Bulletin 890

• Accelerated Wear Tests
• on Common
• Floor-covering Materials

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TEXAS AGRICULTURAL EXPERIMENT STATION

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SUMMARY

Accelerated wear tests made on six common floor covering materials indicated there are variations in the changes of appearance and wear in these materials.

Solid sheet vinyls and rubber tiles showed significantly less wear than asphalt tiles, vinyl-asbestos tiles, linoleums and cork. Asphalt tiles showed significantly more wear than the other floor covering materials tested.

Maintenance cannot be recommended for decreasing wear, as determined from these tests, except on linoleums and cork. Waxing may be desirable on all materials to maintain appearance.

With the exception of rubber tile, light-solid or light-mottled colored materials generally showed less change in appearance than dark-solid or dark-mottled materials. Solid-colored materials showed more change in appearance than mottled materials. Dark colors in rubber tiles gave the least change in appearance.

ACKNOWLEDGMENTS

Recognition is given the Department of Genetics of the Texas A&M College System which supervised the statistical analysis of the wear data.

This research was set up in 1954 as part of the Southern Regional Housing Project S-8.

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Accelerated Wear Tests on Common Floor-covering Materials

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FARM BUILDINGS in 13 Southern States are valued at approximately $6,500,000,000. A major portion of this investment is in homes.

Interior covering, surfacing and finishing materials normally account for 8 to 20 percent of the cost of new home construction.

Floor coverings make up a large portion of this interior finish. The costs of maintenance and replacement of floor coverings contribute heavily to the cost of home maintenance.

Accelerated wear tests on floor covering materials were conducted by the Department of Agricultural Engineering in an effort to simulate the wear conditions experienced in a home. The time factor could not be reproduced in such a study, and any changes in the material caused by time could not be observed. It also was impossible to reproduce exactly the effects of human traffic on a floor covering material. It was assumed that the customer would prefer to have the material maintain its original appearance while wearing and aging, and that any type of change would be objectionable.

PROCEDURE

Laboratory tests were begun in 1955 to determine the useful life of different covering materials available for use in farm homes. Additional tests are planned in which these materials will be observed in home installations.

Six common floor covering materials—solid sheet vinyls, rubber tiles, vinyl-asbestos tiles, linoleums, corks and asphalt tiles—were used to construct 63 test specimens 2 x 2 feet in size. Variations in specimens were constructed from the same material by using different material thicknesses or backings, or both. Several duplicate specimens of each material thickness and backing combination were necessary since all the tests with the desired replications could not be run on a single 2 x 2-foot sample.

Covering materials were installed on plywood with adhesives, as recommended by the manufacturers. A minimum of four spots on each sample were subjected to accelerated wear with an abrasive wearing machine for 10 periods of 5 minutes each. Several of the samples received eight wear spots. The four additional wear spots were produced in the development of the test procedure.

Each sample with four areas of wear contained three spots or areas on which a coarse abrasive was used and one spot on which a fine abrasive was used to accelerate wear. Two of the spots with the coarse abrasive were worn wet, the third was worn dry. The spot with the fine abrasive was worn dry only. This method of subdividing permitted comparisons of wear which resulted from the use of different sizes of dry abrasives and the use of wet and dry abrasives of the same size and of different sizes.

The abrasive consisted of air-dried sand which had been screened to two levels of fineness. The coarse abrasive consisted of all the sand particles passing through a 40-mesh screen. The finer abrasive consisted of all particles passing through a 50-mesh screen. These grit sizes were selected as representative of the sizes of sand which are commonly carried into the home by pedestrain traffic. Grit sizes may vary with dfferent localities depending on the types of soils which predominate in the area. Only the coarser or the finer grit was used on a particular test spot.

To determine the effect of maintenance on wear, two sample of each material were waxed with three coats of recommended liquid wax be-

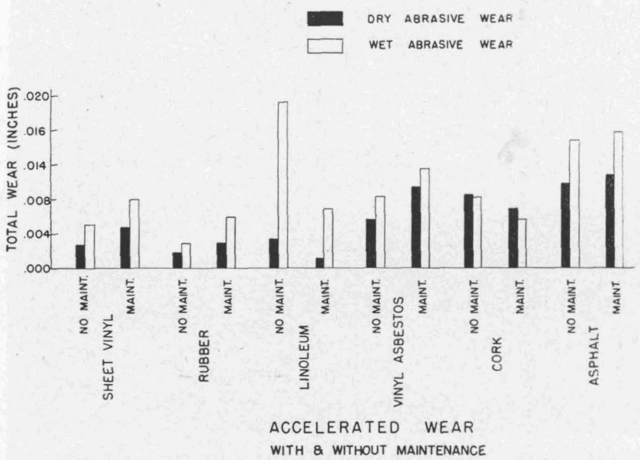

Figure 1. A comparison of total accelerated wear on six common floor covering materials as affected by wet and dry abrasives on maintained and unmaintained materials.

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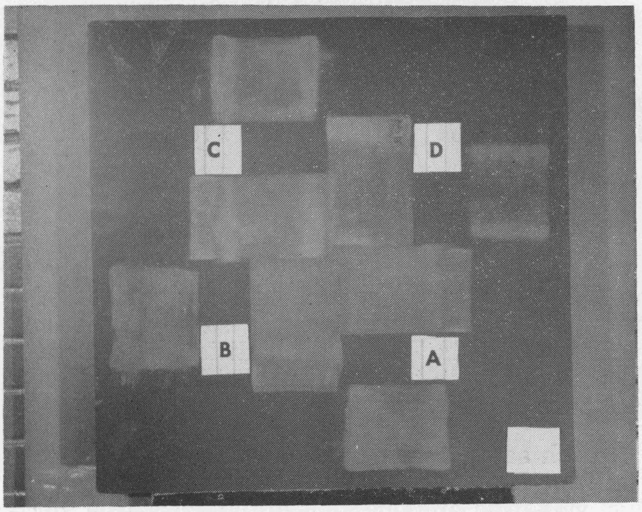

Figure 2. Unmaintained, plain brown, standard gage linoleum. Wear spots "A" and "B" were subjected to a wet abrasive and spots "C" and "D" were subjected to dry abrasives. Where eight wear spots occur in Figures 2-8, letters are between spots subjected to like treatments. All "A" and "B" spots were subjected to a wet abrasive and all "C" and "D" spots were subjected to dry abrasives.

fore wear was started, and thereafter following every 10 minutes of accelerated wear.

Gloss and diffuse reflection measurements were made to determine the nature and degree of change in surface conditions which resulted from severe wear. Gloss or specular reflection is the result of a beam of light striking a surface and then being reflected in a beam, the angle of reflection being the same as the angle of incidence measured from the normal to the surface. 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

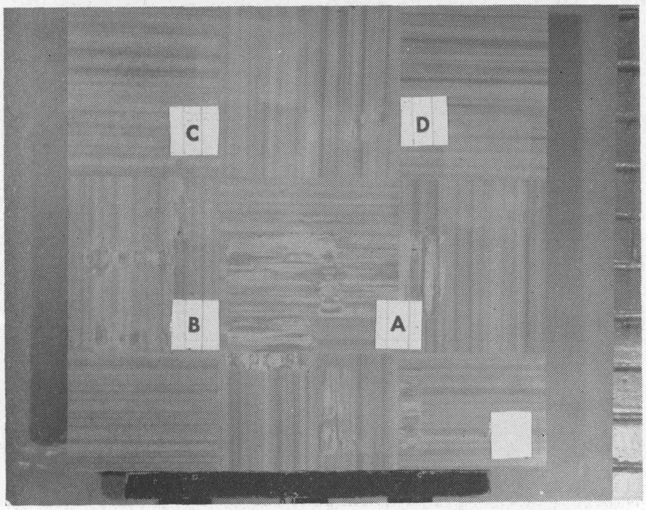

Figure 3. Unmaintained standard gage linoleum with striated pattern. Wear spots "A" and "B" were subjected to a wet abrasive and spots "C" and "D" were subjected to dry abrasives. Pattern changes resulting from wear are obvious.

a portion of the reflected light to be diffused in all directions.

Measurements of gloss and diffuse reflection were made with a photoelectric indicating meter.[1] The glossmeter consists of the instrument proper and the search unit. The instrument proper contains the indicating meter, power supply and controls. The search unit—containing the light source, the optical system and the photocells—is connected to the instrument proper by a flexible cable. The reflection meter is an alternate unit which can be used with the instrument proper.

RESULTS AND CONCLUSIONS

Average total wear for 2,062 cycles of the abrasive wearing machine for the six different floor covering materials is given in Figure 1. Among numerous comparisons which can be made, the graph shows the comparison of wear with wet and dry abrasives, and wear with maintenance compared with wear with no maintenance.

The accelerated wear tests showed an interaction between materials and treatments by the failure of treatment differences to respond consistently in the different materials.

The following differences between materials and treatments were found to be statistically significant in the accelerated wear tests:

On maintained and unmaintained linoleum, asphalt tile, rubber tile and solid vinyls, wet abrasives caused more wear than dry abrasives.

On all unmaintained materials, with the exception of cork, wet abrasives caused more wear than dry abrasives.

Rubber tile and solid vinyl showed less wear than any of the materials tested.

Linoleums, vinyl-asbestos tiles and cork did not wear as well as rubber tiles and solid vinyls, but they showed less wear than asphalt tiles.

Unmaintained rubber tiles, solid vinyls and vinyl-asbestos tiles showed less wear than maintained samples of these materials. Linoleum and cork were the only materials for which there was an indication that waxing would increase their ability to withstand wear.

The following differences between treatments and materials were not statistically significant when related to wear even though the observed data indicated some differences in results.

No real differences occurred because of material backing such as felt underlayment compar-

[1]Photovolt Photoelectric Glossmeter with a Model 660A Search Unit and a Model 610Y Reflection Meter Search Unit, as manufactured by the Photovolt Corporation, 95 Madison Avenue, New York 16, N. Y.

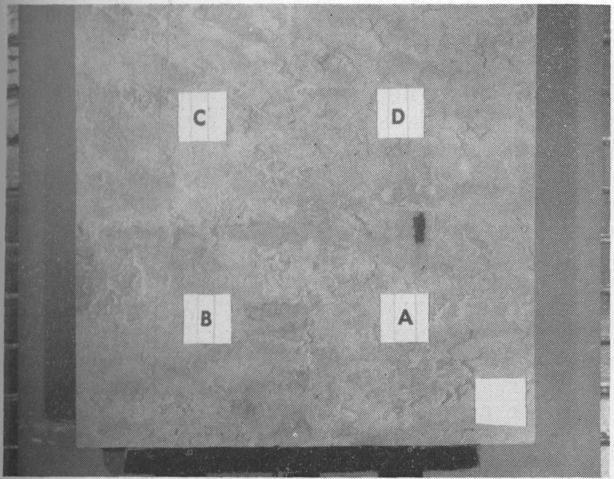

Figure 4. Unmaintained, standard gage linoleum with non-directional graining. The pattern hides wear well. The spot above and to the right of "A" shows where the linoleum has been worn through to the backing.

ed with no felt underlayment, size of abrasive or thickness of material.

Asphalt tiles tended to wear more when maintained than when not maintained.

Maintained vinyl-asbestos tiles showed little difference in wear when subjected to wet or dry abrasives.

No real difference was found when maintained or unmaintained cork was worn with wet or dry abrasives.

Differences in gloss and diffuse reflection readings taken on floor covering materials before and after the accelerated wear tests can be attributed to surface changes in the material. Surface changes influence appearance and, consequently, the differences in such readings are a measure of the changes in appearance.

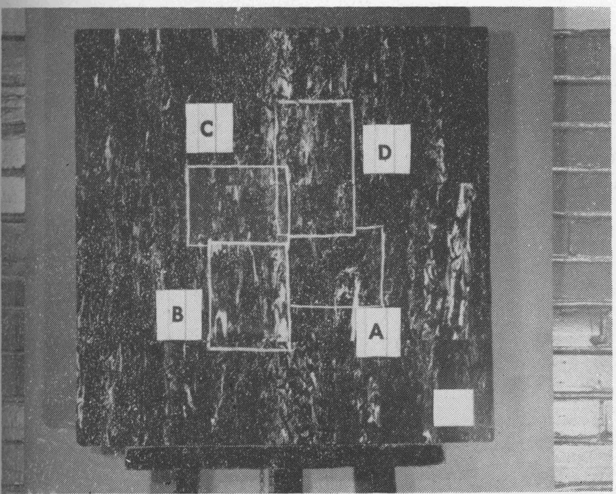

Figure 5. Mottled black, unmaintained rubber tiles, .08 inch thick. This pattern shows a slight color change resulting from accelerated wear.

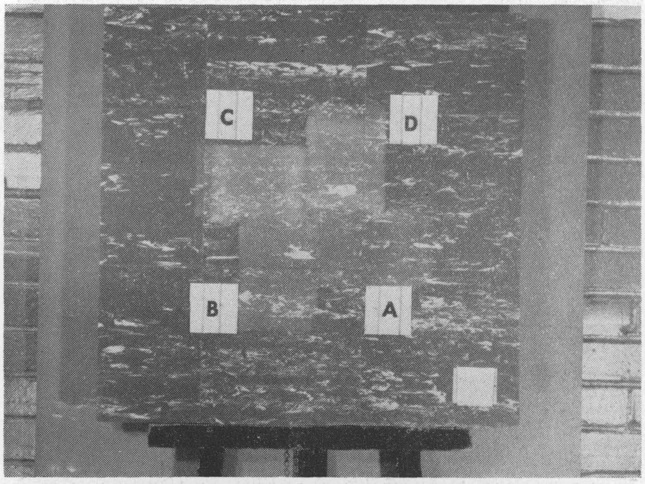

Figure 6. Mottled medium green, unmaintained rubber tiles, .08 inch thick. This pattern shows a marked color change resulting from accelerated wear.

Regardless of material or color, the major changes in gloss and diffuse reflection occurred in the early stages of accelerated wear.

Changes in color, as determined from diffuse measurements, are related to material as well as to original color and pattern. The materials ranked in the following order from least to most change in color, regardless of original color or pattern: solid vinyls, rubber, asphalt and vinyl-asbestos (tied), cork and linoleum.

Figures 2, 3 and 4 indicate the effect of pattern and original color on the degree of change in appearance caused by wear. In Figures 2 through 8, where eight wear spots occur, the letters are between spots subjected to the same treatments. All "A" and "B" spots were subjected to a wet abrasive, and all "C" and "D" spots to dry abrasives. Throughout the tests, gloss and diffuse reflection measurements showed non-directional grain patterns changed least

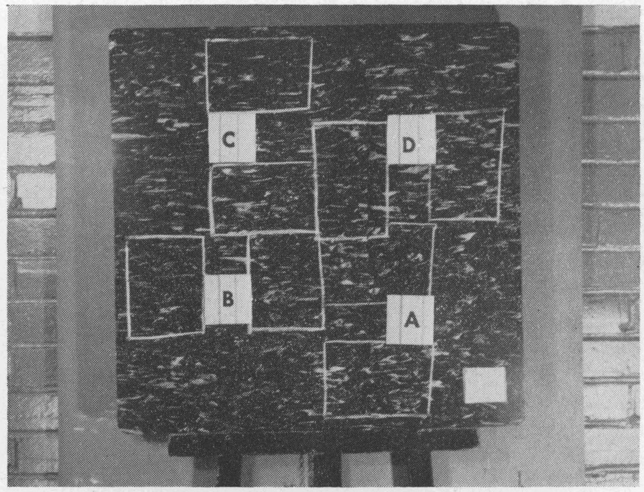

Figure 7. Mottled black, unmaintained solid vinyl, 1/8 inch thick. Wear did not produce a marked change in color of this material.

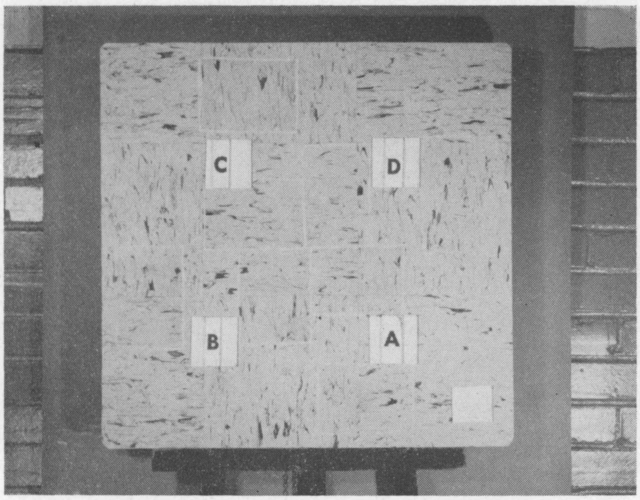

Figure 8. Mottled light gray, unmaintained solid vinyl, 1/8 inch thick. Observations show practically no color change between worn and unworn areas.

in appearance. Solid patterns tended to change most.

Gloss and diffuse reflection readings showed that, with the exception of rubber tile, dark colors tend to change more than light colors, regardless of materials.

Rubber tiles in Figures 5 and 6 show a greater change in color on light than on dark colors.

Figures 7 and 8 indicate the ability of solid vinyls to maintain their original color, regardless of whether they are light or dark, maintained or unmaintained.

Gloss and diffuse reflection measurements showed that, with the exception of cork tiles and linoleum, changes in color were less for all colors and materials when worn with wet abrasive than with dry abrasives. On cork, there was no apparent difference in change in color between spots subjected to wear with dry or wet abrasives. Greater change in color occurred on linoleum samples worn with a wet abrasive.

Major gloss changes occurred during the first 10 minutes, or within the first 20 percent of the total time of accelerated wear. This change did not depend on color or type of abrasive.

After accelerated wear, all materials tended to reach the same low gloss value.

The greatest loss in gloss during the wear period was incurred by materials which started with the highest gloss before wear.

In order of increasing change in gloss, the materials ranked: linoleum, asphalt, cork, vinyl-asbestos, rubber and solid vinyl.

In order of decreasing average amount of gloss retained throughout the wear period, the materials ranked: solid vinyl, vinyl-asbestos, asphalt, linoleum, rubber and cork.

Several unmaintained samples selected at random were waxed after completion of the wear tests. Waxing at short intervals had no appreciable effect on total gloss change. This was indicated by a visual comparison of these unmaintained samples with like samples having periodic maintenance throughout the wear tests.

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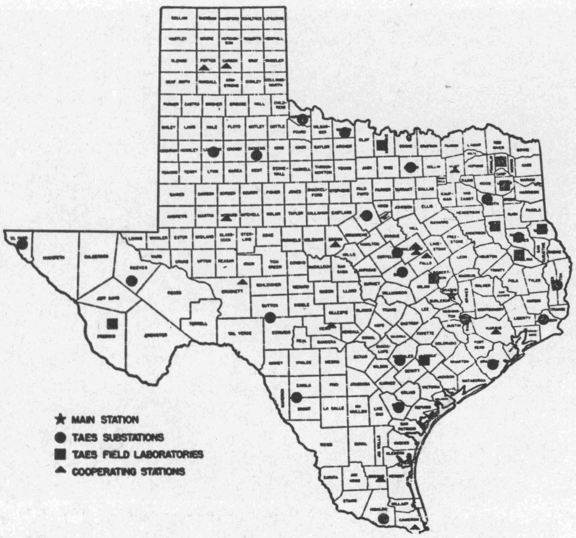

Location of field research units of the Texas Agricultural Experiment Station and cooperating agencies

State-wide Research

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

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

Texas Agricultural Experiment Station, R. D Lewis, Director, College Station, Texas.