POLYAMIDE PLASTICIZED WITH UREA FOR USE IN FUSIBLE COMPOSITIONS


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13 Claims

ABSTRACT OF THE DISCLOSURE

A fusible fabric is disclosed which comprises a fibrous web base having a solid fusible composition incorporated on at least one surface thereof. The fusible composition has a fusing point below 145°C and comprises a polyamide and a plasticizing material containing urea, thiourea or ethyl urea.

This invention relates to fusible compositions and, in particular, to fusible compositions for incorporation into fibrous webs to form fusible fabrics and the like.

It is known to form fusible fabrics by incorporating discrete amounts of solid fusible compositions, for example, the thermoplastic materials polyethylene, cellulose acetate, or vinyl chloride copolymers, into at least the surface layers of woven or non-woven fabrics. Such fusible fabrics are very useful in the textile trade, for example, for imparting shape retention to conventional fabrics by lamination to the conventional fabrics under the influence of heat and pressure. Certain fusible fabrics may also be shaped into stiff articles of desired shape either alone or on lamination to conventional fabrics by the application of heat and pressure.

It is important that the fusible composition incorporated in the fusible fabric is substantially resistant to normal laundering processes and to dry cleaning fluids so that during laundering and/or dry-cleaning the tendency for laminated products formed from the fusible fabric to delaminate is at a minimum. It is also important that the fusible composition does not discolour or decompose under the fusing conditions and that the fusing temperature is such that the fibres of the fusible fabric or the fabric or other base material to which the fusible fabric may be laminated, are not scorched or otherwise discoloured. Preferably, the fusing temperature of the fusible composition should not exceed about 145°C and more preferably should lie in the temperature range between about 95°C and 130°C, which temperatures can conveniently be attained by conventional presses. Hitherto these desirable requirements have not all been found in fusible compositions of the prior art.

We have now found that alcohol-soluble linear polyamides are useful as improved fusible compositions when the fusing point of the polyamides has been lowered by incorporating in the polyamide a plasticising material comprising urea and/or a urea derivative. Accordingly, the present invention includes a fusible composition comprising at least one alcohol-soluble linear polyamide and a plasticising material in which the plasticising material comprises at least 20 parts by weight of urea and/or a urea derivative for each 100 parts by weight of polyamide with or without one or more further plasticisers for the polyamide, the plasticising material being present in such an amount that the fusing point of the fusible composition is below 145°C.

By “alcohol-soluble linear polyamide” is meant a linear polyamide capable of being dissolved in a lower aliphatic alcohol such as methyl or ethyl alcohol.

When the plasticising material comprises urea and/or a urea derivative as the sole plasticiser, the urea and/or urea derivative is preferably present in an amount not less than 100 parts by weight per 100 parts by weight of polyamide. More preferably, the amount of urea and/or urea derivative is present in an amount between 150 and 250 parts by weight for each 100 parts by weight of polyamide. In general, the urea and/or urea derivative should not exceed about 400 parts by weight for each 100 parts by weight of polyamide.

When the plasticising material comprises urea and/or a urea derivative together with one or more further plasticisers, at least 20 parts by weight of the further plasticiser or plasticisers is preferably present per 100 parts by weight of polyamide. More preferably the amount of urea and/or urea derivative together with the further plasticiser or plasticisers shall not exceed 150 parts by weight for each 100 parts by weight of polyamide and in the mixture of urea and/or urea derivative should not exceed about 125 parts by weight. Even more preferably, the plasticising material comprises between 50 and 100 parts by weight of urea and/or urea derivative and between 20 and 30 parts by weight of one or more of the further plasticisers for each 100 parts by weight of the polyamide.

Suitable urea derivatives which can be used in accordance with the invention are thiourea, ethyl urea and the like.

The further plasticisers suitable for use with the urea and/or urea derivative are conveniently conventional polyamide plasticisers such as substituted benzene sulphonamides or 2 ethylhexyl p-hydroxybenzoate. A suitable substituted benzene sulphonamide for incorporating in the plasticising material is toluene sulphonamide and, in the practice of the invention, it is particularly convenient to use a mixture of ortho and para toluene sulphonamides marketed by Monsanto Chemical Company, London, England, under the name “Santizer 9.”

The fusible compositions in accordance with the invention generally have a fusing point below 140°C and more usually in the range of from 110°C to 130°C and since, in addition, they have high adhesive properties in respect of fibrous materials, they are particularly useful in the manufacture of fusible fabrics.

When it is desirable that the fusing point of the fusible composition should be particularly low, for example, from about 100°C to 120°C or lower, it is preferable to employ alcohol-soluble linear polyamides which are water-sensitive, that is, polyamides which are capable of absorbing water and will soften in boiling water or under the influence of steam. Examples of suitable alcohol-soluble, water-sensitive linear polyamides are copolyamides formed from the monomers of nylon 6 and nylon 66 in the ratio of monomer weights of between 70:30 and 40:60, and polyamide compositions marketed by Badische Anilin und Soda Fabrik A.G. of Ludwigshafen am Rhein,
Germany under the trade names “Ultramid 1C” and “Ultramid 6A” and mixtures of such compositions. “Ultramid 1C” is a mixed polyamide in which the ratio of initial substances from which the polyamide is produced is 33.3% adipic acid and hexamethylene-diamine, 33.3% caprolactam and 33.3% adipic acid and diamino-dicyclohexylmethane. “Ultramid 6A” is a mixed polyamide produced from a combination of 66% adipic acid and hexamethylene-diamine and 33.3% caprolactam.

The present invention also includes fusible fabrics comprising fibrous webs incorporating a fusible composition in accordance with the invention upon at least one surface of the web.

The fibrous web may be a non-woven or bonded fibre fabric comprising textile fibres bonded together at points of contact with regenerated cellulose, natural or synthetic rubber or other material or a woven or knitted fabric. The fusible composition may be incorporated into at least the surface layer of the fibrous web in discrete portions by sprinkling as a powder followed by heating to fuse the particles to the fibres of the web, by spraying a solution of the fusible composition in a volatile solvent such as alcohol or an alcohol/water mixture on to the web followed by evaporation of the solvent or by printing a solution of the fusible composition on to the web in the form of dots, lines or other discontinuous pattern followed by evaporation of the solvent.

The fusible fabrics in accordance with the invention may readily be laminated to conventional fabrics by heat and pressure, sufficient to fuse the incorporated fusible compositions, to produce a laminate of high bond strength between the laminated parts, at a temperature readily attainable with conventional steam and dry presses which does not scorch or otherwise discolor the fabric.

Such lamination of the fusible fabric with the conventional fabric imparts shape retention to the conventional fabric and the method is particularly of use in the manufacture of stiffened articles of wearing apparel such as collars, shirts, cuffs, belts, skirts, and the like.

The bond strength of the laminate is not seriously weakened by normal laundry operations or conventional dry-cleaning fluids such as tetrachloroethylene to such an extent that delamination tends to occur.

The fusible fabrics in accordance with the invention may also be used for forming shaped articles, particularly articles of wearing apparel, where a blank of the fabric is shaped in a suitable formed die under heat and pressure, and the invention includes such a shaped article.

The fusible composition may, if required, be coated as a substantially continuous surface coating upon the fibrous web to form a heat-sealable fabric capable of being laminated to other fabrics or base material under the influence of heat and pressure, for example, for the purpose of repasting a rent in the fabric or base material.

The invention will now be further described by way of the following examples:

EXAMPLES 1 TO 7

Alcohol-soluble, water-sensitive linear polyamides marketed by Messrs. Badische Anilin und Soda Fabrik A.G. of Ludwigshafen am Rhein, Germany, under the trade names “Ultramid 1C” and “6A” were separately dissolved in the proportions shown in Table 1 in an 80:20 parts mixture of methyl alcohol and water to form a 15% by weight solution of polyamides. To the separate solutions a mixture of ortho and para toluen sulphonamide marketed by Monsanto Chemicals Limited of London under the name “Santizer 9” and urea in the percentage proportions by weight shown in Table 1. The solutions were then sprayed on to one surface of a non-woven fabric, formed of rayon and polyamide fibres bonded by a synthetic rubber, in various amounts to yield, on evaporation of the solvent, discrete dry spots of fusible composition of various weights as shown in Table 1. Strips 1 inch by 3 inches were cut from the surface treated fabrics and each strip was heat-sealed across its width to a 2 inch by 3 inch sample of the non-woven fabric which had not been surface treated with the fusible composition, by a heat-sealing apparatus in which the temperature of the heat-seal bar was varied as shown in Table 1 and the pressure applied was 3 pounds per square inch. No heat discoloration of the laminated fabrics was observed. The bond strengths of the laminates were measured by measuring the peel strength of the laminates by securing the free ends of the two strips forming each laminate to the jaws of a tensile testing machine and noting the force required to peel the strips apart. In certain cases the bond strength was greater than the strength of the fabric and delamination of the fabric occurred.

For the purpose of comparison of results, three extra experiments designated A, B, and C in Table 1, were carried out with urea or both of the plasticisers omitted. Unsatisfactory peel strengths were obtained in each case.

<table>
<thead>
<tr>
<th>Table 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>1</td>
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<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
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<tr>
<td>4</td>
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<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>7</td>
</tr>
</tbody>
</table>

(d) indicates that the non-woven fabric delaminated.

EXAMPLE 8

25 parts by weight of powdered “Ultramid 1C” polyamide resin was mixed with 25 parts of powdered “Ultramid 6A” polyamide resin, 12.5 parts of “Santizer 9” toluen sulphonamide mixture and 37.5 parts of urea. The components of the mixture were melted together by heating slowly up to 150° C. and intimately mixed. After cooling, the melt was broken into granules which were then introduced with solid carbon dioxide into a laboratory hammer mill to form a powder. The powder was then sprinkled on to one surface of a series of samples of non-woven fabrics of the same type as used in Examples 1 to 7 at rates of 0.55 and 0.8 ounce per square yard. The particles of powder on the fabric samples were fused in situ to the fabric by passing the samples through an air oven at 140° C. The resulting fusible fabric samples were cut into strips 3 inches by 1 inch and separately heat-sealed across their width to woven rayon and worsted cloths using respectively a “Hoffmann” Steam Press at 140° C. a flat iron heated at 130° C. and a hand electric iron at a surface temperature of 130° C. No heat discoloration of the laminated samples was observed. The laminated samples were tested for peel strength in a tensile testing machine as described in Examples 1 to 7, when dry, when wet after shaking in tetrachloroethylene for 5 minutes and when wet after boiling in a 1.0%
aqueous soap solution for five minutes. The results obtained are shown in Table 2.

<table>
<thead>
<tr>
<th>Weight of Powder per square yard of fabric (ounces/sq. yard)</th>
<th>Woven Fabric Type</th>
<th>Press Type</th>
<th>Tetra-ethylene Glycol Solution (g/100 gm.)</th>
<th>Soap Solution Wet (g/100 gm.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.55</td>
<td>Rayon........</td>
<td>Dry Plate</td>
<td>600</td>
<td>600 (g/100 gm.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dry Plate</td>
<td>600</td>
<td>600 (g/100 gm.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Iron.......</td>
<td>520</td>
<td>520 (g/100 gm.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Iron.......</td>
<td>520</td>
<td>520 (g/100 gm.)</td>
</tr>
<tr>
<td></td>
<td>Rayon........</td>
<td>Dry Plate</td>
<td>600</td>
<td>600 (g/100 gm.)</td>
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<tr>
<td></td>
<td></td>
<td>Dry Plate</td>
<td>600</td>
<td>600 (g/100 gm.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Iron.......</td>
<td>520</td>
<td>520 (g/100 gm.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Iron.......</td>
<td>520</td>
<td>520 (g/100 gm.)</td>
</tr>
<tr>
<td>0.8</td>
<td>Rayon........</td>
<td>Dry Plate</td>
<td>1,200</td>
<td>1,200 (g/100 gm.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dry Plate</td>
<td>1,200</td>
<td>1,200 (g/100 gm.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Iron.......</td>
<td>1,000</td>
<td>1,000 (g/100 gm.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Iron.......</td>
<td>1,000</td>
<td>1,000 (g/100 gm.)</td>
</tr>
<tr>
<td></td>
<td>Worted........</td>
<td>Dry Plate</td>
<td>1,200</td>
<td>1,200 (g/100 gm.)</td>
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<tr>
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<td>1,200</td>
<td>1,200 (g/100 gm.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Iron.......</td>
<td>1,000</td>
<td>1,000 (g/100 gm.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Iron.......</td>
<td>1,000</td>
<td>1,000 (g/100 gm.)</td>
</tr>
</tbody>
</table>

(d) indicates that non-woven fabric delaminated.

From the results shown in Table 2, it is seen that there is some decline in peel strength when the laminated samples are tetra-chloroethylene wet and more decline when the laminated samples are soap solution wet; however, these wet strengths were sufficiently high to permit the laminated fabrics to be laundered or dry cleaned without any undue risk of delamination.

EXAMPLE 9

50 parts by weight of a powdered copolymer of 70% nylon 6 (condensation product of polyacrylonitrile) and 30% nylon 66 (condensation product of hexamethylenediamine adipic acid) were introduced into a jacketed "Pastorex" mixer and 10 parts of water, 12.5 parts of "Santizer 9" and 37.5 parts of urea were separately added in that order. When all the ingredients had been added, steam was introduced into the jacket of the mixer and the contents were held at from 90° C. to 95° C. for 30 minutes before the cover was removed to allow free evaporation of the water. The resulting granules were ground to a powder which was then applied to one surface of a non-woven fabric of the same type as was used in Examples 1 to 7, at the rate of 0.75 ounce per square yard. The particles were fused in situ by passing the fabric briefly beneath an infra red heating unit. The fabric was cut into samples 3 inches by 1 inch and sealed under heat and pressure to a woven rayon and woven worsted fabric, using the Hoffman press, a dry plate press and an electric iron as described in Example 8. The peel strengths obtained were about 90% of the values obtained in Example 8, and the laminates withstood five commercial dry cleaning and five commercial laundry operations without any appreciable signs of delamination. Further, no scorch marks or discolouration were observed in the laminated samples.

EXAMPLE 10

The procedure described in Example 9 was repeated except that the polyamide component consisted of 50 parts by weight of a powdered copolymer of 40% nylon 6 and 60% nylon 66 and the mixer jacket was maintained at from 70% C. to 75° C. for 30 minutes by steam. The fusible fabric sample and the laminates formed therefrom had properties similar to the samples and laminates prepared in Example 9.

EXAMPLE 11

100 parts by weight of a powdered copolymer of 70% nylon 6 and 30% nylon 66 was mixed in a Pfeiferer type mixer with 50 parts by weight of mixed N-ethyl derivatives of ortho and para sulphonamide with cooling water in the jacket of the mixer until a homogeneous dry powder was obtained. 25 parts of water were then added and when evenly distributed, 75 parts of urea were added and the mixing continued. The temperature of the mixture was then raised to from 90°-95° C. for 30 minutes and the mixer cover removed to permit free escape of water vapour.

The fusible composition, and samples of fusible fabrics and laminates formed therefrom were found to have properties similar to the composition, samples and laminates prepared in Example 9.

EXAMPLE 12

A web of 3 denier nylon fibres of weight, 2 ounces per square yard, was needled by a needle punch machine at the rate of 3000 needles per square decimetre. The needled web was then sprayed with a 12% solution of "Ultramid" polyamide 10 and 6A in an 80/20 parts methyl alcohol/water mixture also containing 3% "Santizer 9" and 9% urea to give a dry weight of fusible composition of 0.8 ounce per square yard. The fusible composition bonded the fibres together to form a bonded fibre fabric. The fabric after drying was laminated to a knitted nylon taffeta material in a shaped steam press at 100° C. to impart a cup-like shape to the laminated product. The laminate retained the cup-like shape and showed no sign of delamination even after five commercial laundry operations.

EXAMPLE 13

The procedure as described in Example 9 was repeated except that 50 parts of urea were used in place of the mixed plasticiser of "Santizer 9" and urea, and the laminates were formed by sealing in a dry press at 140° C. The results obtained were substantially the same as those obtained in Example 9 when using a dry press at a temperature of 130° C. No scorch marks or discoloration were observed.

EXAMPLE 14

The procedure described in Example 9 was repeated except that 37.5 parts of thiourea was used in place of the urea component of the mixed plasticiser. The results obtained on testing the laminate were substantially the same as those obtained in Example 9 and no scorch marks or discoloration were observed.

The word "Santicizer" is a registered trademark. We claim:

1. A solid fusible composition having a fusing point below 145° C. comprising at least one lower aliphatic alcohol-soluble linear polyamide and a plasticizing material in which the plasticizing material comprises between 20 parts and 400 parts by weight of at least one plasticizer selected from the group consisting of urea, thiourea, and ethyl urea for each 100 parts by weight of the polyamide.

2. A solid fusible composition as claimed in claim 1 in which the plasticizing material comprises between 100 and 400 parts by weight of at least one plasticizer selected from the group consisting of urea, thiourea, and ethyl urea as the sole plasticizer for each 100 parts by weight of the polyamide.

3. A solid fusible composition as claimed in claim 2 in which the plasticizing material comprises between 150...
and 250 parts by weight of at least one plasticizer selected from the group consisting of urea, thiourea, and ethyl urea as the sole plasticizer for each 100 parts by weight of the polyamide.

4. A solid fusible composition as claimed in claim 1 in which the plasticizing material comprises at least 20 parts by weight of at least one further plasticizer for each 100 parts by weight of the polyamide.

5. A solid fusible composition as claimed in claim 4 in which the total weight of plasticizer in the plasticizing material does not exceed 150 parts by weight for each 100 parts by weight of polyamide and in which the plasticizer selected from the group consisting of urea, thiourea, and ethyl urea does not exceed 125 parts by weight.

6. A solid fusible composition as claimed in claim 5 in which the plasticizing material comprises between 50 and 100 parts by weight of a plasticizer selected from the group consisting of urea, thiourea, and ethyl urea and between 20 and 30 parts by weight of at least one further plasticizer for each 100 parts by weight of the polyamide.

7. A solid fusible composition as claimed in claim 6 in which the further plasticizer is a mixture of ortho and para toluene sulphonamide.

8. A solid fusible composition as claimed in claim 1 in which the lower alkyl alcohol-soluble linear polyamide is water-sensitive.

9. A solid fusible composition as claimed in claim 8 wherein said water sensitive lower alkyl alcohol-soluble linear polyamide is taken from the group consisting of copolymers formed from the monomers of nylon 6 and nylon 66 in the ratio of monomer weights between 7:30 and 40:60, a mixed polyamide formed from 33.3% adipic acid and hexamethylene-diamine, 33.3% caprolactam and 33.3% adipic acid and diaminodicyclohexyl- methane and a mixed polyamide produced from 66.6% adipic acid and hexamethylene-diamine and 33.3% caprolactam.

10. A fusible fabric comprising a fibrous web taken from the group consisting of woven and non-woven fabric having a solid fusible composition incorporated on at least one surface thereof, said fusible composition having a fusing point below 145° C. and comprising at least one lower aliphatic alcohol-soluble linear polyamide and a plasticizing material, said plasticizing material comprising between 20 parts and 400 parts by weight of at least one plasticizer selected from the group consisting of urea, thiourea, and ethyl urea as the sole plasticizer for each 100 parts by weight of the polyamide.

11. A fusible fabric as claimed in claim 10 in which the plasticizing material comprises between 100 and 400 parts by weight of at least one plasticizer selected from the group consisting of urea, thiourea, and ethyl urea as the sole plasticizer for each 100 parts by weight of polyamide.

12. A fusible fabric as claimed in claim 10 in which the plasticizing material comprises at least 20 parts by weight of at least one further plasticizer for each 100 parts by weight of polyamide.

13. A fusible fabric as claimed in claim 12 in which the total weight of plasticizers in the plasticizing material does not exceed 150 parts by weight for each 100 parts by weight of polyamide and in which the plasticizer selected from the group consisting of urea, thiourea, and ethyl urea does not exceed 125 parts by weight.

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