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HEAT SEALING ADHESIVE SHEETS OR TAPES

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This invention relates to heatsealing adhesive sheets or tapes. While not limited thereto it is particularly concerned with heatsealing adhesive sheets or tapes for use in mending all types of household fabrics, and laundry goods in general.

Adhesive sheets or tapes of the type under consideration have their chief utility in the mending and patching of fabrics, in the household, and in the commercial laundry. It is desirable that such products adhere to a wide variety of fabrics including those of cotton, linen, wool, viscose rayon, cellulose acetate rayon, synthetic fabrics such as superpolyamide, coated fabrics, impregnated fabrics, tightly woven material or loosely woven cheese or tobacco cloth and the like.

Sheets or tapes of the type contemplated by our invention are provided with a strong but inexpensive, flexible, usually porous, backing such as paper, coated paper, impregnated paper, cotton cloth (among woven materials those woven tighter than 50 square are usually preferred), coated cloth, impregnated cloth, nonfibrous film and the like. For the purposes of the invention, however, the type of backing is not important and any backing will serve provided that it has sufficient strength for the use contemplated and sufficiently tight consistency to prevent undue penetration of the adhesive into the body of the backing and consequent loss of adhesive body on the surface of the backing.

Prior to our invention heatsealing adhesive tapes for mending purposes were usually composed of a polymer which would be proof against washing and solvents used in drycleaning. Solvent and washproof polymers are necessary because fabrics and household goods mended with heatsealing adhesive tape often undergo washing and drycleaning. In the case of fabrics not resistant to water or solvents the mend would be disturbed otherwise in places where the water or solvent removes or destroys the heatsealing adhesive bond. Various thermoplastic polymers have been preferred for use as heatsealers in this art.

Many heatsealing tapes of the proir art are based on vinyl chloride acetate copolymers. These adhesives are superior to all others of the prior art but have several important defects. They do not adhere satisfactorily to synthetic fabrics such as viscose or cellulose acetate rayon. They do not withstand repeated washings too well, and a mending patch will frequently come loose after but a few washings. In view of the temperature required for satisfactory sealing and in view of the heat which the patch should withstand during normal wear the softening point of the heatsealing adhesive has to be relatively high. The high temperature in turn requires that the sealing period be short otherwise the backing of the tape

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or sheet or the fabric being mended may be burned. Prolonged heating would frequently cause the heatsealing adhesive to flow through the backing of the sheet or tape, soil the back side of the mending tape or sheet and make an unsightly and unsatisfactory mend.

Where, on the other hand, a polymer having too low a sealing temperature is provided, complete blocking may result and the finished patch again may be unsatisfactory because of the softness of the adhesive at normal temperature. Accordingly the patch will come off easily even where the mended spot receives merely mild mechanical rubbing or mild rubbing in a washing machine or laundry.

In accordance with the invention the adhesive sheet or tape has two substantial superposed layers in the heatsealing adhesive coat which, preferably, has a total coating weight of at least two and not more than seven ounces per square yard.

In a preferred form of the invention, the surface layer of the adhesive will be composed of a maleic modified soft vinyl chloride acetate copolymer having a relatively low melting point and a relatively high degree of cold flow. The preferred maleic modified copolymer, in accordance with the invention, is a member of the group consisting of the copolymers of more than 65 percent by weight of vinyl chloride and less than 30 percent by weight of vinyl acetate. The maleic acid or anhydride modification should be to the extent of 0.5 to 5 percent of maleic acid based on the weight of the copolymer.

We have found that adhesion to a great variety of surfaces is obtained where an unusually soft copolymer, say one comprised of substantially 86 percent vinyl chloride, 13 percent vinyl acetate and 1 percent maleic acid, is employed. The more vinyl chloride is present in the composition the higher a viscosity, molecular weight and melting point will be obtainable in the copolymer. In applicant's preferred range the polymer is fairly soft, has a low melting point and is quite weak.

The weakness of the polymer, if the copolymer were used alone, would account for a weak final bond which in turn would cause poor laundering and unsatisfactory wear of fabrics. Suprisingly we have been able to provide a completely satisfactory bond which will wash, dryclean and wear well and yet adhere satisfactorily to almost any surface by application of a high strength polymer coat between the backing and the adhesive surface cost. This polymer should be compatible with the surface adhesive layer when a melt thereof is mixed therewith. Compatibility can readily be ascertained by simple visual observation of the blend. If the two polymers blend

readily or react to blend readily and appear homogeneous there is compatibility; if they tend to separate when heated or dissolved in mutual solvents they are incompatible and unsuitable in our invention. In addition to compatibility the lower adhesive layer should have a softening point more than 20 and less than 100° F. higher than that of the top surface layer. A lower softening point differential would cause the underlying layer to sink into its own backing at the effective sealing temperature of the top layer and would thus provide an insufficient effective bonding layer. Moreover, the fabric backing would be too much stiffened due to penetration by the lower bonding layer and would thus provide an unsatisfactory mend. Such a mend would have an irritating "feel" and insufficient flexibility for proper handling and wear.

If the softening point differential is too high, the lower layer will not soften at the heatsealing temperature of the top layer. Accordingly the lower layer will not blend sufficiently with the top layer and will not provide the unified structure and secure bond which would not separate into two layers. Moreover, in view of the absence of blending between the two layers, the top layer would still be too weak and have not enough reinforcement from the lower layer. Using the structure of the invention, however, it is possible to obtain satisfactory blending between the two adjacent layers providing sufficient mutual anchorage and satisfactory reinforcement of the weaker low softening layer.

Thus the invention consists in one of its aspects in the provision of a multiple layer heatsealing mending tape having an adhesive surface composed of a soft relatively low softening maleic modified vinyl chloride acetate copolymer and thereunder, of one or more layers of a higher softening compatible polymer having a softening point substantially 20–100° F. higher than said adhesive layer providing body and strength to said heatsealing adhesive layer. A flexible backing is provided under this higher softening layer.

The lower layer may be composed of any polymer material provided it comes within the specified softening point differential range and is compatible with the surface adhesive coat as specified above. Suitable undercoats within the above specification may be made readily from various vinyl chloride-acetate copolymers, polyvinyl choride, vinylidene chloride-vinyl chloride copolymers, polyvinyl chloride-acetate, butadiene-acrylonitrile copolymers having an excess by weight of butadiene, mixtures of the above recited polymers and copolymers, and in fact in view of the physical, rather than chemical nature of this phase of the invention, of any other composition coming within the specified limits of physical properties. Each layer or group of layers should comprise at least 25 percent of the total coating weight in the heatsealing mending tape.

Where adhesion to a wide variety of surfaces is not so important, of course, it is always possible to make a satisfactory adhesive product using any heatbonding surface coat which comes within the specified softening point differential and has sufficient adhesion for the purpose instead of the maleic modified copolymer. In this connection heatsealing compositions composed of lower softening vinyl chloride acetate copolymers as the vinyl chlorides, vinylidene chloride copolymers largely vinylidene chloride, methacrylate, polystyrene and many other materials are known in the art. Maleic modifications of these heatsealers may be used. The important factors, as far as the invention is concerned is that the surface coat and intermediate coat are highly compatible with each other and that the required softening point differential exists. In view of the laundering requirements for the product it is desirable to have both the top and the under coat from materials which are resistant to repeated washings and to drycleaning solvents which are usually straight aliphatic or aromatic or chlorinated hydrocarbons.

Suitable plasticizers may be used to obtain the desired melting point differential. Where polyvinyl chloride acetate copolymers are used the preferred plasticizers are dioctyl phthalate and also triglycol di-2-ethyl hexoate, although in fact many compatible plasticizers may be used. Among such compatible plasticizers there are: amyl phthalate, chlorinated diphenyl, butoxyglycol adipate, butyl phthalate, butyl sebacate, butyl stearate, butyl tartrate, ethoxyglycol phthalate, ethoxydiglycol phthalate, ethylhexyl phthalate, ethyl phthalate, triglycol di-2-ethylbuyrate, triglycol chlorhydrin phthalate, ethyl o-benzoyl benzoate, diglycol dipropionate, methoxyglycol acetylricinoleate, butoxyglycol phthalate, tricresyl phosphate, methoxyglycol phthalate, methoxyglycol sebacate, methoxyglycol stearate, methyl phthalate, phenolindene-coumarone oil, phenyl phthalate, diphenyl-o-xenyl phosphate, tri-(p-tertiary butylphenyl) phosphate, o- and p-toluene ethyl sulfonamides, o-cresyl-p-toluene sulfonate, ethyl phthalyl ethyl glycollate, butyl phthalyl butyl glycollate, methyl phthalyl methyl glycollate, di-(methylcyclohexyl) adipate, tributyl citrate.

Other usual compounding agents may be used with any and all of the polymer coatings to modify them as desired. Inert fillers may be added to cheapen the product or to color or reinforce it. Typical fillers which have been used to great success are zinc oxide, titanium dioxide, lead oxide, calcium carbonate, clay, magnesium carbonate. In the case of the vinyl chlorides and vinylidene chlorides, copolymers, some of which are not too stable chemically when heated, stabilizers may be added to provide higher stability. Among suitable stabilizers are lead oxide and hydroxide condensation products of urea, the aliphatic esters of acetoxy chloride stearic acids, tertiary ethyl urea, for instance tertiary amyl urea or tertiary butyl urea, phthalimides, sulfonimides such as sodium sulfonimides and magnesium sulfonimides, calcium ethyl acetal acetate, lead stearate, lead oleate, diphenyl lead stearate, diphenyl lead oleate, tribenzyl lead stearate, tribenzyl lead oleate, tribenzyl lead ricinoleate, diphenyl tin oxide, diphenyl lead oxide, triphenyl lead stearate, triphenyl basic tin stearate, ethyl benzidene, calcium stearate, and many others. Provision of such additions to vinyl or vinylidene copolymers or polymers is well known in the art and forms the subject of a wide list of patents and other literature.

In appropriate instances fillers and stabilizers may be left out entirely and compositions where they are not added are included among the important comprehended embodiments of our invention.

To illustrate the embodiments of this invention the following examples in the form of representative formulations are given in which ingredients are used in approximate percentages by weight as indicated, based on the final composition as a whole:

Table of compositions used in the examples—heatsealing

[All parts are by weight]

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Maleic Modified Vinyl Chloride Acetate Copolymer (82% vinyl chloride, 16.5% vinyl acetate, 1½% maleic acid; molecular weight 9,000) [1]	70		74		67														
Maleic Modified Vinyl Chloride Acetate Copolymer (86.3% vinyl chloride, 13% vinyl acetate, 0.7% maleic acid; molecular weight 7,000)		64		78		64													
Vinyl Chloride Acetate Copolymer (85% vinyl chloride, 15% vinyl acetate; molecular weight 10,000)							37	32	32					37	31				
Vinyl Chloride Acetate Copolymer (88% vinyl chloride, 12% vinyl acetate; molecular weight 13,000)							25	33	32						31				
Vinyl Chloride Acetate Copolymer (90% vinyl chloride, 10% vinyl acetate; molecular weight 16,000)														25					
Vinyl Chloride Acetate Copolymer (93% vinyl chloride, 7% vinyl acetate; molecular weight 22,000)											80						67		100
Vinylidene Chloride Vinyl Chloride Copolymer (major portions of vinyl chloride and vinylidene chloride extra high molecular weight, tough relatively insoluble copolymer softening point 450° F.)										80						67		100	
Vinyl Acetate Polymer (Viscosity 60 centipoises when in molar solution in benzene)												100							
Butyl Methacrylate Polymer, Soft													100						
Alkyd Plasticizer (soft, high molecular weight, low cross-linkage, soluble in esters and aromatics, nitrocellulose compatible acid number 1, Gardner-Holdt viscosity R–U, in 50% solution in ethylene dichloride is R–U)						36													
Dibutyl Phthalate				22							20								
Dibutyl Sebacate			26				27			20									
Dioctyl Phthalate	30													27					
Methyl Phthalyl Ethyl Glycollate		36							33										
Triethylene Glycol Di-2-Ethyl Hexoate								32										33	
Trioctyl Phosphate					33											27	33		
Basic Lead Carbonate							9							9	9				
Lead Stearate								2	2										
Titanium Dioxide							1							1	1				
Stearic Acid							1	1	1					1					
Softening Point (°F.), Lowest Point of Range	240	240	240	240	240	240	240	240	240	375	380	150	100	275	260	340	340	440	440
Softening Point (°F.), Highest Point of Range	275	275	275	275	275	275	260	265	265	405	410	200	130	290	285	370	370	475	475

[1] All percentages and molecular weights are averages and approximate as closely as obtainable. All polymers are heat stabilized in one of the manners indicated earlier in this specification.

These compositions may be applied to backings to form heatsealing adhesive tapes in accordance with the invention, for instance in the following examples:

Example No.	Backing	Wt. in Ounces per Sq. Yd. and Composition of Surface Coat	Wt. in Ounces per Sq. Yd. and Composition of Base Coat	Approximate Temperature Differential between Base and Surface Coat (°F.)
1	80 x 80 Cotton Cloth	1.0 of A	2.0 of N	25
2	do	1.5 of A	1.5 of O	25
3	do	2.0 of A	1.0 of P	95
4	56 x 64 Cotton Cloth	do	1.0 of Q	100
5	do	.75 of B	2.25 of N	25
6	do	do	2.25 of O	25
7	80 x 80 Cotton Cloth	1.5 of B	1.5 of P	95
8	do	do	1.5 of Q	100
9	Finely Woven Nylon	1.5 of C	1.5 of N	25
10	do	do	1.5 of O	25
11	56 x 64 Cotton Cloth	2.0 of C	1.0 of P	95
12	80 x 80 Cotton Cloth	do	1.0 of Q	100
13	do	2.0 of D	1.0 of N	25
14	do	do	1.0 of O	25
15	do	2.25 of D	.75 of P	95
16	do	do	.75 of Q	100
17	Finely Woven Acetate Rayon	2.25 of E	.75 of N	25
18	do	do	.75 of O	25
19	56 x 64 Cotton Cloth	do	.75 of P	95
20	do	do	.75 of Q	100
21	Finely Woven Nylon	1.5 of F	1.5 of N	25
22	Finely Woven Acetate Rayon	do	1.5 of O	25
23	80 x 80 Cotton Cloth	do	1.5 of P	95
24	do	2.0 of F	1.0 of Q	100
25	do	2.0 of G	1.0 of N	30
26	do	do	1.0 of O	20
27	do	do	1.0 of P	100
28	do	do	1.0 of Q	100
29	56 x 64 Cotton Cloth	1.0 of H	2.0 of N	30
30	do	do	2.0 of O	25
31	do	do	2.0 of P	100
32	do	do	2.0 of Q	100
33	do	1.5 of I	1.5 of N	30
34	do	do	1.5 of O	20
35	do	do	1.5 of P	100
36	do	do	1.5 of Q	100
37	Finely Woven Nylon	1.5 of L	1.5 of G	75
38	do	do	1.5 of I	80
39	Dead Soft Aluminum Foil	do	.5 of A	90
40	do	do	.5 of B	90

Example No.	Backing	Wt. in Ounces per Sq. Yd. and Composition of Surface Coat	Wt. in Ounces per Sq. Yd. and Composition of Base Coat	Approximate Temperature Differential between Base and Surface Coat (°F.)
41	Finely Woven Nylon	2.25 of L	.75 of C	90
42	do	1.0 of L	2.0 of D	90
43	Dead Soft Aluminum Foil	do	1.0 of E	90
44	do	do	1.0 of F	90
45	80 x 80 Cotton Cloth	1.0 of J	2.0 of R	60
46	do	do	2.0 of S	60
47	Glass Cloth	1.0 of K	2.0 of R	55
48	do	do	2.0 of S	55
49	Vinyl Film	1.5 of M	.75 of L	60

In general the compositions may be prepared in any suitable manner, for instance by mixing in an internal type mixer or on a rubber mill. Specific mixing procedures are not critical and will occur readily to those skilled in the art. Merely for illustrative purposes, however, typical mixing and coating procedures for use, for instance the one used in connection with Example A follows:

First the lower coat is prepared:

The vinyl chloride acetate copolymers are intimately worked on a hot rubber mill until substantial homogeneity is obtained. A mixture of the plasticizers and fillers is then added into the mill gradually so as to prevent cooling of the polymers. After all is added and the entire composition is uniform the coating may be applied to the backing by use of a calender or, alternatively, may be dissolved in an ester type solvent and coated on cloth by means of a knife coater or a reverse roll coater. The amount of coating applied and type of coating may be regulated by adjustment of coating conditions, e. g. speed, viscosity of solution, etc. Care should be taken where cloth backings are used to prevent loss of effective adhesive film strength by disappearance of the adhesive film into the backing. Accordingly fairly viscous coating solutions or compositions should be employed, and in the case of calender coating, the calender should not be too hot.

The surface coat is made by dissolving the copolymer and the plasticizer in a solvent, e. g. in a mixture of equal parts of toluene and methyl ethyl ketone or acetone. A solution comprising approximately 40 percent solids is prepared. This solution is then applied in any desired manner to the precoated side of the backing, for instance using a reverse roll coater. A satisfactory product results.

Usually in mending the fabric, a piece of the tape or sheet, somewhat larger than the repair to be made is rounded at the corners and placed with the coated side down, on the torn portion. Heat and pressure are applied to the tape or sheet by a hot iron which is held in place for a short period (say 7 seconds) to soften the thermoplastic adhesive. The iron is then removed and the thermoplastic, upon cooling, forms a bond between the cloth part of the tape and the cloth of the garment or other item to which it has been applied. Hot iron mending tapes come in several basic colors in addition to black and white so that the user may match as closely as possible the color of the material to be repaired and render the repair as inconspicuous as possible. Alternatively the user may want to cut patterns out of the heat-sealing tape and apply them to a fabric background so as to ornament such background.

Wherever mention is made herein of softening points such softening points are determined in the following manner:

A film of the adhesive mass about 5 mils thick is cast on the surface of a suitable cloth backing, such as 80 x 80 cotton sheeting. The apparatus consists of an electric soldering iron which has been modified so that the heated block has a one-inch square smooth surface in place of the point. A very small hole is drilled into the block parallel to, and about 3 millimeters from the surface. The apparatus is mounted by means of clamps and a stand so that the surface is perpendicular and the needle of a pyrometer can be inserted in the hole from the side. A 1 x 2 inch piece of the sample to be measured is applied firmly to the surface by means of an electric iron so that it covers the surface and the extra inch hangs down. A clamp and weight, whose combined weight is 75 grams, is fastened to the hanging tab of cloth and the current to the apparatus turned on. The rise in temperature is observed by means of the pyrometer. The temperature readings are taken when the cloth begins to slide and when it falls off. These two temperatures are reported as the range of the softening temperature.

All embodiments within the scope of this specification and/or the appended claims are comprehended. Having described these various embodiments of our invention for purposes of illustration rather than limitation, what is claimed is as follows:

1. As a new article of manufacture, a mending sheet adapted for the repairing of torn surfaces by adherence thereto under the influence of heat and pressure, comprising in combination a flexible fabric base one surface of which is coated with a plurality of superimposed coatings, one of said coatings adhering to said base member as an undercoat, another of said coatings adhering to said undercoat and comprising a surface coat, said surface coat consisting essentially of at least about six parts by weight of vinyl chloride vinyl acetate copolymer including at least sixty-five per cent by weight of vinyl chloride and from about ten to about thirty per cent of vinyl acetate; and of a minor portion, not exceeding about four parts by weight of the surface coat composition, of a compatible plasticizer; said undercoat consisting essentially of at least about six parts by weight of a vinyl chloride vinyl acetate copolymer including at least sixty-five per cent by weight of vinyl chloride and from about ten to about thirty parts by weight of vinyl acetate;

and of a minor portion, not exceeding thirty-six per cent by weight of the undercoat, of a compatible plasticizer; said undercoat being compatible with said surface coat and having a softening point between about twenty degrees Fahrenheit and about 100 degrees Fahrenheit higher than said surface coating.

2. As a new article of manufacture a mending sheet adapted for the repairing of torn surfaces by adherence thereto under the influence of heat and pressure, comprising in combination a flexible fabric base one surface of which is coated with a plurality of superimposed coatings, one of said coatings adhering to said base member as an undercoat, another of said coatings adhering to said undercoat and comprising a surface coat, said surface coat consisting essentially of at least about six parts by weight of a maleic modified vinyl chloride-vinyl acetate copolymer including at least about sixty-five per cent by weight of vinyl chloride, from about ten to about twenty per cent of vinyl acetate and from about five tenths of one per cent to about five per cent of maleic acid; and of a minor portion, not exceeding about four parts by weight of the surface coat composition of a compatible liquid plasticizer; said undercoat consisting essentially of at least about six parts by weight of a vinyl chloride vinyl acetate copolymer, including about nine parts by weight of vinyl chloride, about one part by weight of vinyl acetate; and a minor portion, not more than about four parts of its weight of a compatible plasticizer; said undercoat being compatible with said surface coat and having a softening point between about twenty degrees Fahrenheit and about 100 degrees Fahrenheit higher than said surface coating.

3. As a new article of manufacture, a mending sheet adapted for the repairing of torn surfaces by adherence thereto under the influence of heat and pressure, comprising in combination a woven fabric backed member one surface of which is coated with a plurality of superimposed coatings, one of said coatings adhering to said backing member as an undercoat, another of said coatings adhering to said undercoat and comprising a surface coat, said surface coat having a softening point in the range of from about 240 degrees Fahrenheit to about 300 degrees Fahrenheit and consisting essentially of at least about six parts by weight of a vinyl chloride vinyl acetate copolymer including at least about eighty per cent by weight vinyl chloride and from about ten to about twenty per cent vinyl acetate; and a minor portion, not more than about four parts by weight of a compatible liquid plasticizer; and said undercoat consisting essentially of at least about six parts by weight of vinyl chloride vinyl acetate copolymer; and of a minor portion, not more than about four parts by weight of a compatible plasticizer, said undercoat being compatible with said surface coat and having a softening point from about twenty degrees Fahrenheit to about 100 degrees Fahrenheit higher than said surface coat.

4. As a new article of manufacture, a mending sheet adapted for the repairing of torn surfaces by adherence thereto under the influence of heat and pressure, comprising in combination a flexible woven fabric base one surface of which is coated with a plurality of superimposed coatings, one of said coatings adhering to said base member as an undercoat, another of said coatings adhering to said undercoat and comprising a surface coat, said surface coat consisting essentially of at least about six parts by weight of a maleic modified vinyl chloride vinyl acetate copolymer including at least about eighty per cent by weight of vinyl chloride, from about ten to about twenty per cent of vinyl acetate and from about five tenths of one per cent to about five per cent of maleic acid; and of a minor portion of liquid dioctyl phthalate plasticizer; said undercoat consisting essentially of at least about six parts by weight of a vinyl chloride vinyl acetate copolymer including about nine parts by weight of vinyl chloride and about one part by weight of vinyl acetate, and of a minor portion, not more than about four parts by weight, of compatible plasticizer, said undercoat being compatible with said surface coat and having a softening point between about twenty degrees Fahrenheit and about 100 degrees Fahrenheit higher than said surface coating.

5. As a new article of manufacture, a mending sheet adapted for the repairing of torn surfaces by adherence thereto under the influence of heat and pressure, comprising in combination a flexible woven fabric base one surface of which is coated with a plurality of superimposed coatings, one of said coatings adhering to said flexible woven fabric base as an undercoat, another of said coatings adhering to said undercoat and comprising a surface coat, said surface coat consisting essentially of at least about six parts by weight of a maleic modified vinyl chloride vinyl acetate copolymer including about eighty per cent by weight of vinyl chloride, from about ten to about twenty per cent by weight of vinyl acetate and from about 0.5 to about five per cent by weight of maleic acid; and a minor portion, not more than about four parts by weight of liquid compatible plasticizer; said surface coat having a relatively low softening point in the range of from about 240 to about 300 degrees Fahrenheit; said undercoat consisting essentially of at least about six parts by weight of a polymeric, thermoplastic vinyl polymer, compatible with said surface coat, and having a softening point at least twenty degrees higher than the softening point of said surface coat.

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