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SURFACE COVERING PRODUCT

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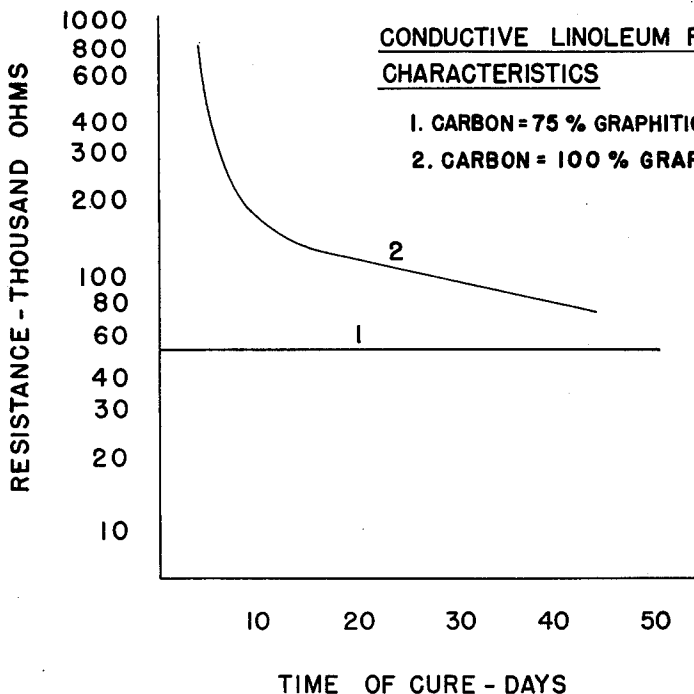


FIG. 1

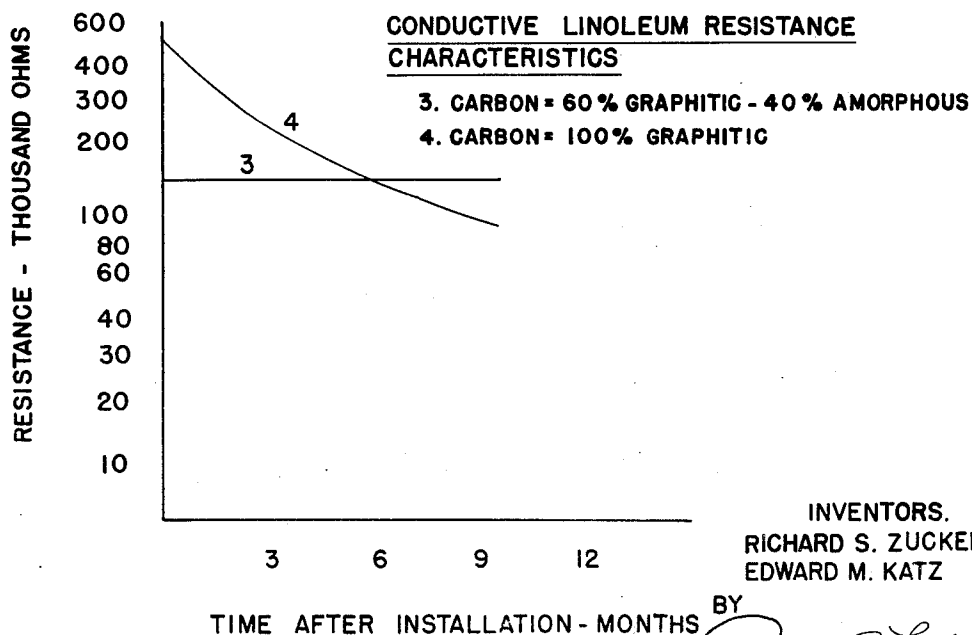


FIG. 2

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SURFACE COVERING PRODUCT

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This invention relates to surface coverings and particularly to static-conductive surface coverings for use in hospitals, arsenals and the like.

This application is a continuation-in-part of our co-pending application Ser. No. 606,608, filed August 28, 1956, now abandoned.

It is well known that if two surfaces of insulating material are rubbed together and separated following contact, an electrostatic charge will be built up between the two surfaces. This accumulation of electrostatic charge under these conditions can readily be observed when one walks across a woolen carpet in a dry atmosphere and then touches an object which is grounded. It is apparent that the building up of such charges on objects and the subsequent discharge with the formation of a spark can be particularly hazardous in areas which contain combustible or explosive compositions, such as in arsenals and explosives manufacturing plants, and also where combustible chemicals exist in admixture with air or oxygen such as in chemical plants and hospital operating rooms.

The problem in hospital operating rooms is particularly serious and has received a great deal of attention in the past. Certain anesthetic gases such as cyclopropane, ethyl chloride, ethyl ether and ethylene can form violently explosive mixtures with air or oxygen. Fatal accidents which have been attributed to ignition of these mixtures as a result of an electrostatic spark discharge have occurred. For this reason, the National Board of Fire Underwriters has set forth rules governing safe practice for hospital operating rooms. One of the principal series of rules relates to the type of flooring which should be used in such locations. The code calls for the use of static-conductive flooring which must have a resistance of less than 1,000,000 ohms as measured between two electrodes placed three feet apart on the floor, but which must have a resistance of more than 25,000 ohms as measured between a ground connection and any point on the floor and also between two electrodes spaced three feet apart on the floor.

The above requirements set forth both a lower limit and an upper limit for resistance. The need for an upper limit is obvious, since this requirement assures that static charges will be conducted away and dissipated. The requirement for a lower limit is of equal importance. If the floor were constructed of aluminum or iron, or other low resistance material, there would be a great hazard to personnel from electric shocks from the electric equipment within the room.

The static-conductive flooring material which is used to satisfy this code conventionally contains graphite as a conductor. One widely used type of conductive flooring is made by adding graphite to conventional linoleum composition, thus producing a conductive linoleum. As is well known, linoleum possesses unusual resistance to wear with resulting long service life. There are, however, several disadvantages which are encountered when one attempts to make linoleum conductive by adding graphite to the product.

One such disadvantage is that the resistance characteristics of a linoleum-graphite blend change considerably during the seasoning or stoving of the linoleum product. Thus it is not infrequently found that a conductive linoleum sheet which falls within the limits for safe use in hospital operating rooms at the time it is first

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formed will exhibit such a great change in resistance during stoving as not to pass the specifications when the product is ready for installation. It thus becomes extremely difficult to determine the proper proportions of graphite in the linoleum composition in view of this great change in resistance during stoving. It is also found that this change in resistance continues after the product is installed; thus it is not uncommon for hospital operating room floors to possess unacceptable resistance characteristics after only one or two years in service, necessitating installation of a new flooring at considerable expense. It is apparent that there is great need for a flooring material which will possess good wearing characteristics and which will also have a stable resistance value during its life.

It is an object of the invention to provide a static-conductive linoleum characterized by having a stable resistance during cure. It is a further object of the invention to provide a static-conductive flooring which will maintain acceptable electrical properties for long periods of time. Other objects and the advantages of the invention will appear hereinafter.

In the drawing, FIGURES 1 and 2 graphically represent the conductive linoleum resistance characteristics of the various compositions disclosed.

In accordance with the invention, a static-conductive resilient floor covering composition having stable resistance characteristics is prepared by incorporating in the floor covering composition a blend of graphitic carbon and amorphous carbon.

This invention is particularly applicable to resilient floor covering compositions, such as linoleum. Linoleum is conventionally produced by mixing a linoleum binder with fillers, pigments, stabilizers and the like and then calendaring into a sheet, followed by curing for extended periods of time. The linoleum binder or cement is formulated from drying oils such as linseed oil, soy bean oil, tung oil, China-wood oil and the like and resins such as rosin, ester gum, kauri gum, dammar and the like. These oils and resins are processed in the conventional manner for the formulation of a linoleum binder, that is, the oils are oxidized in the presence of air to high viscosity and blended with the resins to make the finished cement. The resins can be added to the oils either before, after or during the oxidation. The oxidation can be carried out in the presence of driers such as litharge, manganese resinate and the like. Normally, oxidation is carried out at a temperature between 120° F. and 240° F. for from 8 to 30 hours.

Although linoleum is the preferred floor covering composition used in accordance with the invention, other plastic compositions can be used containing synthetic resinous binders such as plasticized vinyl resins including polyvinyl chloride, polyvinyl acetate, vinyl chloride-vinyl acetate copolymer and the like plasticized with such materials as tricresyl phosphate, dioctyl phthalate, dicapryl phthalate, dibutyl sebacate and the like. Also, such thermosetting elastomers as butadiene-styrene, butadiene-acrylonitrile and the like are applicable as resinous binders.

The plastic composition for the floor covering is prepared by blending the linoleum binder or synthetic resinous binder with conventional fillers such as wood flour, calcium carbonate, calcium sulfate, talc, clay, dolomite, mica, silica, barytes, slate flour, asbestos, cork and the like. Lubricants such as stearic acid, metal stearates and the like, and stabilizers, such as basic lead carbonate, basic lead stearate and the like, can be present in small quantities.

The floor covering composition is made static conductive by adding a blend of graphitic and amorphous carbon to the composition.

Graphitic carbon is characterized by possessing a high

degree of crystallinity. In the case of naturally occurring graphite crystallinity can be considered 100 percent and synthetic graphites can closely approach this value. The crystal structure of either type of graphitic carbon consists of sheets of platelets appearing in the hexagonal crystal system. The specific gravity of graphitic carbon is 2.26. Natural graphite is widely distributed and is commercially mined in large quantities. Artificial graphite can be produced by a high temperature process, for example, the heating of a mixture of resinous binder and coke for several days in an electric furnace. Either natural or artificial graphite can be used as the graphitic carbon in accordance with the invention.

Amorphous carbon is characterized by a substantial absence of crystallinity and a specific gravity of less than 2.18. It can therefore be readily distinguished from graphitic carbon by its ability to float in ethylene bromide (specific gravity of 2.18) whereas graphitic carbon sinks and by X-ray diffraction which permits determination of degree of crystallinity. Amorphous carbon is exemplified by such materials as charcoal, coke and carbon black or lamp black. Carbon black is preferred in the composition of the invention due to its high conductivity. Typical carbon blacks include furnace black, which is made by the partial combustion of carbonaceous fuels such as oil or natural gas, and acetylene black, which is made by the continuous thermal decomposition of acetylene.

A surface covering with suitable properties of strength, resilience and wear resistance and which also has a resistance value within the limits set by the National Board of Fire Underwriters' rules comprises about 15 to about 50 percent binder, about 10 to about 35 percent of a blend of graphitic carbon and amorphous carbon, and the balance filler. A preferred conductive linoleum in accordance with the invention comprises 35 to 45 percent binder (which consists of oxidized drying oils with from 15 to 35 percent resin), 20 to 30 percent of a blend of graphitic carbon and amorphous carbon, and the balance filler. A surface covering having a substantially stable resistance value both during processing and after installation results when the blend is about 25 to about 70 percent amorphous carbon and about 75 to about 30 percent graphitic carbon, although maximum stability is attained with a blend of 30 to 40 percent amorphous carbon and 70 to 60 percent graphitic carbon.

In the formation of a conductive surface covering in accordance with the invention, the mixture of binder, filler, and blend of graphitic carbon and amorphous carbon is processed in the conventional manner. In the case of linoleum, the processed composition commonly calendered between calender rolls in which the composition is laminated or keyed or imbedded to a backing such as burlap. Enhanced resistance stability in the product can be attained if the backing is itself conductive, as by the incorporation of conductive particles such as carbon within the fibers of the backing. The sheet is then cured by heating at about 140° to 180° F. for from about 3 to 8 weeks. The finished product can be used in the form of a sheet or it can be cut up into individual tiles.

Surface coverings comprising plasticized thermoplastic resins or elastomeric resins require no long cure prior to use, but are available after sheet formation. Sheets from plastic compositions containing synthetic resins can be formed by calendering between rolls, or by pressing the plastic composition while maintaining it at a high temperature so that fusion of the resin, in the case of plasticized thermoplastic resins, or cross-linking, in the case of thermosetting resins, occurs simultaneously with sheet formation. These products are most commonly used in the form of tiles and can, in some instances, have a laminated backing such as felt or burlap.

The following examples are given for purposes of illustration.

EXAMPLE 1

A linoleum cement was prepared by heating a mixture

of 130 parts linseed oil, 23.2 parts of rosin, 1.7 parts litharge and 0.1 part manganese resinate in the presence of air at a temperature of 180° F. for 11 hours to form a linoleum cement.

To the oxidized cement (155 parts) was added 100 parts wood flour, 17 parts ground limestone, 3 parts stearic acid, and as conductive ingredients, 69 parts synthetic graphite and 23 parts furnace carbon black.

This composition was formed into a sheet in the conventional manner by blending in a Banbury, extruding, sheeting between calender rolls, and then laminating to a burlap backing. The linoleum composition contained 25 percent of a blend of 75 percent graphitic carbon and 25 percent amorphous carbon.

The linoleum sheet was cured (stoved) by being held at 170° F. for an extended period of time until the sheet had the requisite hardness and strength required of finished linoleum.

Periodically during the stoving, the resistance of the sheet was tested according to the procedure outlined in Section 6-2 of pamphlet NBFU No. 56 entitled "Recommended Safe Practice of the National Board of Fire Underwriters for Hospital Operating Rooms," published in June 1954. In this test, a suitably calibrated ohmmeter with an open circuit potential of 500 volts D.C. and a short circuit current of 2.5 to 10 milliamperes is used. Each electrode weighs 5 pounds and has a flat, dry, circular contact area 2½ inches in diameter which comprises a surface of aluminum or tin foil 0.0005 to 0.001 inch thick backed by a layer of rubber ¼ inch thick and measuring 50 plus or minus 10 hardness as determined with a Shore type A durometer. In making the test, the electrodes are placed 3 feet apart on the sheet.

The measured resistance values at different times during the stoving are shown below.

Resistance (1000 ohms):	Time since start of cure (days)
55	7
55	11
45	15
55	25
35	33
60	43
50	50

Substantially constant resistance during stoving was observed.

EXAMPLE 2

A conductive linoleum composition was prepared in accordance with the composition and procedure given in Example 1, except that 70 percent furnace carbon black and 30 percent synthetic graphite was utilized to give a total of 92 parts of conductive material in the composition. The measured resistance values at different times during the stoving are shown below.

Resistance (1000 ohms):	Time since start of cure (days)
150	1
120	7
120	14
130	20
145	27
155	35
160	41
170	48
170	55

EXAMPLE 3

A conductive linoleum composition exemplifying that of the prior art was made with the same composition as indicated in Example 1 except that the conductive ingredient consisted solely of 81 parts of synthetic graphite.

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The composition thus contained 23 percent conductive carbon which was 100 percent graphitic carbon.

The linoleum composition was sheeted and laminated to a burlap backing and the product then was cured at 170° F. Periodically during the stoving, the resistance of the sheet was tested according to the standard procedure outlined in Example 1.

The measured resistance values at different times during the stoving are shown below.

Resistance (1000 ohms):	Time since start of cure (days)
610	5
350	7
175	12
130	18
110	24
80	47

A steady reduction in resistance was observed during the cure.

EXAMPLE 4

The following two conductive linoleum compositions were prepared in accordance with Example 1 to show that blends of graphite with smaller amounts of carbon black are not stable in resistance:

Batch Number	Parts by Weight	
	A	B
Linoleum Cement ¹	930	930
Wood Flour	600	600
Stearic Acid	14	14
Limestone	150	150
Graphite	432 (80%)	450 (79%)
Carbon Black	108 (20%)	120 (21%)

¹ A mixture of 130 parts linseed oil, 23.2 parts rosin, 1.7 parts litharge and 0.1 part manganese resinate oxidized in the presence of air at 180° F. for 11 hours.

The measured resistance values at different times during the stoving are shown below.

Sheet Prepared From Batch A

Days of cure:	Resistance, 1000 ohms
1	1200
7	500
13	275
19	240
26	180
34	165
40	150
54	140
97	120

Sheet Prepared From Batch B

Days of cure:	Resistance, 1000 ohms
1	4500
2	1250
3	340
13	35
17	25
30	20
50	15

EXAMPLE 5

A conductive linoleum composition was made in accordance with the invention as indicated in Example 1 except that as conductive ingredients, a blend of 58 parts synthetic graphite and 38 parts furnace carbon black were used. The composition thus contained 26 percent conductive carbon which was 60 percent graphitic carbon and 40 percent amorphous carbon.

The linoleum composition was sheeted and laminated to a burlap backing. The product was cured at 170° F. until it possessed the necessary strength, hardness and

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flexibility characteristics of finished linoleum. The product was adhesively secured to a floor in a hospital operating room and subjected to the normal wear common in such locations.

Resistance measurements made according to the test procedure described in Example 1 immediately after installation and after a six-month interval showed a constant resistance of 140,000 ohms.

EXAMPLE 6

A conductive linoleum of the prior art where the conductive ingredient is 100 percent graphitic carbon (similar to the product of Example 3) was installed in a hospital operating room and the resistance measured at intervals according to the standard test procedure described in Example 1.

Resistance (1000 ohms):	Time after installation
480	1 week
275	3 months
135	8 months

A rapidly decreasing resistance value was observed.

A comparison between Examples 1 and 3 and Examples 5 and 6 are shown in FIGS. 1 and 2 respectively of the drawing. The lines designated as 1, 2, 3 and 4 refer to the products prepared in Examples 1, 3, 5 and 6, respectively. The conductive products made in accordance with the invention exhibit constant resistance characteristics during cure and after installation, whereas prior products show rapid change in resistance both during cure and after installation.

EXAMPLE 7

A sheet of burlap is impregnated with a 1 percent solution of a tetra alkyl quaternary ammonium chloride in water by dipping the cloth in the solution for 5 minutes at 100° F. The impregnated burlap is dried and then immersed in an agitated bath of a dispersion of 15 percent carbon black in water for 5 minutes. The cloth is washed, and then dried, thereby yielding a burlap with conductive carbon black particles embedded and locked within the fibers.

The conductive linoleum composition of Example 1 is laminated to the treated burlap and the product stoved for 6 weeks at 175° F. A static-conductive linoleum with a high degree of resistance stability when installed results.

Any departure from the above description which conforms to the present invention is intended to be included within the scope of the claims.

What is claimed is:

1. In an electrically conductive resilient surface covering having a resistance between 25,000 ohms and 1,000,000 ohms as measured between two electrodes spaced 3 feet apart on the upper surface of said covering which comprises about 15 percent to about 50 percent of a resilient plastic binder, about 10 percent to about 35 percent conductive carbon and the balance filler, the improvement which comprises utilizing as said conductive carbon a blend of about 75 percent to about 30 percent graphitic carbon and about 25 percent to about 70 percent amorphous carbon.

2. In an electrically conductive linoleum having a resistance between 25,000 ohms and 1,000,000 ohms as measured between two electrodes spaced 3 feet apart on the upper surface of said covering comprising a backing and bonded thereto a wear layer comprising about 15 percent to about 50 percent cured linoleum binder, about 10 percent to about 35 percent conductive carbon and the balance filler, the improvement which comprises utilizing as said conductive carbon a blend of about 75 percent to about 30 percent graphitic carbon and about 25 percent to about 70 percent amorphous carbon.

3. In an electrically conductive linoleum having a resistance between 25,000 ohms and 1,000,000 ohms as

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measured between two electrodes spaced 3 feet apart on the upper surface of said covering comprising a backing and bonded thereto a wear layer comprising 35 percent to 45 percent cured linoleum binder, about 10 percent to about 35 percent conductive carbon and the balance filler, the improvement which comprises utilizing as said conductive carbon a blend of about 75 percent to about 30 percent graphitic carbon and about 25 percent to about 70 percent amorphous carbon.

4. In an electrically conductive linoleum having a resistance between 25,000 ohms and 1,000,000 ohms as measured between two electrodes spaced 3 feet apart on the upper surface of said covering comprising a backing and bonded thereto a wear layer comprising 35 percent to 45 percent cured linoleum binder, about 10 percent to about 35 percent conductive carbon and the balance filler, the improvement which comprises utilizing as said conductive carbon a blend of 75 percent to 70 percent graphitic carbon and 25 percent to 30 percent amorphous carbon.

5. In an electrically conductive linoleum cement which comprises 35 percent to 45 percent uncured linoleum binder, about 10 percent to about 35 percent conductive carbon and the balance filler, the improvement which comprises utilizing as said conductive carbon a blend

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of about 75 percent to about 30 percent graphitic carbon and about 25 percent to about 70 percent amorphous carbon, thereby imparting to said conductive linoleum cement stability with respect to change in electrical resistance during cure.

6. In an electrically conductive linoleum cement which comprises 35 percent to 45 percent uncured linoleum binder, 20 percent to 30 percent conductive carbon and the balance filler, the improvement which comprises utilizing as said conductive carbon a blend of 75 percent to 70 percent graphitic carbon and 25 percent to 30 percent amorphous carbon, thereby imparting to said conductive linoleum cement stability with respect to change in electrical resistance during cure.

References Cited in the file of this patent

UNITED STATES PATENTS

1,875,735	Jackson	Sept. 6, 1932
2,287,766	Davis	June 30, 1942
2,302,003	Cadwell et al.	Nov. 17, 1942
2,325,414	McChesney et al.	July 27, 1943
2,341,360	Bulgin	Feb. 8, 1944
2,379,976	Maddock	July 10, 1945