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FORMABLE COATED SHEET MATERIALS

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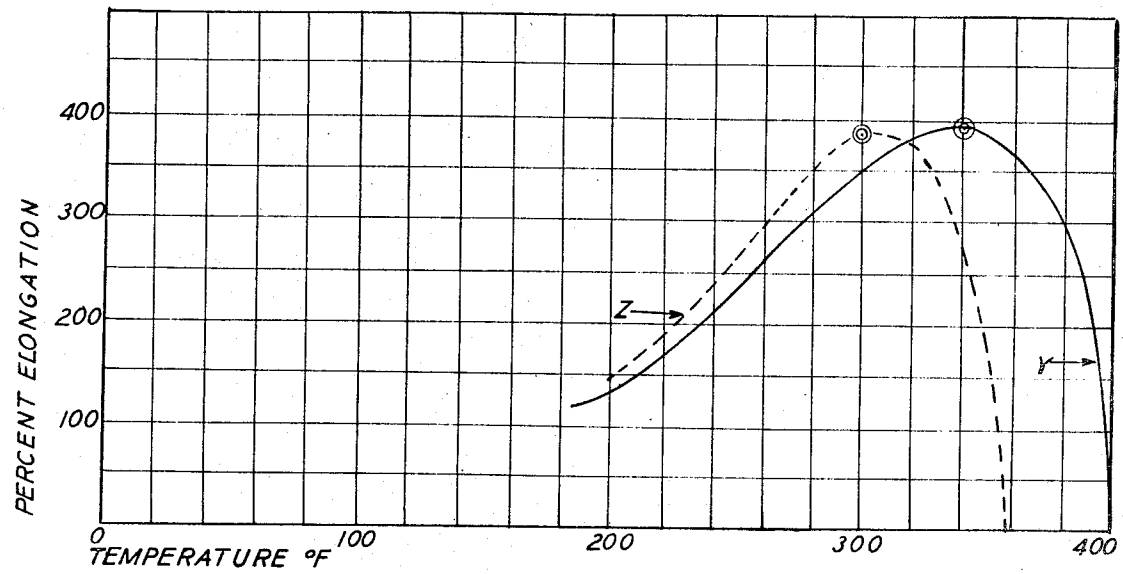


FIG. 1

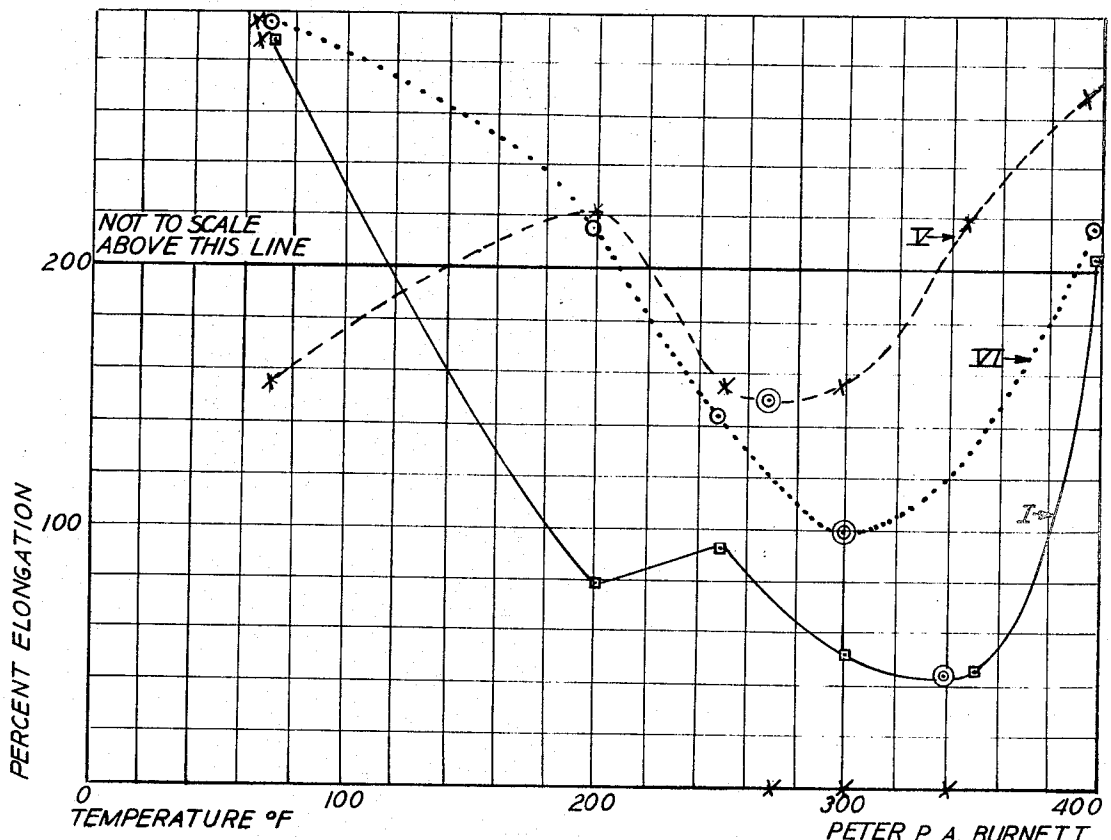


FIG. 2

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FORMABLE COATED SHEET MATERIALS

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ABSTRACT OF THE DISCLOSURE

These sheet materials comprise a polymeric coating adhered to a fabric, with the minimum elongation temperature of the coating being within about 50 Fahrenheit degrees of the maximum elongation temperature of the fabric. The coating is a terpolymer consisting essentially of acrylonitrile, butadiene, and styrene units, blended with polyvinyl chloride and the fabric is made of synthetic fiber preferably containing at least 35 weight percent of acrylonitrile units. Using vacuum forming techniques, the sheet materials can be formed into an integral covering shaped to the top and sides of automotive and household seats without significantly obliterating embossed surface patterns or losing tensile strength, tear strength and softness.

SUMMARY OF THE INVENTION

In the past, sheet materials embossed with various patterns have been used as decorative coverings in a variety of applications. Where the application requires some forming of the material, the most economical manufacturing method embosses the pattern prior to the forming steps. Sheet materials requiring only moderate forming to reach the final shape usually comprised a backing fabric that imparted good tensile and tear strength. Final shapes requiring extensive forming of the embossed sheet material precluded the use of integral backing fabrics because during the forming process the backing fabrics tend to tear, stiffen the hand of the material, or show through the decorative embossment as clothiness. Sheet materials intended for extensive forming, therefore, were made without an integral backing fabric and lacked significant tensile and tear strength. Furthermore, these materials could not be formed extensively without serious blurring or entire obliteration of the embossed pattern and it was necessary then to provide an embossing configuration in the forming molds, thereby increasing tremendously the cost of the molds.

Sheet materials of this invention have excellent formability in addition to having a backing fabric with the high tensile and tear strength provided thereby, and the materials retain previously embossed surface patterns despite extensive forming. Adhered to one side of the backing fabric of these sheet materials is a polymeric coating comprising a blend of a polyvinyl material with an interpolymer consisting essentially of acrylonitrile units, butadiene units, and styrene units. The minimum elongation temperature of the coating is within about 50

Fahrenheit degrees of the maximum elongation temperature of the fabric.

An improved combination of properties is obtained when the fabric has a maximum elongation exceeding 300 percent over a broad range; for example, those fabrics made from fiber comprising at least 85 percent by weight of acrylonitrile units. Sheet materials in which the minimum elongation temperature of the coating is within 10 Fahrenheit degrees of the maximum elongation temperature of the fabric have the best formability.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a graph showing the percent elongation versus temperature of two fabrics useful in this invention. FIG. 2 is a graph showing the percent elongation of several coatings useful in this invention. FIGS. 1 and 2 were obtained by plotting data obtained from a Tinius Olson Tensile Machine in the following manner. First, the fabric or coating to be tested is placed between the jaws of the machine of an environmental chamber. Heat supplied to the chamber raises the temperature of the sample to the test temperature, which is the abscissa of the graphs. One jaw then is moved at a constant speed away from the other jaw until the sample fails, and the distance between the jaws at failure is divided by the initial distance to obtain percent elongation, the ordinate.

DETAILED DESCRIPTION

The curve designated by the letter Y in FIG. 1 represents a fabric made from fiber comprising at least 85 percent by weight of acrylonitrile units. Such fibers are known in the trade as acrylics. At temperatures between about 280 and 380° F., elongation of the fabric exceeds 300 percent. Maximum elongation is about 380 percent and it occurs at a temperature of about 340° F., which is designated by two concentric circles on the curve.

Designated by the letter Z in FIG. 1 is a curve representing a fabric made from fiber comprising 35 to 85 percent by weight of acrylonitrile units. Such fibers are known in the trade as modacrylics. At temperatures between about 275 and 335° F., elongation of the fabric exceeds 300 percent. Maximum elongation is about 370 percent and it occurs at a temperature of about 300° F. Other useful fibers include the polyamides, polyolefins such as polyethylene and polypropylene, polyesters such as esters of a dihydric alcohol and terephthalic acid, polyvinyl chloride, polyvinylidene chloride, polyurethanes, etc. The acrylic and modacrylic fibers are preferred in this invention, however, because they produce sheet materials having the best combination of properties.

Woven, knitted, or intertangled fabrics can be used in the sheet materials of this invention. Knitted fabrics are preferred over woven fabrics because of higher percentage stretch properties. Natural fibers can be used in the fabrics, although synthetic fibers are preferred because of the higher percentage stretch properties produced thereby. Best results are obtained when synthetic fibers constitute at least 45 weight percent of the fabric.

The coating curves in FIG. 2 are designated by Roman numerals I, V and VI that correspond to the number of the example in which preparation of the compounds they represent is described. Each coating represented in FIG. 2 is a blend of a polyvinyl material with an interpolymer of acrylonitrile, butadiene and styrene and has a minimum

elongation point designated by concentric circles on the curves.

Polyvinyl chloride is used usually as the polyvinyl material of the polymeric coating, although other polyvinyl materials such as polyvinyl acetate, polyvinyl alcohol, etc., can be used. Coatings in which the proportion of polyvinyl material to interpolymer ranges between about 1:4 and 19:1 have the best embossment retention properties. Interpolymers of acrylonitrile, butadiene and styrene are available commercially from a number of companies including the Marbon Division of Borg-Warner Corporation and the Naugatuck Chemical Division of the U.S. Rubber Company.

An adhesive can be used to adhere the coating to the fabric. A typical adhesive is made from a terpolymer of polyvinyl chloride, polyvinyl acetate, and maleic acid units blended with a plasticizer and a stabilizer. Di-octyl or di-isodecyl phthalate are useful plasticizers, and a barium-cadmium soap is a useful stabilizer. Methyl ethyl ketone can be used as a vehicle for applying the adhesive. Other useful adhesives include the plastisols and the isocyanate-vinyl copolymer adhesive disclosed in U.S. Pat. 3,067,085.

Sheet materials of this invention can be made by calendering the polymeric coating into a sheet by conventional means, applying adhesive to either the sheet or the fabric, and laminating the sheet to the fabric with pressure and temperature. A surface pattern can be embossed in the coating prior to, during, or after the laminating step.

Ordinarily the embossed sheet material is formed into its desired shape by vacuum forming methods. A typical forming method uses a vacuum forming machine having both top and bottom heaters. The sheet material is placed in the mold and heat is supplied thereto from both heaters for an empirically determined length of time. Heater temperature also is determined empirically; typical values of temperature and time are included in the table. Vacuum then is applied to form the material on the mold.

Additional details of formulating the sheet materials of this invention appear in the following specific examples. Data in the table following the examples was obtained from comparative forming tests of sheet materials prepared according to the examples. The sheet materials were embossed with a decorative pattern and formed over a cube 3 inches on a side with the top rounded to meet the sides in a 0.25 inch radius. In the examples all parts are by weight unless specified otherwise.

Example I

Fifty parts of polyvinyl chloride resin sold as PVC 450 by the Diamond Alkali Company are mixed thoroughly with an ABS resin made up of 12.5 parts Kralastic 2516A, 6.25 parts Kralastic 2590, and 31.25 parts of Paracril 2806 sold by the U.S. Rubber Company, Naugatuck, Conn. Ten parts of titanium oxide pigment and 0.3 part of stearic acid lubricant are added to the mixture followed by 30 parts of di-isodecyl phthalate plasticizer and 4 parts of a barium-cadmium stabilizer (the stabilizer consists of 6 parts Ferro 1212 sold by the Ferro Chemical Company and one part Mark PL sold by the Argus Chemical Company). This mixture is milled on a two roll hot mill for about fifteen minutes at 320–330° F. stock temperature and then calendered into a coating that has the elongation properties of the curve designated by the numeral I in FIG. 2. The temperature of minimum elongation is about 340° F.

An adhesive is prepared from 100 parts of a terpolymer of polyvinyl chloride, polyvinyl acetate, and maleic acid sold as VMCH–3 by the Union Carbide Chemical Company, 60 parts of di-octyl phthalate, 3.5 parts of Ferro 1212 stabilizer, and 250 parts of methyl ethyl ketone. About 0.3 ounce dry weight per square yard of the adhesive is spread on a knitted acrylic fabric weighing about 6.4 ounces per square yard and having the elongation properties of the curve designated by the letter Y in FIG. 1.

Adhesion of the coating to the fabric is obtained by heating the coating to about 320° F. and running the coating and the fabric between embossing rolls applying about 200 p.s.i. The resulting sheet material is designated Sample I in the table and is useful as an integral covering for automotive seats.

For comparison purposes, a coating made solely of polyvinyl chloride was prepared by mixing 100 parts of polyvinyl chloride resin (PVC 450) with 65 parts of di-isodecyl phthalate, 3.5 parts of the barium cadmium stabilizer used in the above coating, 25 parts of calcium carbonate, 10 parts of titanium dioxide and 0.5 part of stearic acid. The mixture was milled on a two roll hot mill, calendered into a sheet and cut into two portions. One portion was bonded to a woven cotton fabric and the other was bonded to a knitted cotton fabric. The resulting sheet materials are designated Samples A and B, respectively, in the table.

Example II

The ABS/PVC coating prepared in Example I is adhered using the adhesive to a woven acrylic fabric made from the same fiber as the knitted fabric of Example I. Sample II in the table summarizes the properties of the resulting sheet material.

Example III

The ABS/PVC coating prepared in Example I is adhered to the woven cotton fabric used for Sample A. Sample III in the table summarizes the properties.

Example IV

The ABS/PVC coating prepared in Example I is adhered to the knitted cotton fabric used for Sample B. Sample IV in the table summarizes its properties.

Example V

One hundred parts of polyvinyl chloride (PVC 40 sold by the Diamond Alkali Company) is mixed thoroughly with 75 parts of an ABS resin sold as Blendex 111 by the Marbon Chemical Division of Borg-Warner Corporation, 70 parts of di-isodecyl phthalate, 10 parts of titanium dioxide, 11 parts of the barium-cadmium stabilizer mixture used in Example I, and 0.5 part of stearic acid. Milling and calendering produce a coating having the elongation properties of the curve designated by the numeral V in FIG. 2. The temperature of minimum elongation is about 270° F.

The coating is adhered to the woven acrylic fabric used in Example II by the technique of Example I. Sample V in the table summarizes its properties.

Example VI

One hundred parts of polyvinyl chloride sold as QYSC–5 by the Union Carbide Company is mixed with 75 parts of an ABS resin sold as Blendex 121 by the Marbon Chemical Division, 75 parts of a butadiene-acrylonitrile resin sold as Paracril 2806 by the U.S. Rubber Company, and the same amounts of di-isodecyl phthalate, titanium dioxide, barium-cadmium stabilizer and stearic acid used in Example V. Milling and calendering produce a coating having the elongation properties of the curve designated by the numeral VI in FIG. 2. The temperature of minimum elongation is about 300° F.

The coating is adhered to the woven acrylic fabric used in Example II by the technique of Example I. Sample VI in the table summarizes its properties.

Example VII

The ABS/PVC coating prepared in Example I is adhered using the adhesive to a knitted fabric made from modacrylic fibers and having the elongation properties

designated by curve Z in FIG. 1. Sample VII in the table summarizes the properties.

TABLE

Sample	Coating, minimum elopgation, temperature ° F	Fabric, maximum elongation, temperature, ° F.	Forming conditions: Top heater, ° F.	Forming conditions: Bottom heater, ° F.	Forming conditions: Time (min.)	Results: Formability	Results: Stiffening	Results: Surface clothiness defects	Results: Embossment Retention	Results: Coating integrity
A	PVC	Woven cotton	400	1,000	1.0	Poor	No	Bad	Poor	Coating pulled into fabric and coating and fabric rupture.
B	PVC	Knitted cotton	400	1,000	1.0	do	No	Bad	do	
I	340	340	600	975	0.6	Good	No	None	Good	Good.
II	340	340	760	1,040	0.6	do	No	do	do	Do.
III	340	Woven cotton	400	1,000	1.0	Poor	No	do	Good	Coating pulled into fabric and coating and fabric rupture.
IV	340	Knitted cotton	400	1,000	1.0	do	No	do	do	
V	270	340	750	1,000	0.6	Good	No	Excessive	Fair	Good.
VI	300	340	750	1,000	0.6	do	No	Slight	Good	Do.
VII	340	300	500	1,000	0.6	do	No	None	do	Do.

As shown in the table, sheet materials designated Samples I and II had a good combination of properties including formability and embossment retention. The minimum elongation temperature of the coating is within 10 Fahrenheit degrees of the maximum elongation temperature of the fabric, and the fabric is made from fibers comprising at least 85 percent by weight of acrylonitrile units. These sheet materials are useful in forming integral coverings for the top and sides of automotive and household seats. Sample VI has a coating minimum elongation temperature about 40 Fahrenheit degrees less than the fabric maximum elongation temperature and is useful for moderate forming although a slight surface deterioration occurs during extensive forming. Sample VII has a coating minimum elongation temperature about 40 Fahrenheit degrees greater than the fabric maximum elongation temperature and is useful for moderate forming also. Sample V has a coating minimum elongation temperature 70 Fahrenheit degrees less than the maximum elongation temperature of the fabric, and although its formability is good, embossment retention is unacceptable.

What is claimed is:

1. A formable sheet material comprising

a fabric which is made from fiber comprising at least 35 percent by weight of acrylonitrile units having a percent elongation at failure that increases with increasing temperature to a maximum percent elongation at a certain temperature and decreases with increasing temperature beyond said certain temperature, and

a polymeric coating comprising a blend of polyvinyl material with an interpolymer consisting essentially of acrylonitrile, butadiene, and styrene adhered to one side of said fabric, said polymeric coating having a percent elongation at failure that decreases with increasing temperature to a minimum percent elongation at a certain temperature and increases with increasing temperature beyond that certain temperature, the temperature at which maximum percent elongation of the fabric occurs being within about 50 Fahrenheit degrees of the temperature at which minimum percent elongation of the coating occurs.

2. The sheet material of claim **1** in which the fabric is made from fiber comprising at least 85 percent by weight of acrylonitrile units.

3. The sheet material of claim **2** in which the fabric is knitted.

4. The sheet material of claim **3** in which the coating includes a plasticizer.

5. The sheet material of claim **4** in which the coating is adhered to the fabric by an adhesive consisting essentially of a terpolymer of vinyl chloride units, vinyl acetate units, and maleic acid units.

6. The sheet material of claim **5** in which the polyvinyl material is polyvinyl chloride.

7. The sheet material of claim **6** in which the minimum elongation temperature of the coating is within 10 Fahrenheit degrees of the maximum elongation temperature of the fabric.

8. The sheet material of claim **1** in which the fabric is made from fiber comprising at least 85 percent by weight of acrylonitrile units.

9. The sheet material of claim **1** in which the fabric is knitted.

10. The sheet material of claim **1** in which the coating is adhered to the fabric by an adhesive consisting essentially of a terpolymer of vinyl chloride units, vinyl acetate units, and maleic acid units.

11. A formable sheet material comprising

a fabric which is made from fiber comprising at least 35 percent by weight of acrylonitrile units having a percent elongation at failure that increases with increasing temperature to a maximum percent elongation at a certain temperature, and

a polymeric coating comprising a blend of polyvinyl material with an interpolymer consisting essentially of acrylonitrile, butadiene, and styrene adhered to one side of said fabric, said coating having a percent elongation at failure that decreases with increasing temperature to a minimum percent elongation at a certain temperature and increases with increasing temperature beyond that certain temperature, said fabric having a percent elongation of at least 300 percent at the temperature of minimum percent elongation of said coating.

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