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METHOD OF PRODUCING A COATED SHEET OF FABRIC

Samuel W. Strickman, Kew Gardens, N. Y., assignor to Gittlin Bag Company, Newark, N. J., a corporation of New Jersey

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The present invention relates to porous and flexible coated sheet materials and particularly to coated fabrics such as fibrous textile fabrics adapted for use in the manufacture of bags and for use as barrier materials. Such bags, barrier materials and the like are required to be impervious to vapors, gases and various liquids.

The principal object of the invention is to provide a two step coating process which will impart the necessary impermeability to standard woven fabrics by making tenacious and permanent bond with them.

Related objects are to accomplish the foregoing purposes efficiently and at low cost without appreciably impairing the flexibility of the base fabric.

A more specific object is to produce a coated fabric of the class described, by the use of a vinyl resin, a plasticizer and a stabilizer without employing any solvent and without requiring any unusually high temperatures or special equipment other than more or less standard coating and heating curing apparatus.

A particular object is to provide a method of applying the coating by two similar but specifically different steps, for the purpose of reducing to a minimum the amount of coating material used, with resulting economy in respect of cost and with preservation of a high degree of flexibility and pliability of the base fabric or other sheet material, and in order to enhance penetration of the intracellular structure of the fibers, so that when the coated material is cured the vinyl resin is well anchored in the fabric.

Other objects and advantages of the invention will be apparent to those skilled in the art as the description herein of a preferred embodiment proceeds.

The principles of the invention may be practiced as follows:

A base fabric material is selected in accordance with whatever specifications may be required of the final product. Thus, the base fabric may be, for example, any standard weave of burlap or cotton, or other natural or artificial fibers.

A coating mixture is made up of the following ingredients:

	Per cent by weight
Polyvinyl chloride-acetate	55
Dioctylphthalate (DOP)	40
"Plumb-O-Sil" *	5

* "Plumb-O-Sil" is a powdered lead orthosilicate sold by National Lead Company, of New York, N. Y.

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The polyvinyl chloride-acetate is used in powder form and constitutes the resinous base of the coating composition. The DOP is the plasticizer, and is used in liquid form.

The three ingredients are mixed and well stirred to provide a uniform and homogeneous suspension. It has a viscosity of 5,000 to 7,000 centipoises at room temperature, and should be kept substantially at room temperature until used. It is stable and keeps well, requiring no special care to preserve it for any reasonable time.

When the foregoing mixture is to be used for the initial coating operation, there is added to it an equal quantity by weight of DOP. The resulting mixture has at room temperature a viscosity of less than 1,000 centipoises, say between 500 and 600.

It is this mixture of the basic coating composition (initially described as a coating mixture but the second in point of time of application) plus the added DOP that is used for the first of the two coating operations. I prefer to make the application by conventional roller coating technique in which a film of the liquid is applied to the fabric sheet as fabric passes between rollers so that the fabric becomes thoroughly impregnated. All the excess liquid that can be mechanically removed, as by passing the coated sheet under a doctor blade, is then scraped off. This results in using a minimum quantity of the coating material, with resulting economy and extremely firm bonding onto and into the fibers of the fabric. The fibers become well permeated by the liquid, and a thin surface layer is formed on the fabric sheet. The superficial appearance of the fabric may or may not remain substantially unchanged, and, depending on the absorption qualities of the fiber and the intercellular spaces, a continuous coating may or may not be discernible on the fabric surface. Some of the interstices between the crossed yarns become filled with the liquid. The degree to which these interstices are filled depends, of course, on the fineness of the mesh. In the case of 7½ ounce burlap the interstices will be largely, but not completely, filled. Finer mesh cloth will show completely filled interstices, while coarser fabric will have more openings left in it.

The initially impregnated sheet is then heated to cure the coating. This is readily accomplished by raising the temperature throughout the resin and plastic mix to approximately 350° F. for a minimum of about 30 seconds, as by passing the sheet under a conventional bank of infra-red

heating lamps. Other methods and apparatus for applying the required heat may be substituted without affecting the result, which is the curing of the coating to produce a dry, stable, flexible and tenaciously anchored thin surface coating penetrating deeply into the fibers. The coated sheet is then allowed to cool down to room temperature.

To the initially coated sheet, which in most cases, depending on the mesh of the fabric, will have some of its original interstices still open or not sufficiently filled to provide a good, durable seal, there is applied a second and final coating. The material for this second application is the composition originally described, without addition of any further DOP. That is to say, I use the well mixed suspension of 55% of the resin, 40% DOP, and 5% "Plumb-O-Sil." The application may be made in the same way, and by the same equipment, as the first coating. However, where a doctor blade or the equivalent is used, adjustment should be made to leave a superficial surface layer of approximately 0.001 inch deposited on top of the first coating. This will fill all the previously unfilled, or thinly filled, interstices, and the result is good covering of all the yarn and of all the original openings. The second coating is cured in the same way and by the same apparatus as the first.

The product thus completed is found to consist of a virtually single coating of cured copolymerized vinyl chloride-acetate resin irremovably anchored to the fibers of the base fabric. The two separate applications of coating material have become inseparably bonded together into a unitary layer by what is apparently a two-way migration of the plasticizer and resin. That is to say, surface portions of each of the two layers penetrate into each other between the time of the second coating and the time of the second curing step, or possibly during the second curing step, so that the entire quantity of coated material becomes integrated into a vertically single layer, which layer, it will be recalled, is firmly anchored to the fabric by penetration of the initial coating into the intracellular structure of the fibers.

This layer is found to be stable under the most severe conditions. It is impermeable to water and most liquids and their vapors and to most gases. It is highly flexible and introduces no appreciable stiffness or rigidity into the original base fabric. Consequently the finished sheet can be fabricated into bags, sacks, tubes or any other type of container or enclosure for which the original fabric was adapted, and this fabrication can be effected by sewing, by the use of adhesive or in any other manner that is practical on uncoated fabric. Moreover, the finished sheet may be heat-sealed and otherwise secured in the same manner as an unsupported or unbacked vinyl resin film or sheet. And in addition to acquiring the impermeability which is an important object of the invention, the fabric sheet has been improved in respect to other desirable physical properties, including flexibility, tensile strength and elasticity.

It is to be noted that an important advantage of dividing the coating application into two steps or operations, comprising a first one using a very thin liquid and a second one using a heavier or more viscous liquid, is the ability to provide deep and firm anchorage in the fibers without using an excessive quantity of resin. The cost of the product is thus materially reduced because the saving in material expense greatly exceeds the cost of the double coating steps. Moreover, the composite double coating, being thinner than a singly applied coating having the same degree of impermeability, adds less stiffness and rigidity to the base fabric and thus makes the final product superior in respect of retention of desirable physical characteristics.

It is to be noted that the resinous material, which is used in powdered form, does not dissolve in the liquid, but forms a suspension. On heating during the curing step the powder particles break down and blend intimately with the plasticizer, forming a very homogeneous solid mixture.

The proportions stated in the formula hereinabove are not critical and need not be followed exactly. However, for best results, in practice of the method which has been explained by way of example, I have found that the weight of the resin in the basic coating composition (second in point of time of application) should not be less than 40% and not more than about 58%, and the weight of the plasticizer should range between 37% and 55%. The stabilizer for the resin should be used in about 5%. It will be understood that varying the proportions of the resin and plasticizer produces compositions of different viscosities, thus permitting the use of different applying techniques, such for example, as calendering.

The very thin liquid which constitutes the coating which is applied directly to the fabric and is the one applied therefore in the first step of the process, is formed by adding an amount of the liquid plasticizer in an amount substantially equal to the combined weight of the three components set out in the preceding paragraph. Thus, expressed in parts by weight, this coating composition would be composed of: 40–53 parts of the resin, 137–155 parts of the plasticizer and 5 parts of the stabilizer for the resin.

In place of the preferred polyvinyl chloride-acetate, polyvinyl chloride may be substituted. In such case an appropriate plasticizer and stabilizer will be added, and the same processes of application can be used.

Other plasticizers which may be used in place of the preferred DOP include the Paraplex series sold by Rohm Haas Company, of Philadelphia, Pa., including Paraplex G–40, G–50, and G–60; the former two being linear polyesters of a glycol and an aliphatic dibasic acid of the type described in U. S. Patent No. 1, 779,367 and the last being a product of the type described in U. S. Patent No. 2,569,502; "Flexricin P–4" which is methyl acetyl recinoleate, and "Flexricin P–6" which is butyl acetyl recinoleate, sold by Baker Castor Oil Company, of New York, New York; the Saniticizer series, including "Saniticizer 140" which is cresyl diphenyl phosphate, sold by Monsanto Chemical Company, of St. Louis, Mo.; or tricresyl phosphate or dibutyl phthalate may be used.

It may be stated here that the invention can be practiced with any plasticizer that is compatible with the resin, i. e., any plasticizer that will blend with it to form a plasticizol, which is a mixture having a suspension of dispersed resin particles therein, with no solvent, and which is curable on heating.

In substitution for the recommended and preferred stabilizer I may use any stabilizer which will prevent breakdown of the resin and liberation of free hydrochloric acid. Acceptacle stabilizers include Stabilizers #3,E–6B and V–1–N, all of which are products of Advance Solvents Co., of New York, N. Y. Stabilizer #3 is covered in U. S.

Patent No. 2,592,926. Stabilizer E–6B is understood to be an epoxy type stabilizer. Stabilizer V–1–N is covered in U. S. Patent No. 2,510,035.

I claim:

1. In the method of producing a coated sheet of fabric, the steps of applying to a porous, flexible fabric sheet a first coating having a viscosity of less than 1,000 centipoises at room temperature which is a homogeneous suspension consisting essentially of approximately: 55 parts of powdered polyvinyl chloride-acetate and 5 parts of powdered lead orthosilicate in suspension in 140 parts of dioctylphthalate, each by weight, whereby the fabric sheet is thoroughly impregnated, and a thin surface layer is formed thereon, then heating to cure the coating and produce a dry, tenaciously anchored thin surface coating, cooling the coated fabric sheet to substantially room temperature, thereafter applying a second coating having a viscosity of 5,000–7,000 centipoises at room temperature which is a homogeneous suspension consisting essentially of approximately: 55 parts of powdered polyvinyl chloride-acetate and 5 parts of powdered lead orthosilicate in suspension in 40 parts of dioctylphthalate, each by weight, thereafter heat curing the second coating, the resulting coated material on the fabric being bonded together into a unitary layer and firmly anchored to the fabric.

2. In the method of producing a coated sheet of fabric, the steps of applying to a porous, flexible fabric sheet a first coating having a viscosity of less than 1,000 centipoises at room temperature which is a homogeneous suspension consisting essentially of approximately: 55 parts by weight of powdered resin from the group consisting of polyvinyl chloride-acetate and polyvinyl chloride, and 5 parts by weight of a powdered stabilizer for said resin in suspension in 140 parts by weight of dioctyl phthalate, whereby the fabric sheet is thoroughly impregnated, and a thin surface layer is formed thereon, then heating to cure the coating and produce a dry, tenaciously anchored thin surface coating, cooling the coated fabric sheet to substantially room temperature, thereafter applying a second coating having a viscosity of 5,000–7,000 centipoises at room temperature which is a homogeneous suspension consisting essentially of approximately: 55 parts by weight of resin from the group consisting of polyvinyl chloride-acetate and polyvinyl chloride and 5 parts by weight of a stabilizer for said resin in 40 parts by weight of dioctylphthalate, thereafter heat curing the second coating, the resulting coated material on the fabric being bonded together into a unitary layer and firmly anchored to the fabric.

3. In the method of producing a coated sheet of fabric, the steps of applying to a porous, flexible fabric sheet a first coating having the viscosity of less than 1,000 centipoises at room temperature which is a homogeneous suspension consisting essentially of approximately 40–58 parts of the powdered resin from the group consisting of polyvinyl chloride-acetate and polyvinyl chloride, and 5 parts of a powdered stabilizer for the resin, 137–155 parts of a liquid plasticizer, each by weight, whereby the fabric sheet is thoroughly impregnated, and a thin surface layer is formed thereon, then heating to cure the coating and produce a dry, tenaciously anchored thin surface coating, cooling the coated fabric sheet to substantially room temperature, thereafter applying a second coating having a viscosity of 5,000 to 7,000 centipoises at room temperature which is a homogeneous suspension consisting essentially of approximately 40 to 50 parts of powdered resin from the group consisting of polyvinyl chloride-acetate and polyvinyl chloride, and 5 parts of a powdered stabilizer for said resin in 37 to 55 parts of a liquid plasticizer, each by weight, thereafter heat curing the second coating, the resulting coated material on the fabric being bonded together into a unitary layer and firmly anchored to the fabric.

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