to remove as it adheres in the interyarn spaces of the fabric. The type and closeness of the weave as well as the fabric's resiliency affect the amount of soil that lodges.

A fabric that has little resiliency as well as being closely woven will hold less dirt than a resilient one with a rough, loosely woven surface. Also, they reported that soil was retained by fabrics as a result of oil bonding. The oil or oily soil adheres to the fabric and penetrates into the capillaries.

Fortess and Kip (16) found that soil would adhere to oil and thus cause soiling. They reported that oil contamination of the pile during manufacture, and the lubricants used when making the jute backing were two important factors in the soiling of acetate and viscose pile carpets.

Utermohlen et al. (45) found that moisture and humidity were factors in fabric soiling as dry pieces of cotton cloth soiled much more heavily than did damp pieces. However, the damp pieces soiled more quickly than did the dry pieces.

Masland (28) reported that fiber diameter and the contour of the fiber were important factors in soil retention. A fiber with a smooth, circular cross section with a large diameter retained less soil than either a fiber with a smooth, circular cross section and a small diameter or one with a large diameter but of irregular cross section. He concluded that carpets constructed from man-made fibers could give low soil retention equal to that of wool fibers.

Soiling may be classed as apparent and absolute. Absolute soiling is that amount of soil actually present, and apparent soiling is that soil which is visible to the eye (13).

Fiber

There are certain desirable characteristics which a carpet fiber should possess. The fiber should have a high degree of durability and crush recovery. It should be permanently twist set and mildew and insect resistant. It should be easily dyed and easily cleaned (30). The fiber should have low soiling tendencies. Masland (28) showed that a fiber with a smooth, circular cross section with a large diameter resisted the tendency to soil.

Rayon. Rayon which is regenerated cellulose was the first man-made fiber to be used in carpeting. The cellulose changed to a cellulose derivative and when solidified becomes regenerated cellulose with certain chemicals added.

Rayon was introduced as a carpet fiber in 1940 (29). These first carpets were made of apparel rayon and proved unsatisfactory (5) as their characteristics for crushing, matting, and soil resistance were low (22). Two years later the producers of rayon began experimentation on a carpet fiber. This work was delayed by World War II but was resumed after the close of hostilities. In 1947, the American Viscose Corporation began producing a permanently crimped viscose staple fiber (18). The latest development in rayon carpet fiber is the American Viscose Corporation's Super-L smooth fiber which is claimed to be 108 per cent better than crimped rayon (7).

Rayon has certain characteristics which when used as a carpet fiber are advantageous and others which are disadvantageous. It can be made to possess properties of stiffness and appearance that are similar to wool by selecting the correct denier and crimp (49). Deniers from 8 to 15 are used most frequently (46). These compare in size to those of the wool fiber used in carpeting which has an average size of 15 denier (5). Rayon can be made in either bright or dull luster (49). From a soiling standpoint, the dull fiber shows less soil. The fiber may be made with a crimped or a smooth cross section (42). Smooth rayon has a round cross section and no irregularities in which soil may become entrapped. As a result, it shows soiling to a lesser degree. The smooth fiber has anti-soiling characteristics comparable to those of wool (33). Whitney and Schappel (48) reported that the smooth fiber was not sensitive to oil wicking action from the jute backing or machinery used in manufacture.

Rayon is more abrasion resistant than wool and its tensile strength is greater than that of wool. It is also resistant to moth damage (5). There is a sameness in shape and dimension of rayon carpet fibers which makes it possible to dye them in a large range of colors from light tints to dark shades (34). This appeals to the consumer who is concerned with beauty since it provides for a greater freedom in choosing the decor of the home.

Rayon carpet fibers clean well (5). The smooth fiber gives up soil as easily as wool when wet cleaning methods are used (34). Finzel and Fok (13) reported that rayon carpeting was relatively free from electro-static accumulation.

Rayon possesses certain disadvantages as a carpet fiber. When it is produced so its luster is bright, an optical effect is created which makes the carpet appear dirtier than it actually is (42). Thus the bright staple readily shows soil. When the fiber is produced with a crimped cross section, the cross section is irregular in shape and it possesses longitudinal serrations. Soil accumulates in the irregularities so it has high soiling tendencies and soil is hard to remove from these soil-holding sites (37). Much of the rayon carpeting produced today is made of the crimped fiber. The reason for this is that the carpet producers prefer the texture and hand of carpeting made from the crimped fiber (33). Whitney and Schappel (48) reported that crimped rayon fiber was most sensitive to oil contamination from the oily jute backing of the carpeting and from the machinery used in the manufacture of the carpet.

The resiliency properties of the rayon carpet fiber are inferior to those of wool (5). The crush recovery characteristics are not good so the rapidity of re-crushing after cleaning is great (26). Finzel and Fok (12) found that when a long-time static load was removed, residual matting was 50 per cent for rayon as compared to nylon which had only 13 per cent. They used crush as the amount that pile is compressed under pressure; recovery as the height that pile rises after pressure is removed; and matting as the difference between the original pile height and the regained one.

Nylon. Nylon, a generic term for a class of long chain polyamides, is a truly man-made fiber produced from the raw materials of carbon, nitrogen, hydrogen, and oxygen (29).

The use of nylon as a carpet fiber began as early as 1947 (30). It possesses many characteristics which make it desirable for this purpose. Work reported by Finzel and Fok (13) showed that the nylon fiber is smooth so it does not have surface irregularities to entrap soil particles. Nylon is made in both bright and dull lusters. Bright lustered nylon may appear to be more heavily soiled than wool which may contain a high degree of absolute soiling where the nylon is showing only apparent soiling. Dull nylon compares with wool in apparent soiling. Nylon, a white fiber, appears to soil more rapidly than wool but when dyed the natural color of wool, there is no appreciable difference in the rate of soiling. Nylon actually is low in absolute soiling (33).

Stain removal from nylon was much more readily accomplished than from rayon, cotton, or wool as the fiber did not swell from moisture. Carpeting made of nylon cleaned easily and it dried nearly twice as rapidly as wool or rayon (13).

Carpeting made of 100 per cent nylon showed high abrasion resistance (13). It has high resiliency properties which add to its desirability as a carpet fiber (44). It has a great affinity for dye and since it is white in color, it can be dyed clear, bright colors from the light tints to the darker shades, thus increasing its styling possibilities. Styling possibilities may be increased even more because nylon is available in both bright and dull lusters (38).

A study made by Finzel and Fok (12) showed that carpeting made of 100 per cent nylon had excellent crush resistance, recovery from static load, and showed very little matting. After a static load of long duration had been removed, 100 per cent nylon carpeting recovered to the degree where no apparent indentation remained. It was superior to wool in this respect. Nylon recovered more slowly than the acrylic and wool fibers but the recovery was more complete (7).

Carpeting made of 100 per cent nylon has exceptional strength and this factor has created the problem of pilling. Pilling is caused when short fiber ends migrate to the surface of the carpet where they become entangled. These pills become fastened to the surface by other nylon fibers. Because of the strength of nylon, the pills do not break off as they do with weaker fibers. Du Pont reported work done which showed how to combat this problem on most types of regular carpet construction (17).

One hundred per cent nylon carpeting showed a moderate amount of electro-static accumulation especially at relative humidities of less than five per cent. This static accumulation disappeared during the normal use of the carpet (13).

Originally, spun nylon carpet fiber was used, but one of the most recent developments has been the use of textured filament nylon carpet fiber. A textured yarn means that the filament yarn has been distorted by mechanical means in such a way that a permanent voluminous effect is produced. Texturing of the yarn was found to add extra resiliency to the carpet yarn. Carpeting made of textured filament nylon cleaned much more easily than the conventional spun nylon yarn. This new type of carpeting did not show a tendency to shed or pill. These yarns fluffed out many times the original size of filament yarns so that they gave more coverage for each pound of yarn. They may be used in carpets made by the woven, tufted, or knitted methods of manufacture (39). Textured nylon yarns should not be considered as a replacement of the nylon staple yarns but as another development to be used along with the staple yarns (6).

Du Pont created a new type nylon during the research on yarn texturing. Prior to this time the staple nylon fiber had been used in carpets. The structure of the new type nylon was entirely different so its properties differed from the regular nylon. Produced in deniers of 1300 and 3700 in continuous filament, it became known as Du Pont Type 501 carpet nylon (6). This yarn possesses several improved properties. It dyes rapidly with the dye penetrating to a greater degree. It has better resiliency and gives a greater bulk in carpets. This greater coverage may eventually reduce the price of the carpeting.

Some carpeting has been made of waste and re-used nylon which was originally made for use in wearing apparel. Carpeting made from this type of fiber does not provide for satisfactory serviceability (2). Carpet nylon should be obtained when purchasing carpeting made from this fiber.

Verel. Eastman Chemical Company introduced a modacrylic staple fiber in the fall of 1957 which was trademarked Verel (40).

This fiber has acrylonitrile as its chief component with modifiers added to give it certain desirable characteristics such as whiteness, flame resistance, optimum moisture regain, and a great affinity for dyes (26). When Verel modacrylic fiber is made, it is carefully controlled in order to reduce pilling and yet produce a fiber with adequate strength (24).

Verel modacrylic is available in both bright and dull luster. In soiling tests, Verel modacrylic carpeting composed of 70 per cent bright and 30 per cent dull fiber had soil resistance as good as wool and in carpeting composed of 50 per cent bright and 50 per cent dull, its soil resistance was superior to that of wool. Studies showed that Verel modacrylic carpeting gave up soil easily and retained its texture during the process. It could be cleaned well by both on-location and in-plant cleaning methods. It dried rapidly and did not lose strength when wet. Many spots and stains normally considered hard to remove from carpeting were removed satisfactorily from Verel modacrylic carpeting (26).

When compared with wool, Verel modacrylic outranks it in strength, elongation, and elastic recovery. It is not affected by moth or mildew. It is resistant to the effect of highly concentrated acid but is somewhat discolored by alkali. It is not affected by drycleaning solvents but dissolves in warm acetone. It is a thermoplastic fiber but withstands temperatures up to 300° F.

Research done by the producers of Verel modacrylic showed that it was more crush resistant than wool so it is considered superior in this respect. When short-term loads were applied, it did not recover as rapidly as wool but it showed somewhat better recovery from heavy loads applied for long periods of time although the recovery was incomplete and slow.

Work done on texture retention showed that Verel modacrylic had a greater tendency to pill than wool but that the pilling disappeared when the carpet was walked on. Verel modacrylic retained its texture well when cleaned as it did not felt as wool did. Since Verel modacrylic can be given a more permanent twist set than wool, and since it has a low moisture regain, moisture from cleaning does not have a significant effect on it.

The carpeting was found to have abrasion resistance, being surpassed only by nylon. Rayon carpeting as compared to Verel modacrylic would have been only one-third as resistant. Verel modacrylic should give satisfactory wear.

Verel modacrylic is easily dyed because of its affinity for dye and because of its natural whiteness. Since it is such a white fiber, it is possible to dye it in bright, clear shades which may be light in value. It is as fast to light as wool. Since Verel modacrylic can be dyed in a wide range of clear colors and since it is available in both bright and dull lusters, carpeting can be made which will appeal to the consumer's sense of beauty (26).

Cleaning

No studies were found which reported on the cleaning of carpets manufactured from man-made fibers. Herrick (22) reported on work done at the University of Wisconsin in 1954 in which cotton, wool, and a blend of 50 per cent wool and 50 per cent rayon were used. Four types of cleaners using different kinds of surface active agents were used. The professional methods of wet shampoo and on-location cleaning also were studied. The cleaners used contained surface active ingredients of these types: a. fatty acid condensation, b. alkyl-aryl sulfonate, c. soap, and d. trichloroethylene in sawdust base. The results showed that on the wool and the blended carpetings, the cleaner with the fatty acid condensation had good cleaning action but the reflectance was not returned to the original reading. This cleaner showed fairly good cleaning power on the cotton carpet. One cleaner of the alkyl-aryl sulfonate gave the results of a better reflectance reading on wool and the blend than the original reading. This was not true of the cotton carpet as the results were varied. When one soap was used as a cleaning agent, all carpets were brought to their original reflectance reading but it caused the cotton carpet to soil to a greater degree. This effect was not noted on the carpetings made of wool and the blend. Another cleaner with the active ingredients of alkyl-aryl sulfonate did not return the reflectance reading of any of the carpeting to the original. This was a poor cleaner for the cotton carpeting. The cleaner with the trichloroethylene gave good results on the first cleaning as it was fairly satisfactory on all fibers but on later cleanings it was less effective.

It was concluded from this study that carpets cleaned with a synthetic detergent did not tend to resoil to as great a degree as those cleaned with soap. Cotton carpets appeared to need professional cleaning. Not any one cleaner was equal in effectiveness on all fibers for all the cleaning runs. The two alkylaryl sulfonates proved more effective than either the fatty acid condensate type or the trichloroethylene.

Consumers Union reported (41) on work done on the evaluation of different rug cleaning devices. It was found that the Bissell Shampoo Master applicator and rug shampoo proved a satisfactory home method for rug cleaning. The Bissell Shampoo Master applicator consists of a soft sponge roller and two rows of bristles attached to the lower end of the handle. It has a plastic tank which holds the rug shampoo solution. The solution is released to the roller through perforations in the bottom of the tank. The shampoo master is pushed back and forth over the rug while the shampoo solution is released. A foam forms on the rug which is allowed to dry. After drying, the rug is vacuumed to remove the loose detergent and soil.

Reflectance

Salsbury et al. (32) reported that the measurement of reflectance of fabrics could be obtained by using a spectrophotometer and reading the per cent reflectance at 557 millimicrons. In numerous soiling studies, the use of reflectometers for the determination of per cent reflectance have been used (32).

The Bausch and Lomb Spectronic 20 Colorimeter with Reflectance Attachment can be used as a reflectometer. This is a sensitive, accurate instrument which picks up all reflected light and converts it into a per cent reflectance reading. The wavelength band used for reflectance measurements is 400 to 700 millimicrons (31) but this instrument has a wavelength band from 350 to 1000 millimicrons. The wavelength ranges in millimicrons for the different colors are: 380 to 450 for violet; 450 to 490 for blue; 490 to 560 for green; 560 to 590 for yellow; 590 to 630 for orange; 630 to 760 for red (9, p. 41).

METHOD OF PROCEDURE

The use of man-made fibers in carpets and the trend toward using lighter colored carpets has emphasized the need for satisfactory methods of carpet care. Effective cleaning procedures should remove soil without materially affecting the color or texture.

Selection of Carpets

The carpeting used in this study served as a pilot study for Kansas Agricultural Experiment Station Project No. 556.

The carpets were made of rayon, nylon, and Verel modacrylic, respectively, and were purchased on the local market. All were tufted with an uncut pile and were from low and moderate price ranges.

Carpeting made of each fiber was purchased in two colors to assure samples from two lots. The colors were in the neutral and rose beige tones. Lots number A and B were assigned to the colors for carpets made of each fiber. This designation will be used to refer to the carpets used in this study. The colors of both the lots of the rayon carpets and Lot B of the Verel modacrylic carpet were darker than Lot A of the Verel modacrylic and both lots of the nylon carpets. Lot numbers as well as information obtained at time of purchase are shown in Table 1.

Table 1. Information obtained about carpets at time of purchase.

Carpet	Cost per sq. yd.	Color	Label information	Salesman information
Rayon				
Lot A	$5.95	Sandalwood		Carpet viscose rayon
Lot B	$5.95	Mink	Display sample stated solution dyed	Carpet viscose rayon
Nylon				
Lot A	$5.95	Sandalwood	100% virgin nylon	Fiber probably was waste nylon
Lot B	$5.95	Sand Beige	100% virgin nylon	Fiber probably was waste nylon
Verel				
Lot A	$8.95	Autumn Beige		
Lot B	$8.95	Spice Beige		

From each carpeting one sample 36 x 27 inches was cut and the edges were overcast.

The carpets, as purchased, were analyzed for total thickness, back thickness, net pile thickness, stitches per inch, yarn ends per inch, needles per inch, yarn ends per needle, and backing material. The backing material was analyzed as to the type of fiber in warp and filling, the fabric weight in ounces per square yard, the number of warp and filling ends per inch, and the type of weave. The construction of the carpets, as purchased, was analyzed according to procedures specified by Committee D-13 of the American Society for Testing Materials (8).

Treatment of Carpets

The carpets, as purchased, were vacuumed and reflectance readings were taken. The treatment given each carpet consisted of soiling, reflectance readings after soiling, shampooing, and reflectance readings after shampooing. Samples were vacuumed after soiling and after shampooing before reflectance readings were taken. They were placed over a rubber mat during the soiling and shampooing procedures. This treatment was repeated five times. After each treatment, the samples were evaluated by a panel of four persons according to a rating sheet (Appendix).

Dimensional Stability

Dimensional stability was measured as follows: a ten-inch square was centered on the back of each sample and marked with indelible ink. After each treatment, this square was measured in three places in both the warp and the filling directions with a ruler calibrated at one-fiftieth of an inch.

Soiling of Carpets

Soil Preparation. The formula used by Florio and Mersereau (15) was followed to compound the synthetic soil. The soil was composed of peat moss, 38 per cent; Portland cement, 17 per cent; kaolin, 17 per cent; silica (200 mesh), 17 per cent; Molacco carbon black, 1.75 per cent; red iron oxide, 0.50 per cent; and light domestic mineral oil, 8.75 per cent.

During the preparation of the soil, the Portland cement and kaolin were passed through a 60-mesh sieve to remove the lumps. Some of the kaolin did not go through the sieve so it was placed in the ball mill where it was ball-milled four days. After being ball-milled, it was passed through the 60-mesh sieve. The primary step in preparing the peat moss was to dry it in a forced-air oven in order to remove the moisture present at the time of purchase. Next, it was ground in a 60-millimeter Wiley mill and then ball-milled four hours until it was the consistency of flour. To break up the large lumps, the red iron oxide was passed through the Brawn crusher once and then through the Brawn upright a number of times until it was fine enough to pass through the 60-mesh sieve. Then it was ball-milled three days. The components of the soil were weighed and mixed with the mineral oil. The mixing was done on the floor with a push broom.

The soil was dried in an oven 14.5 hours, cooled in a desiccator for one hour, and then run through a screen made of marquisette curtain fabric with a mesh of 59 warp and 49 filling yarns per inch. Any particles which did not pass through this screen were ground in a mortar and then thoroughly mixed with the soil. The soil was rebaked in the drying oven 12 hours, cooled one hour, weighed, and stored in a desiccator until used for the carpet soiling.

Soil Application. It was necessary to determine a satisfactory method of evenly distributing the soil on the sample. A shaker with openings one-fourth inch in diameter was used. These openings proved to be too large and caused the soil to be unevenly distributed due to the formation of lumps. Openings one-eighth and one-sixteenth inch in diameter were tried but the same results were obtained. A flour sifter with a mesh approximately one-sixteenth of an inch was tried but the soil lodged in the lower part of the sifter and fell to the carpet in large masses. A piece of marquisette curtain fabric with a mesh of 46 warp and 31 filling threads per inch was placed on top of a bottle. The bottle was tapped gently from either the top or the side. The soil came through the marquisette screen in a fine dust. It was found that shaking the bottle caused the soil to lump while the tapping did not.

Several methods for spreading the soil evenly on the carpet were tried. A frame the size of the sample was covered with a piece of Dacron polyester marquisette curtain fabric. The open weave of the fabric allowed some soil to fall through to the carpet so it was difficult to determine if the soil was being applied evenly. This proved unsatisfactory.

A piece of white kraft paper the exact size of the sample was cut. The entire piece of paper was marked into quarters.

Since the carpets were to be soiled leaving an inch margin on all sides, the paper was marked with this margin. The soil was applied evenly to the paper. By holding the sample by the corners, it was lowered to the paper with the pile next to the soil. The sample and paper were turned over. Caution was used so that the paper did not shift. The soil was transferred from the paper to the sample by tamping gently with a spatula on top of the paper. This method proved the most satisfactory procedure for applying the soil to the carpeting.

Several quantities of soil were tried in order to determine the amount to use. It was decided that 231 grams, as used by Herrick (22), would be tried but after 127.5 grams was applied, it was evident that this was an excessive amount of soil of this composition for the size of sample being used. Approximately one-fourth this amount of soil or 34 grams were tried and this amount also proved to be excessive. Cyanamid (24) made a soiling study using the same formula for synthetic soil as was being used in this study. Cyanamid applied two-tenths gram of soil to 25 square inches of carpeting. Using this proportion, it was concluded that for a sample 36 x 27 inches, ten grams of soil would be a sufficient amount to produce a heavily soiled carpet and to allow for any loss of soil during the soiling application. This amount proved to be satisfactory.

Ten grams of soil for each sample were weighed and divided into four equal parts of two and one-half grams each. Each portion was placed in a shaker bottle and was used to soil one-quarter of the sample. A clean bottle and a clean marquisette screen were used for each quarter of the sample.

After the soil was distributed on the sample, it was embedded by rolling and tamping. The rolling was accomplished by using a one and three-eighths inch weighted brass pipe weighing 14.6 pounds. The sample was rolled 25 times in each of the four directions at a speed of eight seconds for the lengthwise and six seconds for the crosswise. To facilitate a smooth, constant rhythm, a metronome set at 70 strokes per minute was used.

Next, the sample was set aside for two hours. After this time, tamping with a palmyra brush held in a vertical position so that the brush was dropped from a height of three inches was done. The sample was tamped back and forth in both the lengthwise and the crosswise directions. This process was repeated a second time but the brush was shifted half its width so that it struck the sample one-half the brush width from the original place of contact. The tamping procedure was repeated four times in both the lengthwise and the crosswise directions, making a total of eight times. A metronome set at 58 strokes per minute was used to regulate the rhythm of dropping the brush.

The sample was set aside for 24 hours to allow absorption of the soil by the fiber. At the end of this period, the sample was rerolled and retamped. It was set aside for a second 24-hour period.

The sample was vacuumed and reflectance readings were taken but it was not cleaned for approximately another 24 hours.

In early experimental work, brushing the soil into the sample with the brush was tried but the procedure was not used because of the large amount of pile that was lost. The tamping and rolling procedures were sufficient to embed the soil into the sample.

Cleaning of Carpets

Vacuuming of Carpets. An upright vacuum cleaner was used to vacuum the samples, and four cycles were made. A cycle was a stroke up and a stroke back lengthwise of the carpet with the back stroke always in the direction of the pile. Each stroke was ten seconds in duration. Since the vacuum cleaner was approximately one-third the width of the sample, one-third of the carpet was cleaned at one time and the remaining two-thirds was cleaned in a like manner. Each carpet was vacuumed before reflectance readings were taken.

Shampooing of Carpets. Each carpet was shampooed with Bissell liquid rug cleaner using the Bissell Shampoo Master applicator. The rug cleaner was mixed with water according to the manufacturer's directions.

Each carpet was shampooed by making ten cycles lengthwise of the sample and shampoo was released on the odd cycles at the beginning, at each quarter, at the center, and at the end of the carpet. Since the shampoo applicator was approximately one-third the width of the carpet, one-third of the carpet was shampooed at a time, and the remaining two-thirds was shampooed in a like manner. The carpet was set aside approximately 24 hours, then vacuumed and reflectance readings were taken.

Evaluation of Carpets

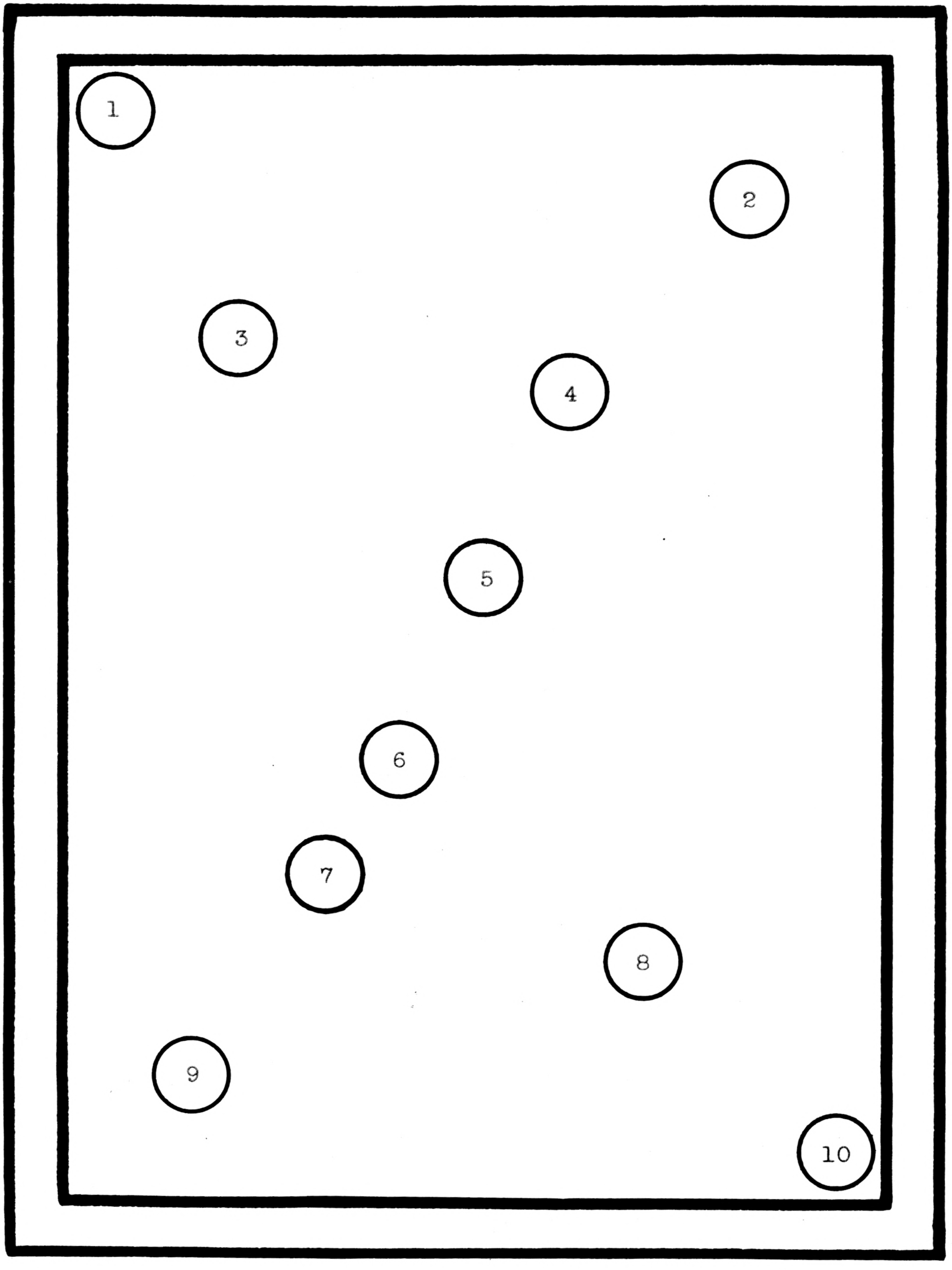
Objective Evaluation. Reflectance readings were made in order to evaluate the effectiveness of cleaning in an objective manner. Readings were measured with a Bausch and Lomb Spectronic 20 Colorimeter with Reflectance Attachment. The sensitivity of the instrument and the height of the pile of the carpets made it imperative to take all reflectance readings in the same area. A pattern was established to determine the areas to be used. The areas were staggered so overlapping of yarns did not occur. The areas which were the size of the aperture of the instrument were marked on the backing with indelible ink. A diagram of the pattern for taking reflectance readings is shown in Plate I.

Reflectance readings were taken on the carpets, as purchased, in three places with calibrations at every five millimicrons beginning with the wavelength of 400 and ending with 700, except at 557 which was read in five places. Reflectance readings were taken after soiling and cleaning for each of the five treatments. For the soiled and cleaned carpets, the reflectance readings were taken in five places at wavelengths 430, 495, 615, and 670 millimicrons. Reflectance readings were taken in ten places at wavelength 557 millimicrons. Since 557 millimicrons is the critical point of daylight, more readings were taken at this wavelength on the carpets, as purchased, as well as after each treatment. The

EXPLANATION OF PLATE I

Fig. 1. Pattern of areas used for reflectance readings.

PLATE I



readings of each area were averaged to give the per cent reflectance for each wavelength.

Subjective Evaluation. Carpets were evaluated by use of a rating sheet (Appendix) after each treatment by a panel of four persons. Color and texture change and the effectiveness of cleaning were evaluated using the carpets, as purchased, as the standard.

The ratings for color and texture change were: no change, slight change, moderate change, more change than acceptable, and excessive change. The effectiveness of cleaning was rated as: highly effective, very effective, effective, slightly effective, and ineffective.

The rankings of the carpets were determined by using a weighted numerical scale. The numerical scale assigned each rating was 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. From the average obtained from the ratings given by the panel, the ranking of the carpets was determined.

RESULTS AND FINDINGS

The effects of repeated soiling and cleaning on the selected carpets have been determined by objective and subjective evaluation after each treatment. The results of these evaluations will be used as an indication of their acceptability in use.

Analysis of Carpets

The rayon Lot A carpeting was made of a three-ply yarn, and the rayon Lot B of a corkscrew yarn made of different size, single yarns. The two nylon carpets were made of two-ply yarns, and the two Verel modacrylics of two single yarns and one slub yarn.

The total thickness of the carpets made from different fibers varied considerably with the nylon carpets having the least and the Verel modacrylic the greatest total thickness. The back thickness for the rayon and nylon carpets was approximately the same but that of the Verel modacrylic carpets was greater than for the other fibers. The nylon carpets showed the least amount of net pile thickness and the Verel modacrylic the most. There was considerable difference in the net pile thickness of the nylon and Verel modacrylic carpets.

In the number of stitches per inch, the rayon and Verel modacrylic were approximately the same but the nylon had considerably less, especially in one lot. The yarn ends per inch and the needles per inch were the same in both lots for each fiber. However, there was considerable variation among the carpets of different fibers with the nylon having the most yarn ends and needles per inch and the Verel modacrylic having the least. There was one yarn end per needle for all the carpets.

The analysis of construction except for the backing material is shown in Table 2.

The backings of all the carpets were made of jute but the two Verel modacrylic carpets also had a scrim backing attached to

Table 2. Physical characteristics of pile of carpets, as purchased.

Carpet	Total thickness in inches	Back thickness in inches	Net pile thickness in inches	Stitches per inch	Yarn ends per inch	Needles per inch	Yarn ends per needle
Rayon							
Lot A	0.26	0.11	0.15	64.3	80.0	80.0	1
Lot B	0.27	0.10	0.17	66.3	80.7	80.7	1
Nylon							
Lot A	0.23	0.10	0.13	56.7	82.0	82.0	1
Lot B	0.24	0.10	0.14	62.0	79.7	79.7	1
Verel							
Lot A	0.34	0.14	0.21	65.0	65.0	65.0	1
Lot B	0.35	0.13	0.22	63.0	64.3	64.3	1

the jute. The backings of all the carpets were of plain weave. The number of yarns per inch of the jute in both the warp and filling of the nylon and Verel modacrylic was approximately the same but that of the rayon in both the warp and filling was greater than for the nylon and Verel modacrylic. The two lots of the Verel modacrylic carpets which had the scrim backing attached to the jute, varied in the number of yarns per inch in the warp of the scrim, but were approximately the same in the filling.

There was considerable variation in the weight per square yard of the jute backings of the carpets made from the various fibers. The Verel modacrylic was the lightest in weight and the rayon was the heaviest. The combined weight of the scrim and jute backing of the Verel modacrylic carpets was greater than that of the rayon or nylon carpets. The analysis of the backing material is shown in Table 3.

Table 3. Physical characteristics of backing material of carpets as purchased.

Carpet		Yarns per inch: Warp	Yarns per inch: Filling	Weight* (ounces per square yard)
Rayon	Lot A	54	45	19.9
	Lot B	54	45	20.1
Nylon	Lot A	48	40	14.1
	Lot B	47	42	15.7
Verel	Lot A	45[1]	39[1]	10.9[1]
		56[2]	31[2]	11.1[2]
	Lot B	46[1]	39[1]	12.5[1]
		61[2]	32[2]	12.6[2]

* Weight per square yard including back-coating.
[1] Refers to jute only.
[2] Refers to scrim only.

Effectiveness of Cleaning

Objective Evaluations. The reflectance readings taken at 430, 495, 557, 615, and 670 millimicrons for all treatments of one sample showed the same trend. Only the per cent reflectance at 557 millimicrons is reported in Table 4.

Graphs showing the per cent reflectance at the different wavelengths are shown in Figs. 1, 2, and 3.

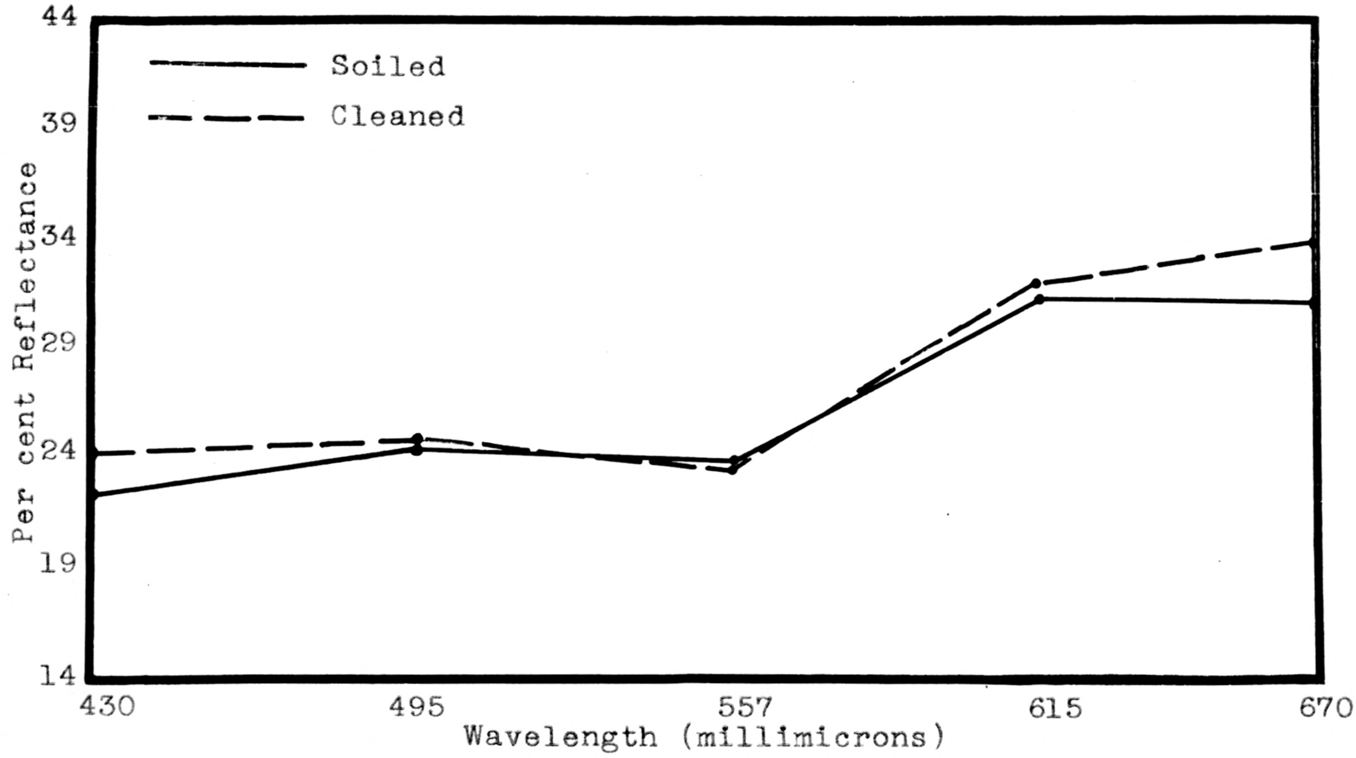
The reflectance readings for the two rayon carpets showed a greater per cent reflectance after the first soiling than as purchased. The nylon and Verel modacrylic carpets showed a greater per cent reflectance, as purchased, than after the first

Table 4. Per cent reflectance of carpets at 557 millimicrons.

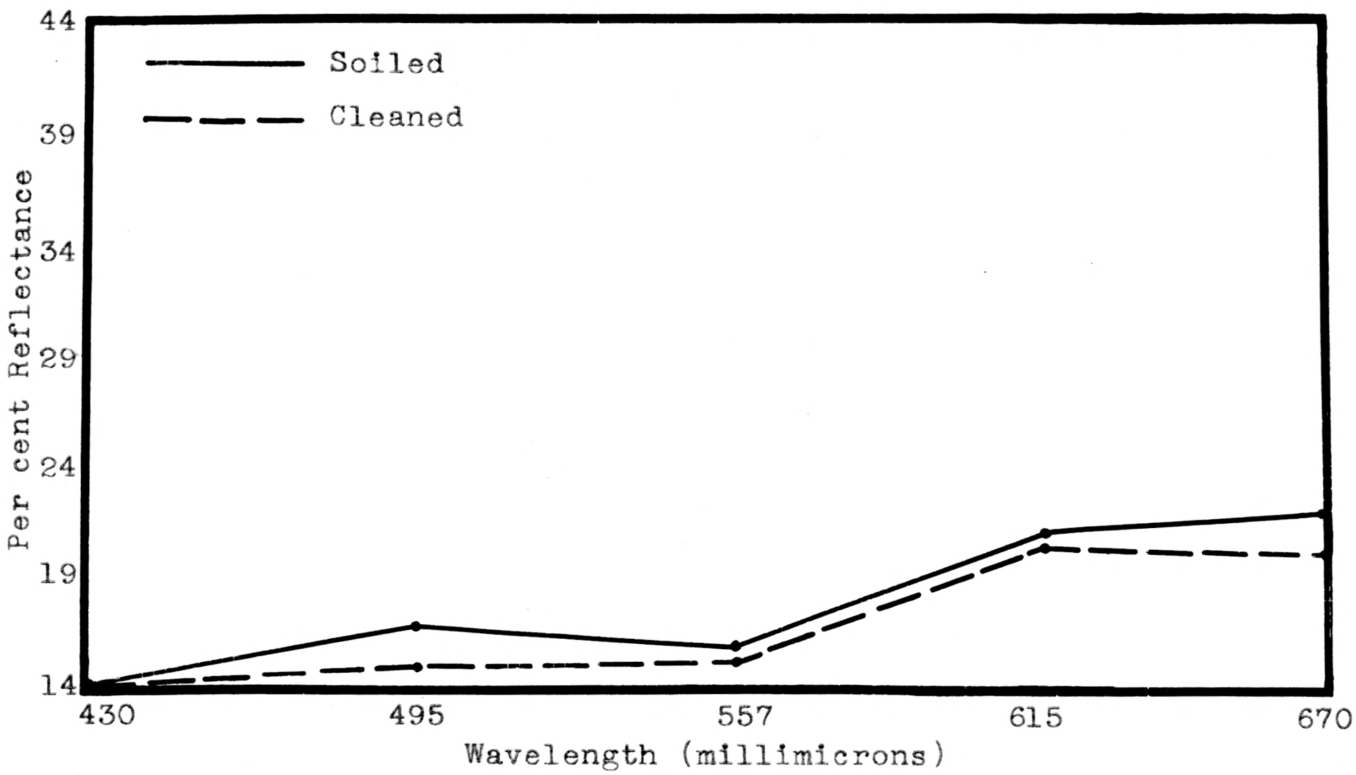
Treatment	Rayon		Nylon		Verel	
	Lot A	Lot B	Lot A	Lot B	Lot A	Lot B
As purchased	21.6	16.9	29.0	43.4	41.4	24.8
Treatment 1						
Soiled	24.7	18.1	28.6	32.2	36.6	28.1
Cleaned	18.5	9.3	22.7	31.9	37.9	25.3
Treatment 2						
Soiled	21.5	10.6	20.8	23.7	30.2	21.2
Cleaned	22.4	12.3	25.2	36.5	35.1	24.6
Treatment 3						
Soiled	22.7	14.9	24.3	29.3	33.5	26.0
Cleaned	24.7	16.4	28.5	41.7	37.7	27.8
Treatment 4						
Soiled	25.4	16.8	26.2	31.1	32.6	25.6
Cleaned	26.0	17.9	31.6	35.7	38.6	28.5
Treatment 5						
Soiled	25.2	19.1	26.9	32.7	35.2	28.2
Cleaned	25.5	20.2	30.0	39.7	39.0	32.0

soiling. The variation of the rayon may be attributed to the fact that rayon fibers are more hydroscopic than nylon and Verel modacrylic and because of oil absorption from the soil, would show a higher per cent reflectance for rayon.

In all instances except the Verel Lot A, the per cent reflectance for the first cleaning was lower than that of the first soiling. There may have been some finish placed on the carpets at the time of manufacture that would cause the per cent reflectance of the soiled carpets to be greater than for the cleaned. In all other cleanings and soilings, the per cent reflectance for all carpets was higher for the clean carpets than for the soiled. The per cent reflectance increased with each successive soiling

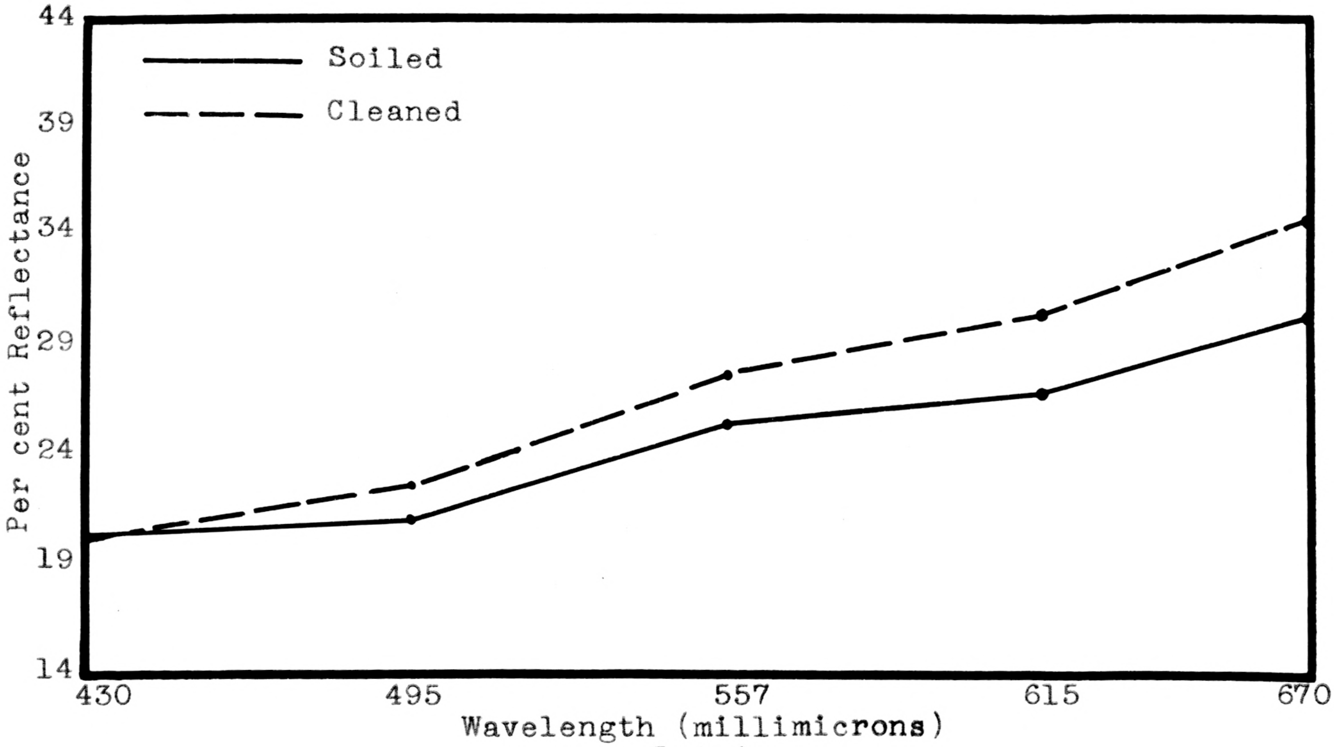


Lot A

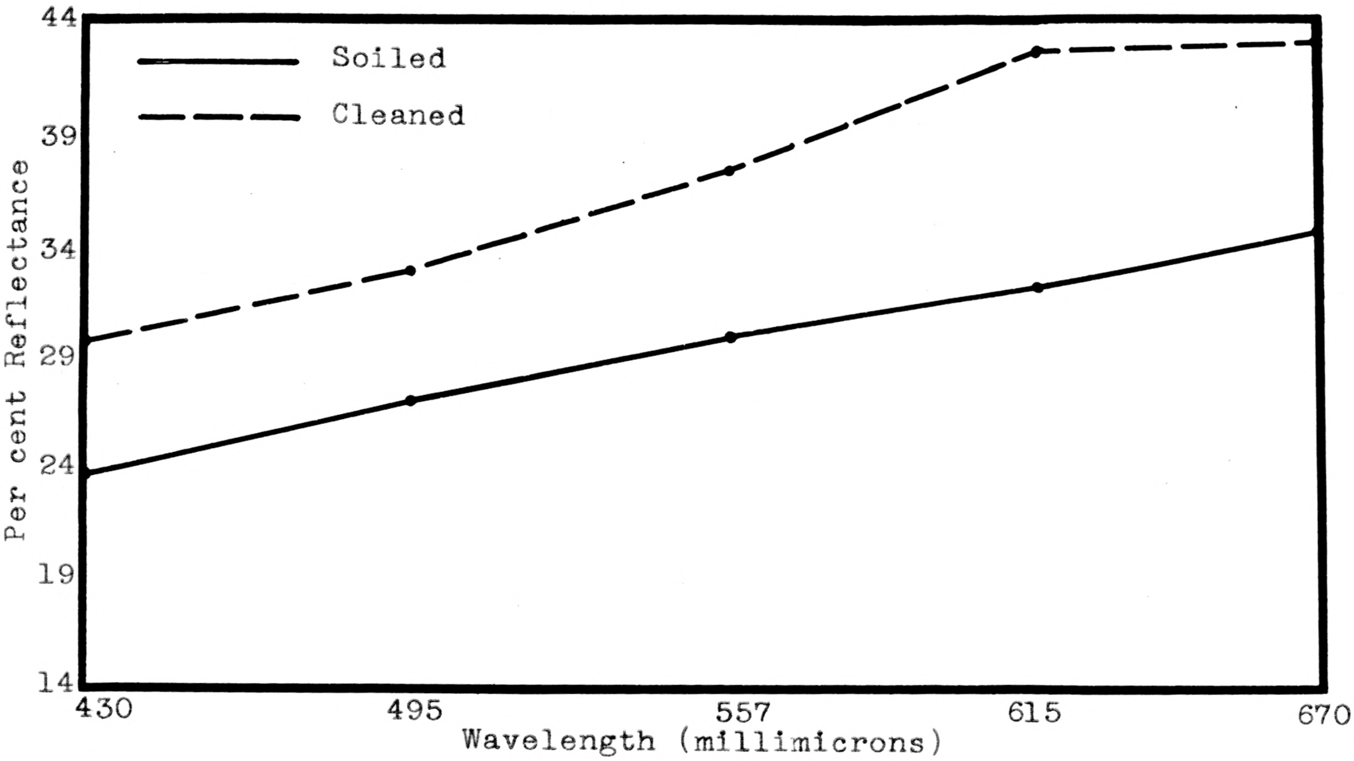


Lot B

Fig. 1. Per cent reflectance for rayon carpets shown at various wavelengths.



Lot A



Lot B

Fig. 2. Per cent reflectance for nylon carpets shown at various wavelengths.

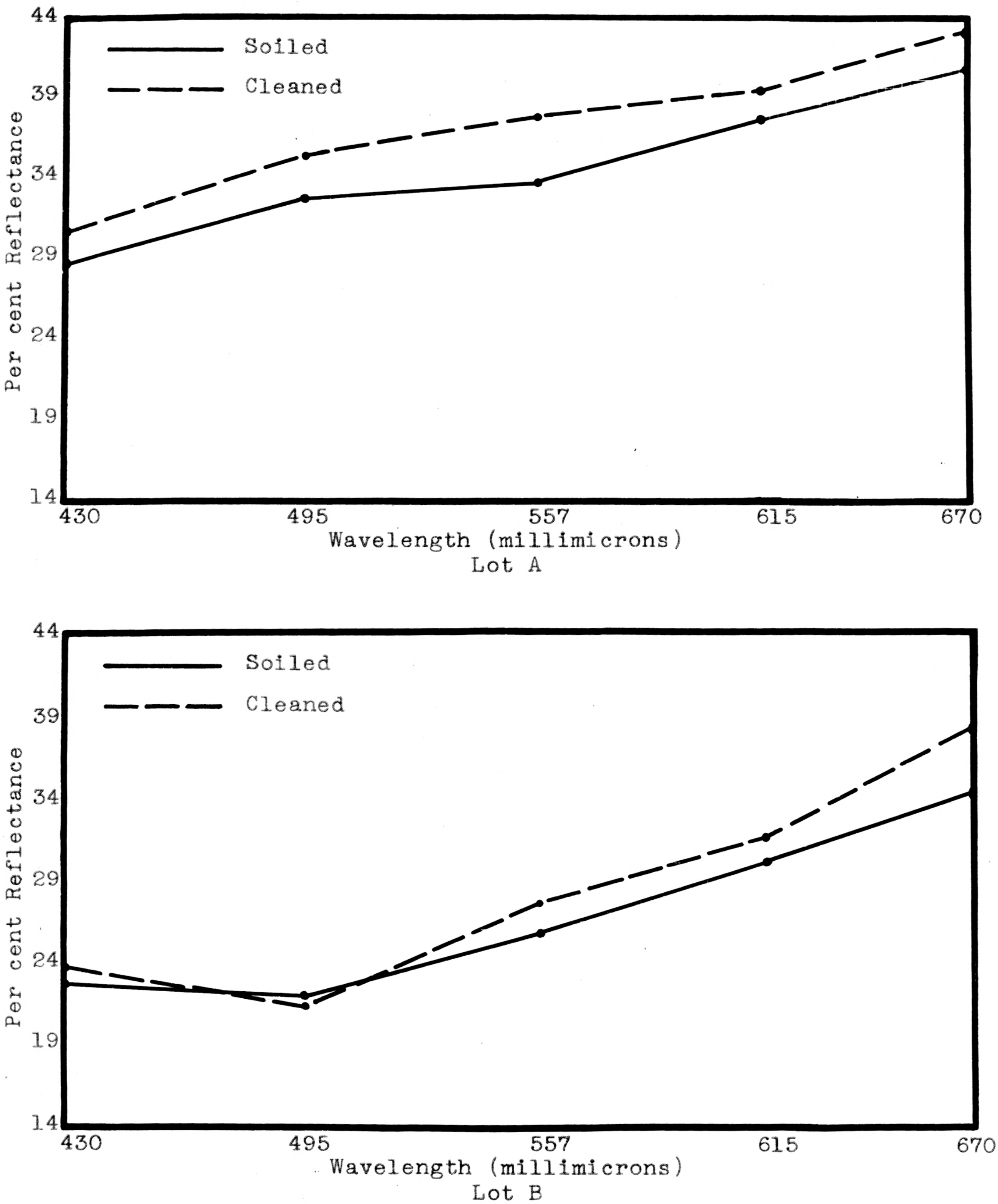


Fig. 3. Per cent reflectance for Verel modacrylic carpets at various wavelengths.

and cleaning. The results indicate that the cleaning apparently had more effect on the color than did the soiling.

Subjective Evaluation. The rankings of the evaluations made by the panel for color and texture changes and for effectiveness of cleaning are shown in Table 5.

Table 5. Ranking of carpets by panel after five treatments.

Carpet		Color change	Texture change	Effectiveness of cleaning
Rayon	Lot A	3	2	3
	Lot B	1	1	1
Nylon	Lot A	4	6	4
	Lot B	6	5	6
Verel	Lot A	5	4	5
	Lot B	2	3	2

The rayon Lot B was rated as showing the least amount of color change and as being the most effectively cleaned, whereas the Verel modacrylic Lot B rated second. The nylon Lot B was ranked as showing the most color change and as being the least effectively cleaned. The rayon Lot B was the darkest color and the nylon Lot B was the lightest color of the carpets as purchased. The color change and the effectiveness of cleaning, as ranked by the panel, compared closely with the darkness of the color of the carpets as purchased. It may be said from this evaluation that carpets of darker colors appear to show less color change and more effectiveness of cleaning than those of lighter colors.

Both lots of the rayon carpets were ranked by the panel as showing the least change in texture and the two lots of nylon carpets showed the most. The rayon Lot B was rated as showing the least texture change and the nylon Lot A as the most. Since the nylon carpets were not made of carpet nylon, this may account for the low rating given them.

The rayon Lot B was ranked by the panel as showing the least color and texture change and as being the most effectively cleaned while the nylon Lot B ranked as showing the most color change and the least effectively cleaned. It was also next to the lowest in texture change.

Dimensional Stability

The data for dimensional stability for all carpets are shown in Table 6.

The two rayon carpets showed more total dimensional change in the warp yarns than in the filling. The rayon Lot B showed less change in the filling than the rayon Lot A. The rayon carpets showed a slight progressive shrinkage in the filling with all cleanings except the second and fourth where some stretching occurred. The warp yarns showed progressive shrinkage with all cleanings.

In the two nylon carpets, Lot B showed more shrinkage in both warp and filling than Lot A. The warp yarns of Lot A showed slightly more shrinkage than the filling while Lot B had the same shrinkage in both warp and filling. Lot A showed some stretching in the warp after the second cleaning and in the filling after the

Table 6. Per cent of dimensional change.

Treatment	Rayon Lot A	Rayon Lot B	Nylon Lot A	Nylon Lot B	Verel Lot A	Verel Lot B
			Warp			
1	1.0	1.2	1.0	1.3	1.7	2.0
2	1.2	1.1	0.9	1.3	1.4	2.1
3	1.4	1.3	1.1	1.6	1.7	2.3
4	1.3	1.4	1.3	1.6	1.7	2.3
5	1.7	1.7	1.4	1.9	1.9	2.5
			Filling			
1	1.2	0.9	1.1	1.5	0.8	1.3
2	1.0	0.8	0.9	1.5	0.7	1.1
3	1.2	0.9	1.1	1.6	1.0	1.3
4	1.0	0.8	0.9	1.6	0.9	1.3
5	1.3	1.1	1.3	1.9	0.9	1.5

second and fourth cleanings. With these exceptions, the carpet showed a gradual shrinkage in both the warp and filling. Lot B showed shrinkage during the first, third, and fifth cleanings for the warp and no change with the other cleanings. The filling showed a progressive shrinkage with all cleanings except the second when a slight amount of stretch occurred and during the fourth when no change was made.

In the Verel modacrylic carpets, the total shrinkage for Lot B exceeded that of Lot A in both the warp and filling. The total shrinkage in the warp was one per cent greater than in the filling in Lot B. Lot B showed the greatest shrinkage in the warp of all the carpets with the first cleaning, and the shrinkage for each successive cleaning increased gradually until the total shrinkage was 2.5 per cent. The shrinkage of the filling was the greatest with the first cleaning. Other changes were some stretching after the second cleaning and some shrinkage after the third and fifth cleanings. Lot A showed gradual shrinkage in the warp with all cleanings except the fourth when no change was made. The filling showed stretching with the second and fourth cleanings, and shrinkage with all other cleanings.

The Verel Lot B showed the most shrinkage of all the carpets in the warp and the nylon Lot B in the filling. For the total shrinkage of the six carpets, the warp ranged from 1.4 to 2.5 per cent and from 0.9 to 1.9 per cent for the filling. Most of the change took place with the first and fifth cleanings. This amount of change for any of the carpets would not be considered objectionable for wall-to-wall carpeting.

SUMMARY AND CONCLUSIONS

The purpose of the study was to determine the effectiveness of cleaning carpets of different fibers with a home method of cleaning. The carpets were evaluated both objectively and subjectively for color and texture changes and for the effectiveness of cleaning. Dimensional stability also was checked.

Six carpets were studied. They were purchased in two lots and the fiber content was of rayon, nylon, and Verel modacrylic. The samples were soiled and cleaned five times. Reflectance readings were taken after each treatment. A visual evaluation after each treatment was made by a panel of four.

The carpets did not change in dimensional stability enough to be considered objectionable although the most shrinkage in the warp was made by the Verel Lot B and in the filling by the nylon Lot B. The results of the evaluation of the panel ranked the rayon Lot B as showing the least amount of color and texture change and also as the most effectively cleaned. The nylon Lot B was ranked as showing the most color change and as the least effectively cleaned. The nylon Lot A was ranked as showing the most texture change. This may be due to the nature of the nylon yarn which was assumed to be waste nylon since it was not labeled carpet nylon.

The two rayon carpets were ranked as showing the least change in texture and the two nylon carpets were ranked as showing the most.

The ranking for color change and the effectiveness of cleaning paralleled the darkness of the color of the carpets as purchased. Since the rayon Lot B was the darkest and the nylon Lot B was the lightest, this may have been a factor in the rankings made by the panel for color change and the effectiveness of cleaning.

ACKNOWLEDGMENT

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APPENDIX

Rating sheet used by panel for subjective evaluation of carpets.

VISUAL EVALUATION OF CARPETS

Date ______________ Cleaning No. ______________

Evaluator ______________________

Evaluation for Color Change

Evaluate the carpets for color change. Check in one of the columns below those terms which best describe your evaluation.

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

Evaluation for Change in Texture

Evaluate the carpets for change in texture. Check in one of the columns below those terms which best describe your evaluation.

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

Evaluation for Effectiveness of Cleaning

Evaluate the carpets for effectiveness of cleaning. Check in one of the columns below those terms which best describe your evaluation.

	Highly Effective	Very Effective	Effective	Slightly Effective	Ineffective
Position 1					
Position 2					
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EFFECTIVENESS OF A HOME CLEANING METHOD OF SELECTED
PILE FLOOR COVERINGS MANUFACTURED FROM
MAN-MADE FIBERS

by

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Increase in the use of carpeting made from man-made fibers has presented new problems relating to carpet maintenance. The purpose of this study was to compare the effectiveness of a home method of cleaning on carpets made from selected fibers in an attempt to provide the consumer with information relating to care of carpets.

The carpets selected for this study served as a pilot study for Kansas Agricultural Experiment Station Project 556 and were made of rayon, nylon, and Verel modacrylic fibers. All were made by the tufting method with an uncut pile. Carpeting of each fiber was purchased in two colors to assure samples from two lots, identified as Lot A and Lot B. The colors were in rose beige and neutral tones.

The carpets, as purchased, were analyzed for total thickness, back thickness, net pile thickness, stitches per inch, yarn ends per inch, needles per inch, yarn ends per needle, and backing material according to procedures specified by Committee D-13, American Society for Testing Materials.

A synthetic soil was used in this study. A treatment given each carpet consisted of soiling, reflectance readings after soiling, shampooing, and reflectance readings after shampooing. This treatment was repeated five times. After each treatment the samples were evaluated subjectively by a panel of four persons for color and texture change and the effectiveness of cleaning. Reflectance readings, using a Bausch and Lomb Spectronic 20 Colorimeter with Reflectance Attachment, were used for objective evaluation of the effectiveness of cleaning. Dimensional stability was measured after each treatment.

The total thickness of the carpets varied considerably with the nylon carpets having the least and the Verel modacrylic the greatest. In the number of stitches per inch, the rayon and Verel modacrylic were approximately the same but the nylon had considerably less. There was considerable variation among the carpets of different fibers in the yarn ends and needles per inch with the nylon having the most and the Verel modacrylic having the least. The carpets did not change dimensionally enough to be considered objectionable although the most shrinkage in the warp occurred in Lot B of the Verel modacrylic and in the filling of the nylon Lot B.

Evaluation by the panel ranked the rayon Lot B as showing the least amount of color and texture change and also as the most effectively cleaned. The nylon Lot B was ranked as showing the most color change and as the least effectively cleaned. The nylon Lot A was ranked as showing the most texture change. The two rayon carpets were ranked as showing the least change in texture and the two nylon were ranked as showing the most.

The ranking for color change and effectiveness of cleaning paralleled the darkness of the color of the carpets as purchased. In the objective evaluation, the per cent reflectance increased with each evaluation which would indicate that the cleaning apparently had more effect on the color than did the soiling.