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MANUFACTURE OF FLOOR COVERINGS INCORPORATING VINYL RESINS

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This invention relates to floor coverings, and more particularly to a hard surface floor covering of the kind incorporating a decorated paper sheet laminated to a resilient base layer, such as the commonly used asphalt saturated felt.

The general purpose of this invention is to produce a floor covering product of the general kind referred to above and having an unusually favorable combination of physical characteristics, such as resistance to wear, while at the same time making possible the achievement of color decorations of great fineness and intricacy, for instance delicate floral designs.

The product of the invention is capable of manufacture at relatively low cost in comparison with such floor coverings as inlaid linoleum and is, at the same time characterized by general wearing qualities which are superior to prior known inexpensive types of hard surface floor coverings and can even be made comparable to those of inlaid linoleum of medium weight.

More particularly, the floor covering of the present invention not only makes possible the achievement of more intricate pattern effects, as above noted, but at the same time the product is characterized by a high degree of abrasion resistance and flexibility, and by excellent alkali and water resistance. Indeed the abrasion resistance of the product can even be made comparable to that of the common rubber tile type of floor covering, and the product, moreover, does not show the effects of scratches as much as many other forms of hard surface floor coverings. Because of the high alkali and water resistance which are characteristic of the product, the floor covering of this invention may readily be cleaned, as by scrubbing with strong soap, notwithstanding the fact that the product incorporates a decorated paper sheet.

The invention also provides a highly effective method for the manufacture of a floor covering of the kind referred to and having the characteristics above mentioned, the method being characterized by employment of certain combinations of materials selected so as to facilitate manufacture and also so as to contribute the advantageous physical properties mentioned.

Briefly, the method of the invention proceeds as follows:

A paper sheet or web, fed for instance from a six or nine foot roll, is first saturated with a water resistant saturant, this operation being carried out continuously, as are various of the other steps hereinafter mentioned. The saturated sheet is then dried and preferably passed

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through pressure rolls or a calender after the drying. A coating, preferably a pigmented coating serving as a background for the decoration, is then applied to one side of the saturated sheet and the sheet is again dried and calendered so as to provide a smooth surface on the background coating for purposes of printing. The sheet is next printed with the desired design, such printing being effected by gravure type of printing applied directly to the calendered surface of the background coating. After drying of the printing, the sheet is top coated with a transparent layer so that the design is visible therethrough, and this top coating step may advantageously be repeated so as to build up the transparent layer to a sufficient thickness to impart the desired wearing life. The top coated sheet is dried, and the saturated, decorated and top coated sheet is thereafter laminated to a resilient base layer such as asphalt saturated felt.

In considering various important features of the invention and for the purpose of giving examples the several individual steps above briefly outlined are discussed herebelow under corresponding headings, but before describing the individual steps in greater detail, certain important general points are here referred to.

First, the use of the paper sheet is of importance for a number of reasons including the fact that the paper sheet alone may much more readily be handled for the purposes of decoration, saturation, coating, etc., than is the case with asphalt saturated felting or other similar resilient bases. The application of the printed decoration, the wear coating, etc., to a paper sheet enables the employment of much higher drying temperatures than are practicable where coatings are applied directly to asphalt saturated felting.

Still another advantage of employment of the paper sheet as the base for the decoration and coatings is related to the nature of the coating materials and the like used according to the invention, as is now explained. Thus, the invention contemplates the employment of vinyl type resins, especially polymeric vinyl chloride either with or without the presence of certain modifiers. For instance, the vinyl chloride may be modified by copolymerization with minor amounts of vinyl acetate. Certain other vinyl resins or copolymers thereof may be used in at least some of the compositions employed according to the invention, although the dispersion grades of the vinyl chloride type are preferred for most of the present purposes. This general type of resin is characterized by a relatively low adhesive prop-

erty with reference to certain materials, so that a coating thereof will not always strongly adhere to the base surface. However, layers or coatings of vinyl type resins will very strongly adhere to each other, and according to the invention vinyl type of resins are incorporated in all of the saturating and coating materials applied to the product. The employment of a paper sheet as the base to which the various coatings are applied, greatly facilitates the provision of a base to which the final coatings will strongly adhere. The paper sheet is of such a nature that it may readily be impregnated or saturated with a vinyl resin and after saturation the sheet presents a surface to which the subsequently applied coatings will strongly adhere. In this way tendency for the coating layers to peel off or for the product to split apart is virtually eliminated.

In general, it may also be mentioned that the vinyl type of resin as used in the product of the invention greatly assists in achieving the desirable combination of physical characteristics above described. Such resins are also of advantage in producing a floor covering incorporating various coatings as herein described, since these resins may be applied in coatings of substantial thickness, and the desired wear life may therefore be attained with a minimum of coatings and of passes through the coating equipment.

PAPER SATURATION

Although the resin materials used in certain of the coatings referred to hereinafter are preferably applied in dispersion in organic dispersion media or solvents, in the case of the saturant for the paper sheet, the invention contemplates that the resin materials be applied in latex form, i. e., in the form of an aqueous dispersion. This not only enables application of a solution of high solids content, but in addition is of especial advantage with respect to saturation, since the fibers of the paper are very readily wetted by the aqueous dispersion.

For a saturant, it is preferred to employ a polyvinyl resin in combination with a polymeric plasticizer preferably characterized by non-migrating properties. The vinyl resin advantageously consists of high molecular weight, dispersion type, vinyl chloride-actate copolymer, or vinyl chloride polymer. The plasticizer is advantageously of the elastomeric type, a particularly effective example being butadiene acrylonitrile copolymer.

Though not essential, the saturant is also desirably pigmented, so as to aid in shielding the dark color of the underlying asphalt saturated felting to which the paper sheet is ultimately laminated. The pigment is preferably of light shade, or white, as is also the pigment of the background coating on which the decoration is printed (as described hereinafter) so as to provide a light shaded background against which the gravure printed design may stand out with sharpness and brilliance.

In general the ingredients of the saturant are advantageously used within the ranges indicated just below:

	Parts
Vinyl resin	40–70
Plasticizer	60–30
Pigment	0–50

The foregoing ingredients are prepared in aqueous dispersion form, the total of such ingredients comprising from 25% to 60% of the dispersion, and the balance being water.

As a specific example of a suitable saturant according to the invention, a dispersion is prepared comprising 57% water and 43% of the following mixture:

	Parts
Polyvinyl chloride	60
Butadiene acrylonitrile copolymer	40
Titanium dioxide	50

The foregoing aqueous dispersion is applied to the paper sheet by means of a roll or the like and the sheet is then fed through an elongated drying oven, after which it is advantageously run through a calender. In the drying oven the temperature of the sheet is preferably raised to from 200° F. to 350° F.

BACKGROUND COATING

The background coating essentially comprises a vinyl resin, a plasticizer, pigment and suitable volatile organic solvents as a dispersion medium. This coating is desirably applied in the form of an organosol, i. e., a dispersion of finely divided or colloidal particles of resin of high molecular weight in a dispersion medium. Upon heating to volatilize the dispersion medium the particles of resin fuse to form a film or coating. The plasticizer present remains in this film, as does also the pigment.

The general proportions for the ingredients for this background coating are as follows: For each 100 parts of the vinyl resin there should be added:

	Parts
Plasticizer	20–60
Pigment	10–50
Dispersion medium	15–150

To the above certain other minor constituents may also be added if desired, such as stabilizers, i. e., agents tending to retard the decomposition of the vinyl resin. From 1 to 5 parts of stabilizers is suitable.

As a specific example of a suitable background coating, the following is given:

	Parts
Vinyl chloride-acetate copolymer	100
Dioctyl phthalate	50
High flash point, straight run petroleum naphtha	38
Xylol	38
Organic phosphate stabilizer (Stabilizer #85 of the Victor Chemical Co.)	3.3
Titanium dioxide	21

The foregoing is spread on one surface of the sheet and the sheet is then fed through an elongated drying oven, where it is heated to a temperature of from 250° F. to 400° F. After passage through the oven the coated sheet is desirably calendered, this calendering providing a smooth surface on the background coating on which to print the decorative design.

DESIGN PRINTING

In most of the floor coverings, it is contemplated to decorate the paper sheet with a design printed on the background coating by means of gravure type printing rolls, or any other similar type of printing providing for the application of small dots of ink of varying size and/or density, so that the color of the background coating shows through to a greater or lesser extent according to the pattern, to thereby achieve a multi-shaded effect even from application of a single ink color. It is preferred for most designs to utilize a background color of light shade, as hereinabove mentioned, so that the gravure printing of other colors will show up against the light background

with sharpness and brilliance. In a typical installation, the gravure printing is applied in a multi-color press in which three or four, or even more colors may be applied.

The ink employed for the printing may employ any of the ordinary pigments, and certain of the binder constituents may be similar to those utilized in the gravure printing art. The ink, however, is preferably formulated so that the binder includes an appreciable quantity of vinyl type resin. In this instance, the vinyl type resin is of relatively low molecular weight, so that this constituent will be soluble in various of the solvents suitable for gravure printing inks. It is of advantage to employ the vinyl resin constituent in the binder of the ink, since this ensures a high degree of adhesion of the ink to the background coating, which latter also incorporates vinyl type resin.

As a specific example of a printing ink which may be used, reference is made to

	Parts
Carbon black	20
Vinyl chloride-acetate copolymer	20
Methyl ethyl ketone	200

TOP COATING

After the printing, the decorated sheet is now top coated with a clear wear layer. For this purpose vinyl type resins are again utilized. Here the coating may be applied in the form of an organosol, i. e., a dispersion of vinyl resin of high molecular weight in a plasticizer and a volatile dispersion medium. Advantageously this dispersion is prepared so as to have a solids content as high as possible consistent with convenient operation of the coating equipment. In general, the constituents of the top coating may conform with the ranges indicated just below:

For each 100 parts of vinyl resin, the following should be added:

	Parts
Plasticizer	20–50
Dispersion medium	15–150

To the foregoing other minor ingredients may be added, such as stabilizers as mentioned above in connection with the background coating.

As a specific example of clear top coat, the following formulation is given:

Top coat Example A

	Parts
Vinyl chloride-acetate copolymer	100
Dioctyl phthalate	40
High flash point straight run petroleum naphtha	38
Xylol	38
Organic phosphate stabilizer (Stabilizer #85 Victor Chemical Co.)	3.3

The foregoing composition is applied by rolls or equivalent coating equipment and the sheet is fed through an oven for drying purposes. In drying, the sheet is preferably heated to a temperature of from about 250° F. to about 400° F. The top coating may be repeated, if desired, in order to build up a wear layer of whatever thickness is contemplated in the finished product.

Another formulation is given herebelow by way of example of a top coating composition which will give a good wear coat even with only a single coating applied.

Top coat Example B

	Parts
Polyvinyl chloride	100
Dioctyl phthalate	40
Xylol	20

The foregoing formulation will yield a satisfactory coating even without the addition of stabilizers.

LAMINATION TO FELT BASE

The completed sheet is now laminated to the felt base so as to complete the product. For this purpose the common asphalt saturated felting may be utilized, and the adhesive employed for lamination is advantageously also of the asphalt base type, although it desirably contains at least some rubber or other synthetic elastomers, so as to give high impact resistance and impart low temperature flexibility. The presence of rubber also increases the bonding properties of the adhesive. Either natural rubber or synthetic elastomers will serve this purpose. Certain resin constituents may also be included, if desired.

As an example of a suitable asphalt base adhesive reference is made to the material marketed under the name Flintkote H M Adhesive #750—Flintkote Co.

VARIATIONS

Certain variations from the techniques described above are permissible without departing from the general spirit of the invention.

For instance, the vinyl type resins for background coating and for top coating may be applied in dispersion media containing appreciably less of the volatile organic dispersing constituent than some of the examples given. Indeed, the quantity of the volatile dispersing constituents may be very greatly reduced as compared with some of those indicated above, depending upon the type of resins and plasticizers utilized. In some cases the plasticizer will serve itself as dispersion medium for the colloidal particles of the vinyl resin. Where no volatile organic dispersing constituent is present, the dispersion of the vinyl resin in the plasticizer constitutes what has been termed a plastisol. Upon application of a coating of the plastisol type, the heating merely fuses the layer of resin and plasticizer. Certain compositions may exhibit some of the characteristics of organosols and of plastisols, depending upon the nature of the constituents and the quantity of volatile organic dispersing constituent present.

For certain purposes, for instance in providing the clear top coat on the product, it is preferred to utilize a formulation exhibiting some of the characteristics of both organosols and plastisols. Formulation B given above for the top coating falls in this category and is of advantage because it enables application of a coating of maximum thickness while retaining ability to be handled readily in high speed coating equipment.

As plasticizers for certain purposes, especially for paper saturation, it is of advantage to utilize the non-migrating type, such as the butadiene acrylonitrile copolymer above mentioned although other non-migrating plasticizers may also be used. For example, some of the liquid alkyd resins known to have non-migrating properties may be employed, such as the alkyd resin known as Glyptal 2557 (General Electric Co.) and Paraplex G–25 (Rohm and Haas Co.). Plasticizers of the alkyd type may be utilized even though they are not elastomers, although it is preferred, especially for purposes of paper saturation, that the saturant incorporate a plasticizer having elastomeric properties, such as the polymeric butadiene acrylonitrile above mentioned. For certain of the formulations still other plasticizers may be utilized, including some which do mani-

fest appreciable migrating properties. For instance in the top coating, a plasticizer such as dioctyl phthalate, as referred to in formulation B given above will give satisfactory results.

With regard to the matter of paper saturation, several alternatives should be kept in mind. First, various of the constituents of the saturant above referred to may be incorporated in the paper during the manufacture thereof. If desired the polymeric butadiene acrylonitrile may be incorporated during manufacture of the paper and a vinyl containing formulation may thereafter be applied to the paper so as to effect at least partial saturation of the sheet and thereby provide the desired adhesion properties with reference to the subsequently applied vinyl coatings.

Regardless of whether some or all of the paper saturating materials are incorporated either during the paper manufacture or are applied thereafter, it is of importance that for paper saturation at least some vinyl resin should be incorporated, although it is not essential that the vinyl penetrate all the way through the paper sheet.

Still other variations in the processing may be adopted, depending somewhat upon the specific nature of the product being produced. For example, depending upon the nature of the saturant for the sheet or the base coating, the saturant and the background coating may be sequentially applied without an intervening separate drying operation between, although in this event it is preferred to apply both the saturant and the background coat in the form of an aqueous dispersion of the saturating and background coating materials. The saturating composition and the background coating composition may also be sequentially applied in the form of aqueous dispersions, even where the sheet is subject to a separate drying operation after each of the compositions has been applied.

Depending upon the nature of the printing, for instance the color and delicacy of design, the application of a separate background coating may be omitted, but in this case, it is preferred to utilize substantial quantities of pigment in the saturant. For most purposes, however, it is preferred to utilize a separate background coating layer, as is described above.

Still another coating in addition to those described above may be applied between the time of saturating the sheet and the application of the background coating. This intervening coating may be termed a primer coat and will serve to further shield the underlying dark color of the asphalt adhesive and felt base. Where such a primer coat is introduced it should also incorporate vinyl type of resin, so as to provide the contemplated high degree of adhesion to the adjoining layers. A primer coat of this kind may be relied upon in part for saturation of the paper sheet.

Although the process or method fully described above may be carried out in a completely continuous manner, it is economical and convenient to utilize a single drying oven and to roll up the paper web being prepared after each pass through the oven. Appropriate coating equipment is arranged in advance of the oven, and other equipment such as a calender at the delivery end of the oven. In this way the equipment may be used for saturation, drying and calendering in one pass; for background coating, drying and calendering in a second pass; and for top coating and drying in each of any desired number of additional passes. The printing will, of course, be accomplished by a press independent of the saturating or coating and drying equipment.

We claim:

1. In the manufacture of floor covering having a decorated paper sheet laminated to a resilient base layer, the method which comprises impregnating a paper sheet with a saturant comprising an aqueous dispersion of a polyvinyl resin and polymeric butadiene-acrylonitrile, applying to one side of the saturated sheet a coating comprising a pigmented dispersion of a polyvinyl resin in a volatile dispersing medium, applying printed decoration to said coating, and applying over the printed decoration a coating comprising a dispersion of a transparent polyvinyl resin in a volatile dispersion medium.

2. In the manufacture of floor covering having a decorated paper sheet laminated to a resilient base layer, the method which comprises impregnating a paper sheet with a saturant comprising an aqueous dispersion of a polyvinyl resin and polymeric butadiene-acrylonitrile, drying the saturated sheet, applying to one side of the saturated and dried sheet a coating comprising a coating layer of an organosol comprising a dispersion of a polyvinyl resin in a volatile dispersion medium, drying the coated sheet, applying printed decoration to the dried coating on the sheet, and applying over the printed decoration a transparent top coating layer of an organosol comprising a dispersion of a polyvinyl resin in a volatile dispersion medium, and drying the top coated sheet.

3. In the manufacture of floor covering having a saturated paper sheet laminated to a resilient base layer, the method which comprises impregnating a paper sheet with a saturant comprising an aqueous dispersion of polyvinyl chloride and polymeric butadiene-acrylonitrile, applying a printed decoration to one side of the sheet, and applying a transparent top coating layer of an organosol comprising a dispersion of a vinyl chloride-acetate copolymer and a plasticizer in a volatile dispersion medium.

4. In the manufacture of floor covering having a decorated paper sheet laminated to a resilient base layer, the method which comprises applying to a paper sheet a pigmented aqueous dispersion of polyvinyl chloride, drying the sheet, applying a printed decoration to the side of the sheet to which said aqueous dispersion was applied, and applying a coating of a transparent polyvinyl chloride resin to the side of the sheet carrying the printed decoration.

5. In the manufacture of floor covering having a decorated paper sheet laminated to a resilient base layer, the method which comprises incorporating in a paper sheet polyvinyl chloride and polymeric butadiene-acrylonitrile, applying a printed decoration to one side of the sheet, and applying a transparent top coating layer of an organosol comprising a dispersion of polyvinyl chloride and a plasticizer in a volatile dispersion medium.

6. In the manufacture of floor covering having a decorated paper sheet laminated to a resilient base layer, the method which comprises incorporating in a paper sheet polyvinyl chloride, applying a printed decoration to one side of the sheet, and applying a transparent top coating layer of an organosol comprising a dispersion of polyvinyl chloride and a plasticizer in a volatile dispersion medium.

7. In the manufacture of floor covering having a saturated paper sheet laminated to a resilient base layer, the method which comprises impreg-

nating a paper sheet with a saturant comprising an aqueous dispersion of polyvinyl chloride, applying a printed decoration to one side of the sheet, and applying a transparent top coating layer of an organosol comprising a dispersion of polyvinyl chloride and a plasticizer in a volatile dispersion medium.

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