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Scrub-resistance Characteristics of Kitchen and Bathroom Wall-surfacing Materials



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SUMMARY

This research shows results concerning the resistance of various wall-surfacing materials to scrubbing with abrasive and nonabrasive cleansers. It does not include studies of other characteristics of these materials. The conclusions drawn are limited to the scrub-resistance characteristics discussed.

A statistical analysis was made to evaluate the gloss differences which resulted from 30-minute scrubbing periods. The times at which the major gloss changes started, as well as the rate at which the changes occurred, were different for the various materials. Analyses for longer or shorter scrubbing operations would undoubtedly place the materials into different groups.

Some of the conclusions from this research follow:

The use of a nonabrasive cleanser produced no significant differences in gloss on any of the materials. All of the materials showed good resistance to scrubbing with a nonabrasive cleanser.

There was a real difference between the reactions produced on the materials by scrubbing with a nonabrasive cleanser and that produced by scrubbing with an abrasive cleanser.

Both abrasive cleansers produced essentially the same results on the materials. There was no significant difference between them.

Prefinished wallboard, enameled steel and plastic tiles experienced most of their gloss change within the first minute of scrubbing with an abrasive cleanser.

Flexible rubber showed its major gloss change within the first 5 minutes of scrubbing with an abrasive cleanser. Enameled copper experienced over 80 percent of its total gloss change within the

first 5 minutes of scrubbing with the same type of cleanser.

Laminated thermosetting sheet material evidenced approximately 60 percent of its total gloss change within the first 5 minutes of scrubbing with an abrasive cleanser. Loss of gloss continued but at a much slower rate as the scrubbing progressed.

Ceramic tile, porcelain-on-steel, stainless steel and vinylized fabric showed little change in gloss during 30 minutes of scrubbing with any of the cleansers.

The surface coatings of enameled steel tiles and scored prefinished wallboard are most subject to damage along the respective tile joints and score lines which run perpendicularly across the areas scrubbed with an abrasive cleanser.

Generally, the materials which started with a high gloss showed large gloss changes. Porcelain-on-steel and stainless steel were exceptions.

Materials which are very subject to abrasion should be installed in areas where there is no occasion for the use of abrasive cleansers and where the abrasives carried into the home by everyday living are not likely to contact these materials.

With the use of the moderately strong abrasive cleanser, vinylized wall fabric, porcelain-on-steel, ceramic tile and stainless steel showed the least change in gloss, following 30 minutes of scrubbing. These materials showed significantly less change than the other materials subjected to the same scrubbing operations.

Plastic tiles, flexible rubber and enameled steel (gray) showed more change in gloss than the aforementioned materials, but less than the prefinished wallboard, enameled steel (green), thermoplastic laminated sheets and copper tiles.

Scrub-resistance Characteristics of Kitchen and Bathroom Wall-surfacing Materials

H. R. Kiser, E. R. Stewart and Fritz Hoberg

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Figure 14, page 11, Bulletin 962, "Scrub-resistance Characteristics of Kitchen and Bathroom Wall-surfacing Materials," is upside down. As the figure appears, damage on the left is from 1 hour of scrubbing; damage on the right is from 30 minutes of scrubbing.

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Scrub-resistance Characteristics of Kitchen and Bathroom Wall-surfacing Materials

O. R. Kunze, B. R. Stewart and Price Hobgood*

WALL-SURFACING MATERIALS for the kitchen and bathroom areas in a home are subjected to more severe wear than are the wall surfaces in other areas. This is particularly true for the splashboard surfaces behind the sink and counter top in the kitchen and the wall surfaces behind the lavatory and bathtub or shower enclosure in the bathroom.

Grady and Smith¹ conducted surveys in 1955 and earlier on wall-surfacing materials used in all major areas of the home and found that paint, enamel, varnish and wallpaper were the most commonly used. Their work shows that the above materials were in use 3 years or less in four-fifths of the kitchens which they surveyed. One-fourth of the families who reported cleaning problems renewed rather than cleaned the surfacing materials. Of the homemakers who reported washing the wall finishes, almost three out of five used washing powders and more than one-fourth used bar soaps. Frequent replacement and frequent cleaning seemed to go hand in hand. During three periods of 1 month each, 59 families maintained records of the time spent in cleaning different surfaces in the home. Almost three times as much time was spent cleaning surfaces in the kitchen and bathroom as in the living room. Faults of materials commonly reported included spots, breaks and changes which included discoloration, wearing off and dulling of the surfaces. Their surveys also showed that, in order of importance, the criteria for selecting surfacing materials are ease of cleaning, appearance, durability and cost.

Interior covering, surfacing and finishing materials normally account for 8 to 20 percent of new home construction costs. The replacement of these finishing materials is an undesirable, added expense of home maintenance. Areas such as splashboards behind counter tops and bathroom walls need materials which give longer satisfactory service.

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¹Grady, Ethyl R. and Smith, Grace H. Interior Surfaces in the Structure of Farmhouses, Bulletins 324, 325, 326 and 329, Agricultural Experiment Station, University of Rhode Island, Kingston, Rhode Island. June 1954-May 1955.

The building industry has recognized these areas of more severe wear and has developed surfacing materials for these particular purposes. Some of these materials are not new but have been too expensive for common use. Others have been in use for several years and still others have just recently entered the market.

Research has been conducted by the Department of Agricultural Engineering in which ten different wall-surfacing materials were subjected to scrubbing for 30 minutes with each of three different cleansers. Some wall-surfacing materials are produced by several manufacturers.

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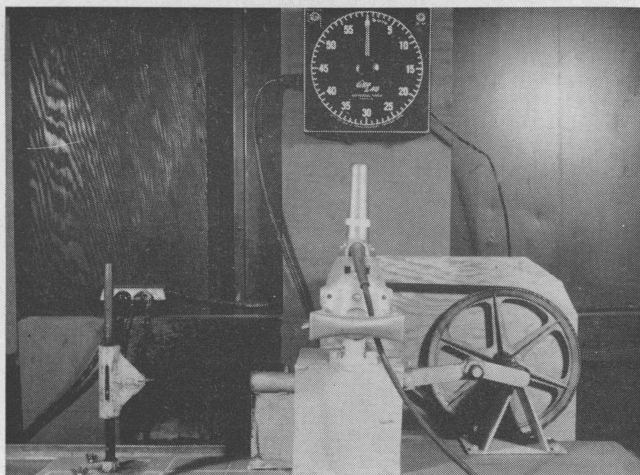


Figure 1. The machine used to scrub the different samples of wall-surfacing materials. As the drill turned, the horizontal arm moved the sponge over the surface. The automatic timer was used to insure equal scrubbing periods.

Consequently, differences may exist within materials which are known by the same name. Other differences may exist in a given base material produced by a given manufacturer but finished in a different way. As a result three materials were duplicated. Two were produced by different manufacturers and were different colors. The third was produced by a given manufacturer and was different in color only. With these duplications, a total of thirteen samples were subjected to the scrubbing operations.

The problems encountered in determining the scrubbing procedure were presented to the home economists of the Texas Agricultural Experiment Station and the Texas Agricultural Extension Service. Their proposals and recommendations were considered in developing the methods used.

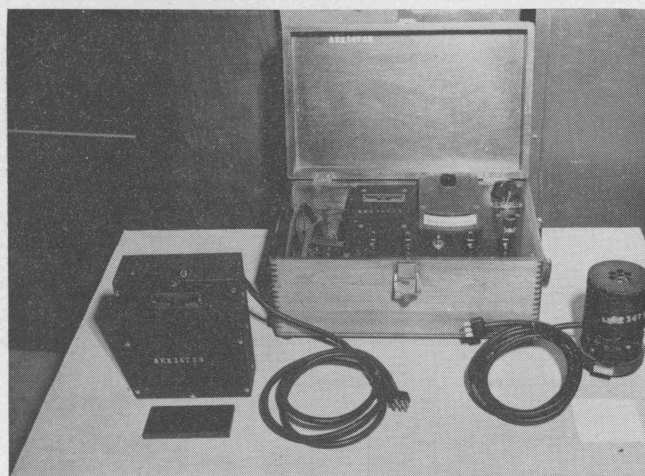


Figure 2. The photoelectric indicating meter which was used to determine the nature and degree of change in surface conditions. The unit on the left with its calibration standard is the gloss search attachment while the unit on the right with its calibration standard is the diffuse search attachment.

Materials selected were those which are available on the market and which are in common use. Three scrubbing agents consisting of two abrasive cleansers and one nonabrasive cleanser were selected. Nonabrasive cleansers are very common cleaning agents, but abrasive cleansers are often used where the cleansing action of the nonabrasive agent is not adequate. The scrubbing agents were selected by the home economists to fit the description of a mild nonabrasive, mild abrasive and a moderately strong abrasive.

EQUIPMENT

The scrubbing machine, Figure 1, was developed by the Department of Agricultural Engineering. A slow speed electric hand drill was connected by a V-belt and sheaves to a jackshaft. Instead of using a second pulley on the jackshaft, an arm with a stubshaft was attached. The distance from the center of the jackshaft to the center of the stubshaft was 3 inches. When rotating the jackshaft, the arm circumscribed a 6-inch circle. A linkage arrangement connected the stubshaft to a horizontal rod mounted in a 4 1/4-inch sleeve bearing. A second sleeve bearing was attached in a vertical position to the free end of the horizontal rod. A vertical shaft with a plate for attaching scouring pads was inserted through this vertical bearing. This arrangement gave the scrubbing unit a reciprocating motion whenever the machine was in operation. The driving unit was connected to an automatic timer which could be set for any particular length of operation desired.

A photoelectric indicating meter, Figure 2, was used to determine the nature and degree of change in surface conditions which resulted from the scrubbing action. Relative values of gloss and diffuse were taken on a particular sample before the scrubbing operation. Additional readings were taken between 5-minute scrubbing periods, and final readings were taken after the sample had been subjected to 30 minutes of scrubbing. The magnitude of the changes in readings taken on a specific scrubbed area indicated the relative changes which had occurred in the material surface.

The gloss meter consisted of the instrument proper and a search unit. The instrument proper contained an indicating meter, power supply and controls. The search unit with the light source, optical system and photocells was connected to the instrument proper by a flexible cable. The diffuse reflection meter is an alternate unit which can be used with the instrument proper.

Both gloss and diffuse reflection measurements were made to determine the nature and degree of change in surface conditions. Gloss or specular reflection results from a beam of light striking a surface and then reflecting in another beam. The angle of reflection is the same as the

angle of incidence. Generally, high gloss denotes a very smooth surface which, in turn, reflects a relatively high percentage of the light falling on that surface. Diffuse reflection results when a beam of light strikes a rough or uneven surface which causes a portion of the reflected light to be diffused in all directions.

The differences in gloss and diffuse readings followed approximately the same pattern but in opposite directions for the respective materials. Generally, when gloss value decreased, the diffuse reflection value increased. The gloss differences were more pronounced and consequently were used in making the data analysis.

Much consideration was given to selecting a suitable and representative scouring pad. The commercial market carries scrubbing pads which range from a soft cloth to harsh metallic pads. The homemaker exercises her good judgment in the use of these and selects a pad suitable for the surface to be cleaned.

A cellulose sponge 1 x 1 ¼ x 3 ½ inches was used in this research. The scrubbing surface of each pad was 4.375 square inches and the machine was operated to give approximately 220 strokes of the sponge per minute or slightly less than four passes per second.

A commercial timing unit which could be set at 1 minute intervals was used to assure equal scrubbing periods on each of the samples.

CLEANSERS

The washing powders used were among those commonly found on the market. Powders were selected instead of bar soaps since previous work by others indicated that this type of cleanser was the most popular for cleaning surfaces in the home.

The nonabrasive cleanser used may be described as an all-purpose cleanser generally recommended for cleaning walls, woodwork, linoleum and modern tile floors. The manufacturer states that it is safe for all washable surfaces. The cleanser is water-soluble and, consequently, was mixed in those proportions recommended by the manufacturer to give the desired cleaning solution.

The manufacturer's description of the cleanser selected as a mild abrasive states that it bleaches, foams and rinses quickly. The powder is recommended for kitchen, bathroom and other household tasks such as cleaning sinks, pots, pans, refrigerators, ranges, basins, bathtubs, porcelain, tile, linoleum, enamel and windows. The grit in this cleanser could not be dissolved; consequently, the cleanser could not be mixed with water to get a homogeneous solution.

The third cleanser selected as a moderately strong abrasive is recommended by the manu-

facturer for cleaning porcelain-enamel bathtubs, sinks, all ceramic tile-surfaces, windows, pots, pans and many other uses which are not itemized. It is described as a foaming cleanser which contains bleach. This powder could not be dissolved to obtain a homogeneous solution because the abrasive was not water-soluble.

The cleanser classifications used in this research were not determined from scientific analyses of the different cleansing agents. Rather the descriptions are the reflection of consumer evaluations as observed by home economists of the Texas Agricultural Experiment Station and the Texas Agricultural Extension Service.

The manufacturers of the different cleansing agents list some definite cleaning functions for which specific cleansers are recommended. Other functions are listed in general terms which leave the final decisions to the homemaker. No manufacturer makes any statement indicating that his agent is *not* a suitable cleanser for a particular purpose. Neither is any statement made to indicate if the cleanser is acid, alkaline or neutral. Containers of the abrasive cleansers have no instructions which state the exact procedure for using the cleanser.

MATERIALS

Metal Tiles

Four different types of metal tiles were subjected to the scrubbing operations. The tiles consisted of different alloys of steel and copper. Coating materials ranged from clear or colored synthetic-resin enamels to porcelain enamels. These protective coatings produced glossy wearing areas which ranged from relatively soft and flexible to hard and inflexible surfaces.

Enameled Steel

These tiles consisted of 28-gage sheet steel treated on both sides with a corrosion inhibitor before the surface was coated with a synthetic-resin enamel and dried in an oven at approximately 300° F.

Tiles had a shallow bevel which permitted the use of a minimum of mastic for installation. The tile was flexible and could be bent without cracking the enamel coating. Tiles are available in a variety of colors and sizes. Two groups of tiles with different colors of enamel surface coatings were studied.

Enameled Copper

The copper tiles tested were of the same gage and configuration as those of enameled steel. In the production process, the metal surface is treated to produce an attractive satin finish. A clear synthetic-resin enamel is used as a protective coating for the polished copper surface. Tiles are

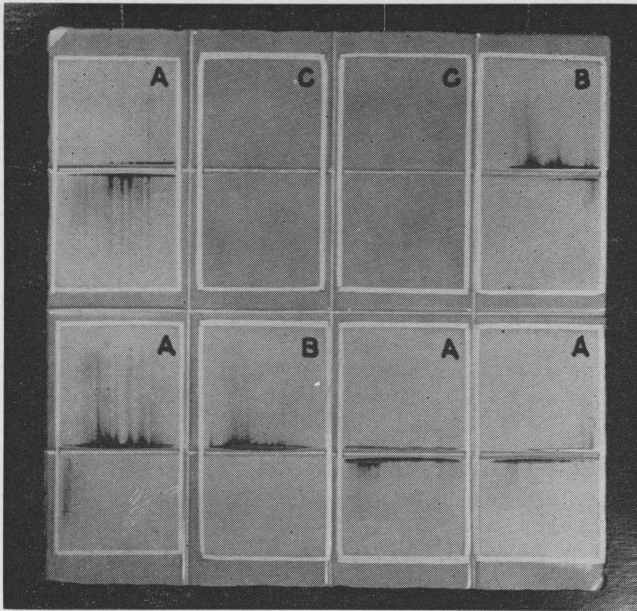


Figure 3. Gray enameled steel as it appeared after the treatments. The letter "A" identifies areas on which the moderately strong abrasive cleanser was used, "B" the areas on which the mild abrasive was used and "C" the areas scrubbed with the nonabrasive cleanser. Preliminary work in developing the procedure caused duplication of the "A" spots.

available in $4\frac{1}{4} \times 4\frac{1}{4}$ -inch size. They can be bent and cut with ease.

Stainless Steel

These tiles can be purchased in different sizes for specific applications. The tiles studied were of the same size, gage and configuration as those of enameled steel. Stainless steel tiles are produced from alloys containing nickel and chrome. They require no protective chemical treatment and do not have a protective enamel coating. The exposed surface is grained with a polisher. During shipment, this surface is protected by an adhesive paper.

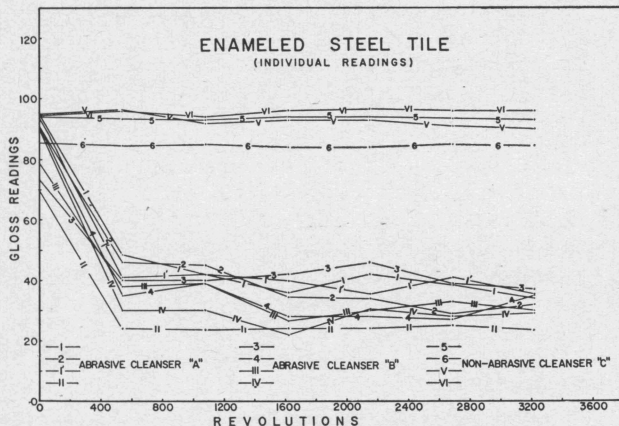


Figure 4. A plot of the individual gloss readings which resulted from the use of the different cleansers on the respective scrubbed areas. Initial gloss readings are plotted along the vertical axis. Readings taken after 5-minute scrubbing periods with the indicated cleansers are plotted consecutively to the right.

Porcelain-on-steel

These tiles, also referred to as ceramic-on-steel tiles, are available in $4\frac{1}{2} \times 4\frac{1}{2}$ -inch and $8\frac{1}{4} \times 8\frac{1}{4}$ -inch sizes. The larger size was used in this research. The tiles were made of 26-gage tempered steel with a conventional ground coat and a single-cover coat of porcelain enamel consisting of molten glass and clay fused to the tempered steel. The resulting surface was hard and smooth. A special cutting machine is required to cut the tiles. A specially manufactured scored foundation board may be applied to the wall surface as an aid for aligning the tile during installation. A complete line of trim, strip, molding, base and corner tiles are also available. Tiles may be purchased in an assortment of colors.

Plastic Tiles

Plastic wall tiles of two different colors and manufactured by two different organizations were studied. Size of the tiles was $4\frac{1}{4} \times 4\frac{1}{4}$ inches. Some $8\frac{1}{2} \times 8\frac{1}{2}$ -inch field tile are also produced. Both tiles were manufactured from polystyrene. One group used was identified as being manufactured from Virgin Styron which is simply a trade name for polystyrene. Other trade names for polystyrene include Loalin and Lustron. Both manufacturers state that their tiles have features which will prevent dishing at the center. The maximum thickness of either tile ranges between .065 and .075 inches. One tile had a slightly oval surface. Both groups are produced in an assortment of colors. Specially shaped accessory tiles also are available.

Ceramic Tiles

The ceramic tiles used were fired at approximately $2,000^{\circ}$ F. All field tile were cushioned and were $4\frac{1}{4} \times 4\frac{1}{4}$ inches in size. Their thickness was approximately three-eighths of an inch. Field tiles of different sizes are available and accessory tiles are also made for specific applications.

Laminated Thermosetting Sheets

These sheets consisted of several layers of fibrous sheet material which was impregnated with thermosetting resins before being treated under intense heat and pressure. A dense lightweight sheet with a smooth glossy surface resulted. Laminated thermosetting sheets are produced in standard and cigarette-proof grades and are available in various colors and designs. The material is produced in thicknesses ranging from one-twentieth to one-fourth of an inch. For this study, a one-sixteenth inch thickness, laminated to different base materials, was used. Sheets are produced in various sizes.

Prefinished Wallboard

This surfacing material consisted of a hard-board panel with a synthetic baked finish which was hard but still flexible. Material is available in several forms such as sheets, planks and blocks. Scored sheets yielding a 4 x 4-inch tile effect were used. The wallboard was approximately five thirty-seconds of an inch thick. Similar wallboard in different colors and produced by two different manufacturers was used.

Vinylized Wall Fabric

This is sheet material, available in roll form, which consists of textured or textured and printed vinyl plastic covered with clear vinyl that is heat-bonded under pressure to a cotton fabric. The material is lightweight and very flexible. It is available in rolls having a standard width of 36 inches and a length of 24 yards. The vinylized fabric is produced in many colors and patterns. The material is applied by the use of an adhesive to a suitable underlayment. Somewhat similar materials are made with paper backing.

Flexible Rubber, Fabric Backed

This nonporous rubber sheet material is manufactured with a fabric backing. The pattern extends through the rubber which is approximately one-twentieth of an inch thick. The material is smooth and flexible. It is available in a variety of colors and patterns, and can be purchased in rolls 36 inches wide and 30 yards long. The same type of material in a somewhat heavier gage is used for flooring.

PROCEDURE

The wall-surfacing material was purchased in the form of tiles, rigid sheets and flexible sheets. Six different types of tiles were studied. The wall-surfacing specimens were mounted on various types of materials which simulated underlayments on a wall. The panels were constructed in sizes which could conveniently accommodate the wall-surfacing materials. At least two samples were constructed with each material. The spots for treatment on the samples were so arranged that two areas could be scrubbed with each cleanser. With three cleansers and two spots per cleanser, each sample received a minimum of six scrubbed areas. This arrangement produced four replications on a particular material with a given cleanser. Samples used in developing the procedure may have received as many as eight scrubbed spots or areas. Figure 3 shows a sample of enameled steel as it appeared after the scrubbing treatments. Four spots on this sample were subjected to treatments with the moderately strong abrasive cleanser.

Before scrubbing, each sample was cleaned with a damp sponge and dried with paper towels.

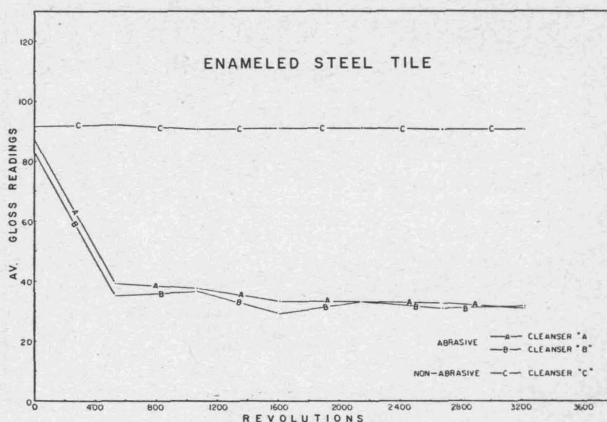


Figure 5. The average gloss values at 5-minute intervals which resulted from four scrubbed areas on the given material with the indicated cleanser.

Gloss and diffuse readings were taken on a smooth and continuous section of the area to be scrubbed. In the case of tiles or scored sheet material, the readings were taken approximately 1 inch from the joint across which the scrubbing occurred. After the readings were taken, the sample was placed into the machine for a 5-minute scrubbing treatment.

The sponge was prepared by soaking it in the cleaning solution whenever the soluble non-abrasive cleanser was used. It was then attached to the machine. The weight on the sponge was only 2 pounds or slightly less than one-half pound per square inch. During the test, only enough additional solution was added to maintain an efficient scrubbing action.

Whenever abrasive cleansers were used, the sponge was soaked in water and squeezed damp-dry before it was attached to the machine. While on the machine, the sponge was momentarily set into a pan with the abrasive cleaning powder. The cleanser which adhered to the damp-dry sponge was used for a 5-minute treatment of the sample. A syringe was used to add only enough

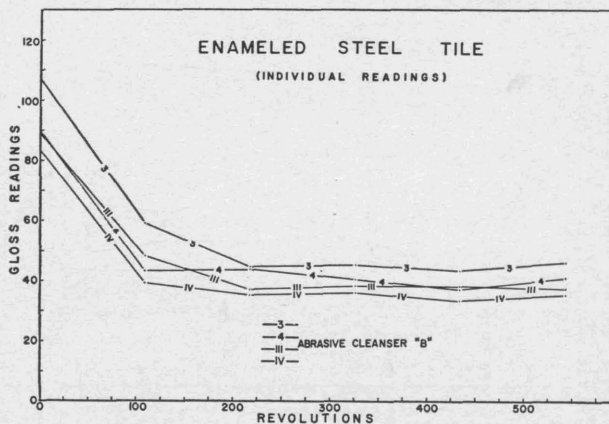


Figure 6. The changes in gloss which resulted from five scrubbing periods of 1 minute each on four spots of the indicated material with the given cleanser.

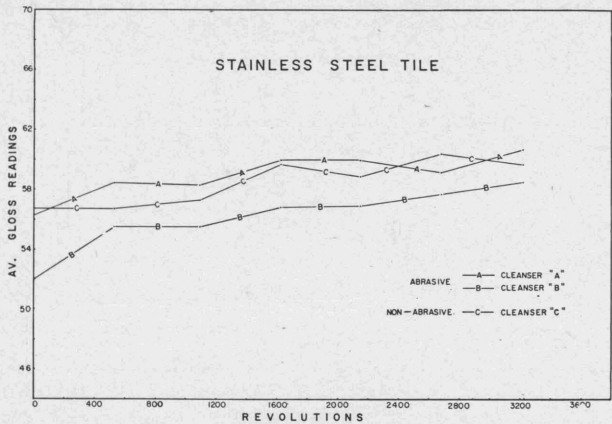


Figure 7. The gloss readings of stainless steel increased slightly as the material was scrubbed parallel with the grain. There was no apparent difference in effect between abrasive and nonabrasive cleansers.

water to give the sponge an effective scrubbing action.

After this treatment period, the sample was removed, rinsed with water and dried. Final gloss and diffuse readings were taken after the 5-minute test period and the differences in initial and final readings were recorded. The next sample was then prepared and scrubbed for 5 minutes. This procedure was continued until each spot on each sample had been scrubbed for six periods of 5 minutes each with a particular cleanser.

The analysis reported in this publication results from the data collected by the above procedure. Since this work revealed that some materials had little resistance to abrasive cleansers, a similar procedure consisting of five scrubbing periods of 1 minute each was used with only the mild abrasive cleanser to determine gloss and diffuse changes for shorter treatment periods.

The 30-minute treatments also revealed that some materials had considerable resistance to abrasive action. Other materials lost much of

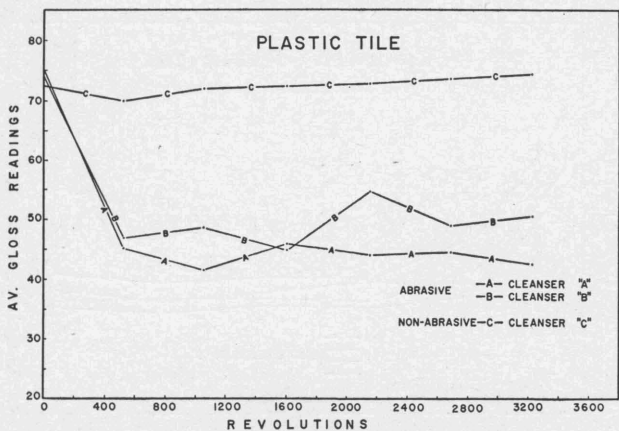


Figure 8. The inconsistent results from the use of abrasive cleansers were caused by additional rubbing and wiping of the tile surfaces.

their gloss but seemed to have considerable service life remaining. Additional panels were built to further investigate certain of these materials. On these additional panels, two areas were treated with each cleanser and a sponge. Two additional areas were scrubbed with an abrasive cleanser and a small nylon-bristled fingernail or handbrush. Each sample received eight scrubbed areas. For comparison purposes, one spot with each cleanser was scrubbed for 30 minutes while the other was scrubbed for 1 hour. A new application of cleanser was used after every 5-minute period of operation.

DISCUSSION

Grit in the Home

Grit is a common household nuisance in most urban and rural dwellings since it is carried into the home by pedestrian traffic on both shoes and clothing. Aside from the use of abrasive cleansers, small amounts of grit are deposited by various means on surfaces in the home. This grit eventually will cause the same results as an abrasive cleanser on materials affected by abrasive action.

The manufacturer's literature concerning several of the wall-surfacing materials does not recommend abrasive cleansers for cleaning. The same literature also states that the surface of some of these materials is hard enough to resist considerable abrasive action. This may be interpreted to imply that the consumer may use abrasive cleansers at his own risk.

Material Finish Characteristics

Some wall-surfacing materials are produced with a high glossy finish while others have little original gloss. Some materials can lose much of their gloss and retain considerable service life while others have little service life remaining after they lose their original glossy finish. The consumer buys the material in its original form with the hope that it will continue to maintain this appearance throughout its service life. The assumption was made in this research that the consumer would object to any type of surface change in a wall-surfacing material.

Underlayments

Certain wall-surfacing materials may have the ability to give many years of service life, but they do not give this length of service because the adhesive used in their application or the materials on which they are applied fail within a shorter period of time. Failures of underlayments may be caused by moisture leaking through the wall-surfacing materials. This leakage often can be attributed to improper surface preparation before installation, poor workmanship, sealer or mastic failures or any combination of these.

Numerous underlayments ranging from one-half of an inch plasterboard to three-fourths of an inch plywood were used in these tests. In each case the materials presented a smooth continuous surface on which the surfacing materials could be applied.

The edges of the panels were sealed with a rubber sealing compound. During the scrubbing periods, the wall-surfacing materials protected the top of the panel. Only a limited amount of moisture came into contact with the bottom of the panel during the relatively short test period. As a result, no underlayment failures or difficulties occurred.

Loose tiles, both metal and plastic, developed during the tests on several of the panels. In nearly every case, this failure was traceable to poor workmanship or to the use of insufficient mastic during installation. General recommendations are that 65 percent of the tile-back should be in contact with mastic. This is a percentage which should be maintained.

Material Function

Wall-surfacing materials should protect from moisture and wear the underlayments to which they are applied. To serve these purposes effectively, the coverings as well as the materials used for their installation must combine to present surfaces which are moisture proof and wear resistant. The materials also should enhance and beautify the areas on which they are installed. Failure to meet any of these requirements is sufficient and often mandatory reason for replacement of the wall-surfacing material.

Other Considerations

The ability of a wall-surfacing material to withstand repeated cleaning operations is most important to the homemaker. Many surfacing materials in the home may not be cleaned because their appearance after cleaning is as objectionable as before. Because of the scope of the work involved, this research was necessarily limited to the scrub-resistance studies reported.

Scrub-resistance is, however, not the only consideration in the purchase of wall coverings. Material characteristics which need further consideration are resistance to stains, acids, alkalis, heat, impact, color change, moisture absorption and others.

RESULTS AND CONCLUSIONS

Graphs were plotted with the data collected from the 30-minute scrubbing treatments with the various cleansers and materials. Individual readings collected on enameled steel tile are shown in Figure 4. The gloss values were plotted on the vertical axis while the cumulative rev-

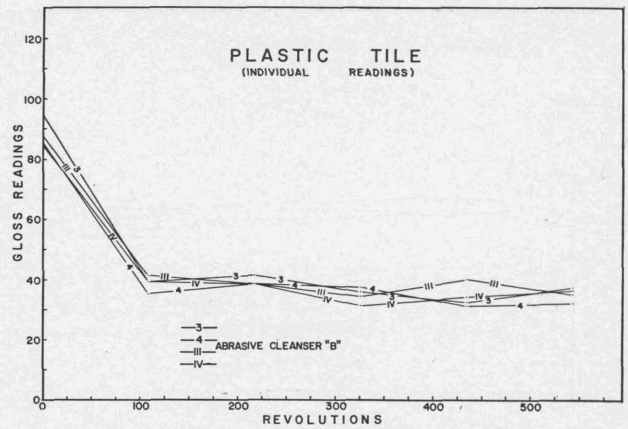


Figure 9. Most of the gloss changes which occurred were produced within the first minute of scrubbing with the mild abrasive cleanser. This indicates that the gloss change actually could have occurred within a shorter time.

olutions of the scrubbing machine were plotted at 5-minute intervals on the horizontal axis. Each revolution of the machine represents two strokes of the sponge. The moderately strong abrasive cleanser is identified by the letter "A"; the mild abrasive cleanser by the letter "B"; and the non-abrasive cleanser by the letter "C." Arabic numerals "1" and "2" were used to identify the plotted data which were collected from the use of cleanser "A" on one of the samples. Roman numerals "I" and "II" were used to identify the plotted data collected on the same material with the same cleanser, but on the two spots of the second sample. The same procedure was used with different Arabic and Roman numerals for plotting data collected with the mild abrasive and the non-abrasive cleansers. This total information was then condensed by taking the average of the four readings at a given time with a particular cleanser and plotting this value as a single point. Results of this procedure are shown in Figure 5.

To further determine the characteristics of certain materials, a graph similar to Figure 4 was plotted with the data from five treatments

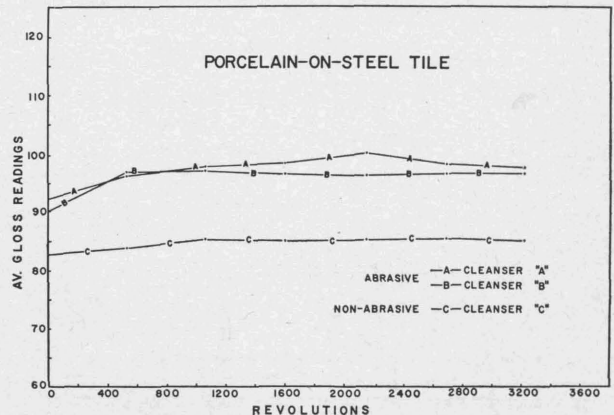


Figure 10. The spread in initial points of gloss indicates inconsistent gloss values of the original tiles. The abrasive cleansers caused a slight increase in gloss value within the first 5-minute scrubbing period.

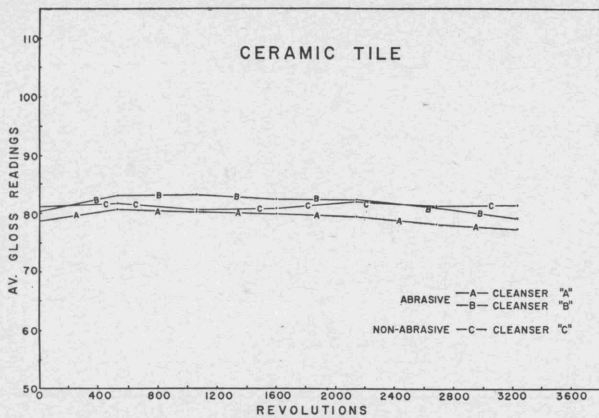


Figure 11. No important change in gloss values occurred when these tiles were scrubbed 30 minutes with either the abrasive or the nonabrasive cleansers.

of 1 minute each in which only the mild abrasive cleanser was used. This information for enameled steel tile is shown in Figure 6.

Considerable differences existed in the initial gloss values among the different materials. In addition, there was a considerable difference in the gloss changes which occurred among the materials during the scrubbing operations. Because of these wide variations, the same scale could not be used on the vertical axes of all the graphical presentations. Care should be exercised to evaluate the numerical differences in the gloss values while comparing material performances.

Enameled Steel

These tiles are recommended for use in kitchens, dinettes, utility rooms, solariums, powder rooms, bathrooms and other tiled areas.

Generally, the tiles showed excellent resistance to scrubbing with the nonabrasive cleanser, but were very subject to abrasion by the abrasive cleansers. These results are illustrated in Fig-

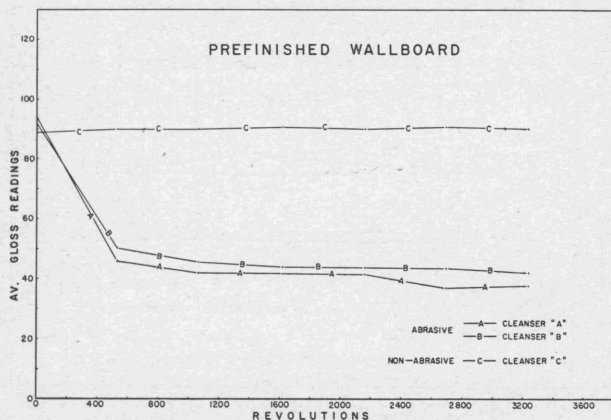


Figure 12. The abrasive cleansers produced considerable gloss change within the first 5-minute scrubbing period. The nonabrasive cleanser produced no important gloss change throughout the 30-minute treatment.

ure 4. Almost all the gloss changes recorded for the scrubbing periods of 30 minutes occurred within the first 5 minutes of scrubbing. Figure 6 shows that a large part of the total gloss change actually occurred within the first minute of scrubbing. The tiles showed some variation in original gloss as shown in the initial gloss readings.

The steel backing was first exposed along ridges of the tile joint perpendicular to the area being scrubbed, Figure 3. Visual inspection also showed a change in depth of color as the scrubbing progressed. Degree of color change varied with different colors. The effective service-life of the material was exceeded before the end of the 30-minute abrasive cleanser tests since the material no longer enhanced the area covered. The enamel surfacing was easily scratched and marred when handled.

Enameled Copper

This material was designed for special decorative effects. It is recommended for kitchens, snack bars or over sinks and stoves. It also is used for decorative panels in living or dining room areas.

These tiles did not react as rapidly as enameled steel when subjected to the use of an abrasive cleanser. The gloss readings were influenced by the finish on the copper itself as well as by the clear enamel protective coating. Approximately 80 percent of the total gloss change occurred within the first 5 minutes of scrubbing with an abrasive cleanser. A gradual but continuous decrease in gloss was evident until the material had been scrubbed for approximately 20 minutes. The copper tiles showed good resistance to scrubbing with the nonabrasive cleanser. The clear enamel surface coating can be scratched easily. When copper is exposed under certain atmospheric conditions, it may start oxidizing.

Stainless Steel

Stainless steel tiles are recommended for installation behind the stove, the kitchen sink or on the backboard of the kitchen counter. They also may be used around the washstand, lavatory, bathtub or shower stall enclosure.

These tiles had a highly finished grained surface. Scrubbing with the grain or across the grain produced different gloss readings. The manufacturer recommended that the tile be cleaned by scrubbing parallel with the grain. This procedure was followed in gathering the data for this analysis. Figure 7 shows that a very slight increase in gloss was produced as the scrubbing progressed. There was essentially no difference in effect between abrasive and nonabrasive cleansers. Neither was there any visual difference between the scrubbed and unscrubbed tiles. The service life of the material was not affected.

When the tiles were scrubbed across the grain, the glossy surface became slightly cloudy and dull. Scrubbing across the grain is likely to occur when tiles are installed with grains that run at right angles to produce a checkerboard effect.

Plastic

These tiles are recommended for bath, utility and playrooms. They also may be used behind snack bars and kitchen counters.

These tiles showed high resistance to scrubbing with the nonabrasive cleanser, but were very subject to abrasion with abrasive cleansers, Figure 8. The abrasive cleansers seemingly did not give consistent results. Further investigation showed, however, that the results were consistent; the apparent inconsistency was caused by the drying and cleaning of the samples. Even though the gloss value of the material was relatively low when a certain scrubbing period ended, the brisk rubbing of the tile with a cloth or paper towel gradually renewed it. The abrasion marks could not be completely removed, but they could be rubbed to produce a highly polished surface.

Plastic tiles are relatively soft and can be severely scratched by placing a fingernail perpendicular to the tile surface and then rapidly stroking the finger back and forth in motions parallel with the nail.

One-minute scrub treatments of plastic tile with the mild abrasive cleanser show that the tiles undergo most of their gloss change within the first minute of scrubbing, Figure 9. The gloss change may actually occur within less than 1 minute. With exception of the loss of gloss and abrasion marks, the material did not change in depth of color and otherwise remained serviceable.

A nylon-bristled handbrush attached to the scrubbing machine was used as the scrubbing unit for further investigation of this material. The weight applied was the same as that applied to the sponge. Noticeable grooves were cut into the plastic tiles with the brush and an abrasive cleanser during six test periods of 5 minutes each. These grooves became more apparent when the same equipment was used in the same manner for 1 hour. Scrubbing with the brush without an abrasive cleanser would produce no grooving effect on the plastic tile.

Porcelain-on-steel

Advertisements show this tile on walls and ceilings of bathrooms and kitchens. The tiles also are used in commercial buildings such as hotels, schools and hospitals. The manufacturer's literature states that the tile can cover any wall.

The porcelain protective coating is fused to the steel and is very hard. Test results in Fig-

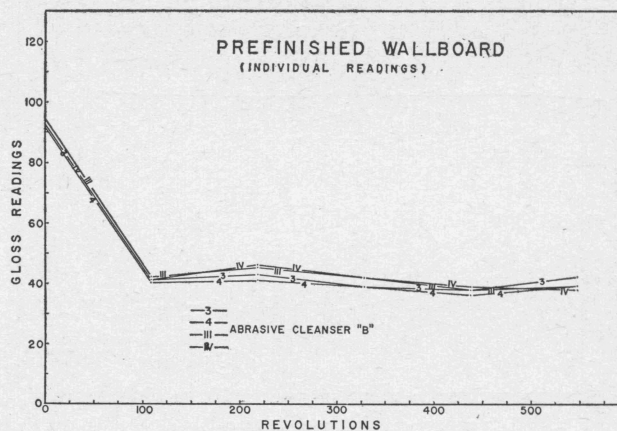


Figure 13. Nearly all of the major gloss changes occurred within the first minute of scrubbing. Treatments for shorter time were not run.

ure 10 show that some differences in gloss values existed in the original tiles. There was a slight increase in gloss when the abrasive cleansers were used, but virtually no change with the nonabrasive cleanser. No visible effects were noticeable between scrubbed and unscrubbed tiles. The service life of the tiles was apparently not impaired and the tiles probably could have withstood additional scrubbing with the cleansers without any harmful effects. Tiles cannot be bent without causing porcelain to crack and chip. Similar chipping occurs when the surface is struck a severe blow with a hard object.

Ceramic

Ceramic tiles have a wide range of application. They are recommended by their producers

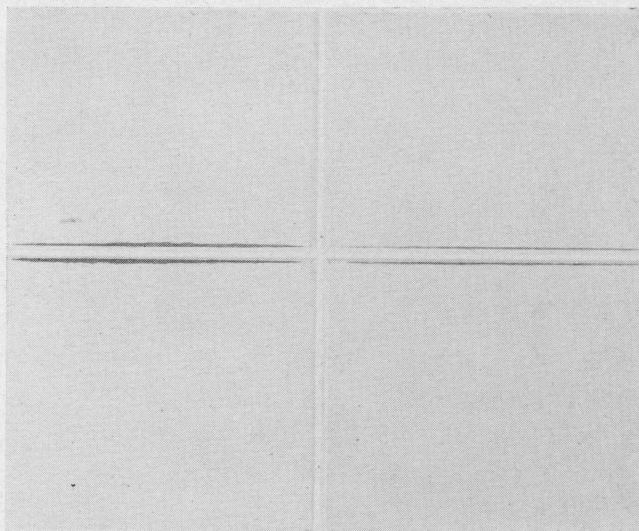


Figure 14. Typical mode of failure which occurred on scored prefinished wallboard. The simulated tiles on the left were scrubbed 30 minutes with a sponge and an abrasive cleanser. Those on the right were scrubbed 1 hour. There is no change in color depth between scrubbed and unscrubbed areas. Also shown are the failures of the protective coating along the score lines which run horizontally across the scrubbed areas.

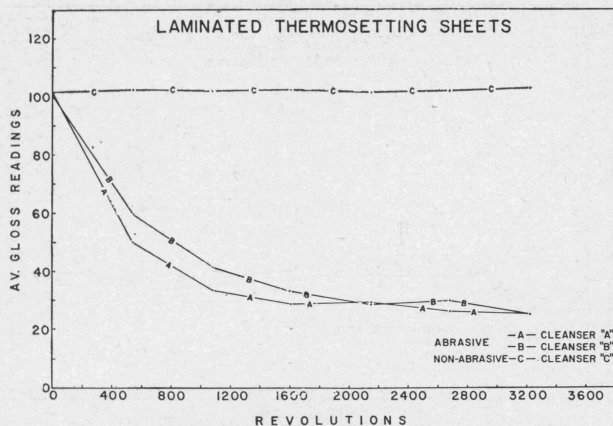


Figure 15. This material remained unaffected when scrubbed with the nonabrasive cleanser. Abrasive cleansers caused a gradual but continuous loss of gloss for the first 15 to 20 minutes of scrubbing.

for bathrooms and kitchens, in restaurants and hotels, in schools and theaters, in hospital operating rooms, corridors and washrooms and in many other places.

The scrub-resistance studies revealed that ceramic tile is a very stable product. Figure 11 shows that almost no gloss change occurred when the tiles were scrubbed with any of the cleansers. Neither was there any evidence from visual inspection which indicated that a surface change would occur. The service life of the tile apparently remained unimpaired.

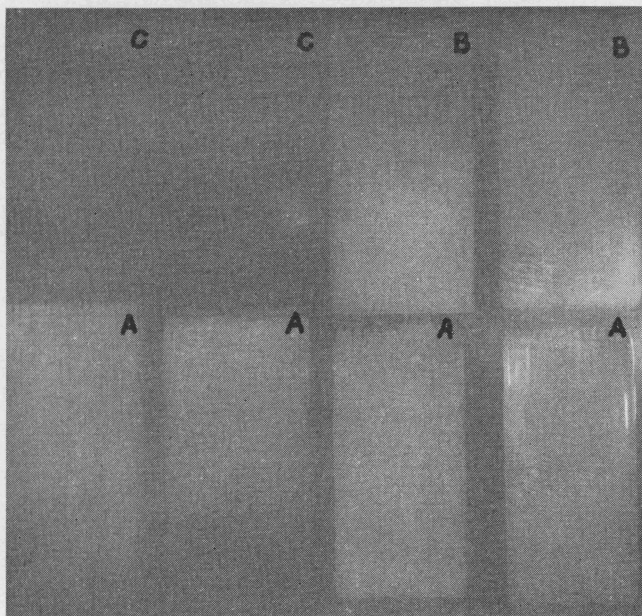


Figure 16. Treatment results on laminated thermosetting-sheet material. Starting at the top, from left to right, each pair of areas was scrubbed with a sponge and the indicated cleanser. The first spot was scrubbed 30 minutes while the second spot was scrubbed 1 hour. The spots in the lower right corner were scrubbed with the indicated cleanser and a nylon-bristled handbrush for the same periods of time, respectively.

The glazed surface of these tiles can be chipped if it is struck with a hard and somewhat pointed object. If the blow is severe enough, the tiles will break readily.

Rigid Sheet Materials

Two of these wall-surfacing materials were studied. They could be classified either as rigid or perhaps semirigid sheet materials.

Prefinished Wallboard

These prefinished panels are recommended for old or new walls in kitchens and bathrooms. They may also serve in stores, offices, shops and hospitals. The material is advertised to have a durable finish that resists moisture, grease, dirt, dust and abrasion.

The panels showed excellent resistance to the nonabrasive cleanser. The material was very subject to abrasion by the abrasive cleansers, Figure 12. One-minute treatments revealed that most of the gloss change occurred within the first minute of scrubbing, Figure 13.

During the scrubbing periods, the protective surface coating did not change in color tone or depth of color as was the case with enameled steel shown in Figure 3. Instead, the color remained the same on the scrubbed and unscrubbed areas, Figure 14. Typical failures of the protective coating along the score lines which run horizontally across the scrubbed areas also are shown. This type of damage is not reflected in the gloss readings which were taken on smooth, flat surfaces approximately 1 inch away from any score line.

Laminated Thermosetting Sheets

These materials are recommended for walls and wainscoting in bathrooms, kitchens, dining areas, playrooms and nurseries. They are also used for counter tops, furniture tops and to cover other work surfaces. They are suggested for commercial buildings, such as hospitals, schools, hotels and cafeterias. The manufacturer's literature states that the material is heat resistant and impervious to stains from foods, cooking oils and fats.

The panels as purchased had uniform glossy surfaces which were not affected by the use of the nonabrasive cleanser. The abrasive cleansers caused a gradual but continuous loss of gloss for the first 15 to 20 minutes of scrubbing, Figure 15. One-minute treatments generally show a small gloss change for each additional minute of scrubbing. The material is definitely subject to abrasion but research shows that the surface yields very gradually.

Additional treatments were made to determine visible changes which might occur if the surfaces were subjected to scrubbing with an abrasive for periods up to 1 hour, Figure 16.

Gloss change is apparent in all cases where abrasive cleansers were used. After the scrubbed surface had lost its gloss, little visible change occurred if the material was scrubbed for an additional 30 minutes with an abrasive cleanser. Only the surface scrubbed 1 hour with the nylon-bristled hand brush shows some small areas where the abrasion has worn through the decorative pattern sheet.

Flexible Sheet Materials

Two different types of flexible sheet materials were tested. Both were fabric backed and purchased in roll form.

Vinylized Wall Fabric

This fabric is a lightweight material which is particularly recommended for use in the bathroom and kitchen. The manufacturer states that its surface is waterproof, stain and scuff resistant, shrink and mildew proof and firesafe. The literature further states that it will not crack, stain, tear, chip or scratch. It can be installed on any smooth wall. Suggested uses in commercial buildings include hotels, schools, hospitals, libraries, theaters, offices and apartments.

This material has an attractive surface with little gloss. When purchasing the material, the consumer expects that it will maintain its original appearance throughout its service life. The treatments indicate that this vinylized wall fabric is immune to damage from scrubbing with the non-abrasive cleanser. The abrasive cleansers caused a gradual increase in gloss, Figure 17. This increased gloss was visibly apparent when the scrubbed areas were inspected. However, the material lost some of its color as the scrubbing progressed.

Additional 1-hour treatments were run to further determine its durability. Results are shown in Figure 18. The change in depth of color is apparent. Even after the severe scrubbing with the hand brush, the material surface remained unbroken and waterproof.

Flexible Rubber, Fabric Backed

The material is made of wear-resistant rubber. It is available in rolls for both floor or wall coverings. The material is recommended for kitchens, bathrooms and recreation rooms. Suggestions for public buildings include hospitals, hotels and schools. It is further recommended for table, sink, counter and desk tops. The manufacturer states that the material is washable, nonporous, practically stainproof and resists abrasion.

The surfacing was installed on the panels as recommended by the manufacturer. This included cleaning and waxing the material after installation. Treatments revealed that this flexible rubber showed practically no change in gloss

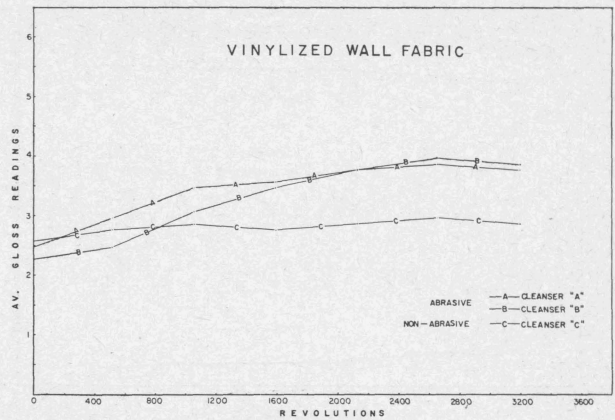


Figure 17. This material had little original gloss. As the scrubbing with the abrasive cleansers progressed, a higher gloss was developed. The nonabrasive cleanser had little effect on the material.

when scrubbed with a nonabrasive cleanser. The abrasive cleansers removed the wax and factory finish within the first 5-minute scrubbing period, Figure 19. The material as installed showed a variation in gloss as is indicated by the averages of the initial gloss values. The surfaces scrubbed with the abrasive cleansers were slightly roughened and nearly without gloss.

Color tone of scrubbed and unscrubbed areas remained unchanged, but the scrubbed areas showed a decrease in gloss. The material received no maintenance or waxing during the tests.

With the exceptions of the loss of gloss and the roughening of surfaces, the flexible rubber

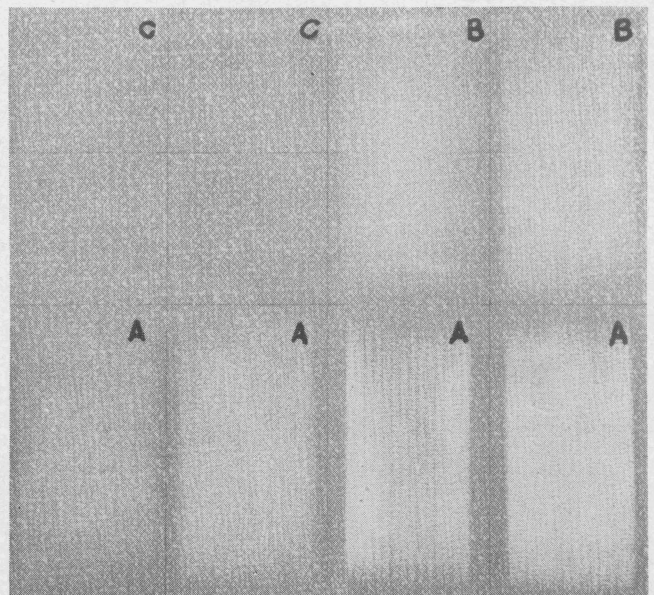


Figure 18. Treatment results on vinylized wall fabric. Starting at the top, from left to right, the first three pairs of areas were scrubbed with a sponge and the indicated cleanser. The first spot in each pair was scrubbed 30 minutes while the second was scrubbed 1 hour. The spots in the lower right corner were scrubbed with the indicated cleanser and a nylon-bristled handbrush for the same periods of time, respectively.

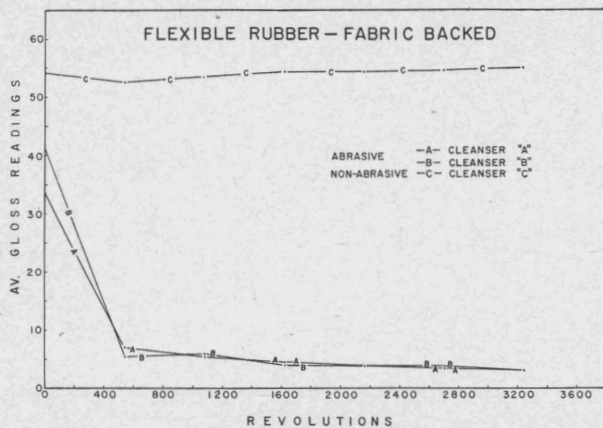


Figure 19. Abrasive cleansers removed wax and factory finish of the material within the first 5 minutes of scrubbing. Nonabrasive cleanser caused practically no gloss change.

retained its body and otherwise appeared unharmed. Waxing the areas scrubbed with abrasive cleansers tended to restore the original gloss but could not restore the surface texture to its original smoothness.

OTHER OBSERVATIONS

The surface covering on any wall performs no better than the underlayment on which it is installed. Smooth, flat underlayments were used for all materials studied. Adequate adhesive or mastic should be used to make the surfacing material adhere permanently to its base. Thin and flexible materials will show small underlayment imperfections more readily than the thicker and more rigid materials.

Color change and loss of gloss caused by the scrubbing of a wall-surfacing material are readily detectable by inspection. If desirable, the prospective customer can test a wall-surfacing

material by scrubbing it with an abrasive cleanser.

Floor-covering Materials

Several resilient floor-covering materials were subjected to the 30-minute scrub-resistance treatments with the different cleansers. The results were generally the same as those produced on the flexible rubber material. In most cases the floor-covering materials did not retain their high original gloss and all final gloss values were relatively low. On several samples of linoleum, vinyl and rubber, the nonabrasive cleanser also tended to remove the protective wax coating.

Stain Resistance

The possibility of measuring stain resistance of the different wall-surfacing and flooring materials was investigated. Objective measurements with available instruments were difficult to make because the initial stains could not be exactly duplicated.

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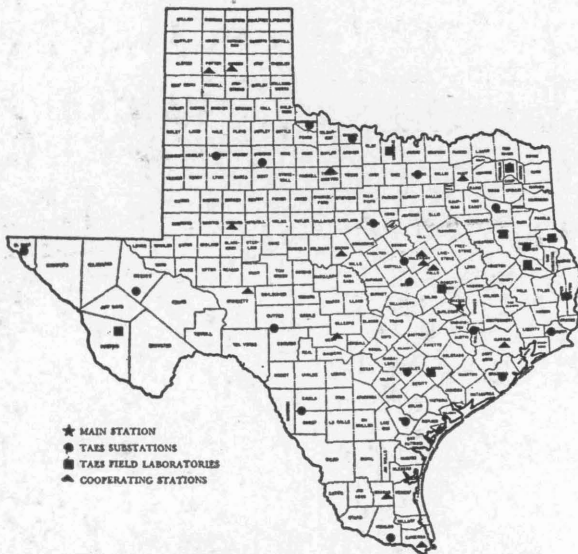
Thanks are extended to all the companies who contributed materials and supplies to help make this study possible.

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State-wide Research



★ MAIN STATION
● TARS SUBSTATIONS
■ TARS FIELD LABORATORIES
▲ COOPERATING STATIONS

Location of field research units of the Texas Agricultural Experiment Station and cooperating agencies



The Texas Agricultural Experiment Station is the public agricultural research agency of the State of Texas, and is one of the parts of the A&M College of Texas.

ORGANIZATION

IN THE MAIN STATION, with headquarters at College Station, are 16 subject-matter departments, 2 service departments, 3 regulatory services and the administrative staff. Located out in the major agricultural areas of Texas are 21 substations and 9 field laboratories. In addition, there are 14 cooperating stations owned by other agencies. Cooperating agencies include the Texas Forest Service, Game and Fish Commission of Texas, Texas Prison System, U. S. Department of Agriculture, University of Texas, Texas Technological College, Texas College of Arts and Industries and the King Ranch. Some experiments are conducted on farms and ranches and in rural homes.

OPERATION

THE TEXAS STATION is conducting about 400 active research projects, grouped in 25 programs, which include all phases of agriculture in Texas. Among these are:

- | | |
|--------------------------------------|---------------------------------|
| Conservation and improvement of soil | Beef cattle |
| Conservation and use of water | Dairy cattle |
| Grasses and legumes | Sheep and goats |
| Grain crops | Swine |
| Cotton and other fiber crops | Chickens and turkeys |
| Vegetable crops | Animal diseases and parasites |
| Citrus and other subtropical fruits | Fish and game |
| Fruits and nuts | Farm and ranch engineering |
| Oil seed crops | Farm and ranch business |
| Ornamental plants | Marketing agricultural products |
| Brush and weeds | Rural home economics |
| Insects | Rural agricultural economics |
| | Plant diseases |

Two additional programs are maintenance and upkeep, and central services.

Research results are carried to Texas farmers, ranchmen and homemakers by county agents and specialists of the Texas Agricultural Extension Service

AGRICULTURAL RESEARCH seeks the WHATS, the WHYS, the WHENS, the WHEREs and the HOWS of hundreds of problems which confront operators of farms and ranches, and the many industries depending on or serving agriculture. Workers of the Main Station and the field units of the Texas Agricultural Experiment Station seek diligently to find solutions to these problems.

Today's Research Is Tomorrow's Progress