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(54) **Anti-tacking adhesive surface for thermal-printing elements.**

(57) A thermal print element comprising a support having thereon a layer containing a thermally-transferred dye image, the element having at least one layer of adhesive thereon having an anti-tack surface, the anti-tack surface comprising at least 0.2 g/m² of particulate material, such as fumed silica, silica, alumina or polystyrene matte beads, having a particle size up to 20 µm.

In a preferred embodiment, the adhesive layer comprises a linear, random copolyester of one or more aromatic dibasic acids and one or more aliphatic diols, modified with up to 30 mole % of one or more aliphatic dibasic acids, having a melt viscosity of between 1,000 and 20,000 poise at 150 °C.

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ANTI-TACK ADHESIVE SURFACE FOR THERMAL PRINT ELEMENTS

This invention relates to the use of certain anti-tack adhesives used to laminate thermal print elements for protective and security purposes.

In recent years, thermal transfer systems have been developed to obtain prints from pictures which have been generated electronically from a color video camera. According to one way of obtaining such prints, an electronic picture is first subjected to color separation by color filters. The respective color-separated images are then converted into electrical signals. These signals are then operated on to produce cyan, magenta and yellow electrical signals. These signals are then transmitted to a thermal printer. To obtain the print, a cyan, magenta or yellow dye-donor element is placed face-to-face with a dye-receiving element. The two are then inserted between a thermal printing head and a platen roller. A line-type thermal printing head is used to apply heat from the back of the dye-donor sheet. The thermal printing head has many heating elements and is heated up sequentially in response to the cyan, magenta and yellow signals. The process is then repeated for the other two colors. A color hard copy is thus obtained which corresponds to the original picture viewed on a screen. Further details of this process and an apparatus for carrying it out are contained in U.S. Patent No. 4,621,271 by Brownstein entitled "Apparatus and Method For Controlling A Thermal Printer Apparatus," issued November 4, 1986.

The use of the above process to produce identification (ID) cards is described in copending European application No. 871189452. It would be desirable to provide protection and additional tamper-proofing of such ID cards.

Heat-lamination of a cover sheet of polymeric film, such as polycarbonate or a polyester such as poly(ethyleneterephthalate), over the entire surface and extended sides of an ID card is an excellent way to increase protection from surface abrasion and to minimize tampering. Attempts to remove the cover sheet ideally should result in its destruction to prevent alteration and reuse.

European application Number 87118943.7 relates to an adhesive, meltable at a controlled temperature, that adheres rapidly, firmly and uniformly, to the ID card receiver layer surface, card support stock, and a protective cover sheet. That adhesive also does not adversely affect dye-stability nor alter definition of the thermal dye-transfer image or any auxiliary information on the card.

A problem has developed with the use of such adhesives on a "butterfly" pouch used to laminate an ID card. The "butterfly" pouch is formed by laminating two sheets of adhesive-coated cover sheet together at one edge, the adhesive surfaces being face-to-face, to form a V-shaped laminate. Alternatively, one piece of adhesive-coated cover sheet could be used if folded in the middle.

There is a problem in that the adhesion of the adhesive-coated surfaces is so great that the pouch cannot be readily opened to insert the thermal transfer print. It is an object of this invention to find a way to utilize adhesives in laminating a thermal print element in a "butterfly" pouch.

These and other objects are achieved in accordance with this invention which comprises a thermal print element comprising a support having thereon a layer containing a thermally-transferred dye image, the element having at least one layer of adhesive thereon having an anti-tack surface, the anti-tack surface comprising at least 0.2 g/m² of particulate material having a particle size up to 20 μ m.

Any particulate material can be used in the invention provided it has a particle size up to 20 μ m and performs the desired function. In general, good results have been obtained with fumed silica, silica, alumina or polystyrene matte beads. In a preferred embodiment of the invention, the particulate material is fumed silica.

The particulate material can be present in any amount which is effective for the intended purpose. In general, good results have been obtained when the particulate material is present from 0.2 to 0.3 g/m².

Any adhesive used to laminate ID materials which has the tackiness problem described above would be useful in the invention. Such adhesives include polyvinyl acetates, polyalkyl-acrylates, polyalkyl-methacrylates, polyalkyl-diacrylates, polyalkyl-dimethacrylates, polyvinyl chlorides, urea-formaldehydes, phenol-formaldehydes, polyurethanes, polyamides, polyimides, polysiloxanes, polysulfides, epoxy resins, natural rubbers, chloroprene rubbers, nitrile rubbers and other thermoplastic rubbers. In a preferred embodiment of the invention, the adhesive comprises a linear, random copolyester of one or more aromatic dibasic acids and one or more aliphatic diols, modified with up to 30 mole % of one or more aliphatic dibasic acids, the copolyester having a melt viscosity of between 1,000 and 20,000 poise at 150° C.

In another preferred embodiment of the invention, the aromatic dibasic acid of the copolyester adhesive is terephthalic acid, isophthalic acid, dipicolinic acid or 2,2-bis(p-carboxyphenyl)propane. In another preferred embodiment, the aliphatic diol of the copolyester adhesive is ethyleneglycol, diethyleneglycol, triethyleneglycol, 1,4-butanediol, 1,2-propanediol, 1,3-propanediol, 1,6-hexanediol, cyclohexanedimethanol,

or 1,4-cyclohexanediol. In yet another preferred embodiment, the aliphatic dibasic acid of the copolyester adhesive is sebacic acid, glutaric acid, adipic acid, azelaic acid, or 1,4-cyclohexanedicarboxylic acid.

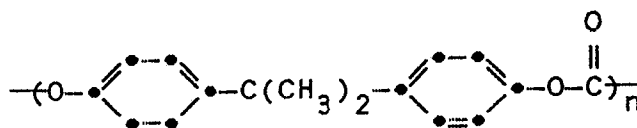
The adhesive layer may be solvent-coated or thermally-applied as a self-supporting layer to either or both sides of the thermal print element.

Any thickness of adhesive may be used provided it provides a secure bond to the cover sheet and thermal print element. In general, good results have been obtained using thicknesses of from 5 to 100 μm .

The layer containing the dye image employed in the invention may comprise, for example, a polycarbonate, a polyurethane, a polyester, polyvinyl chloride, poly(styrene-co-acrylonitrile), poly-(caprolactone) or mixtures thereof. The dye image-receiving layer may be present in any amount which is effective for the intended purpose. In general, good results have been obtained at a concentration of from 1 to 5 g/m².

In a preferred embodiment, a polycarbonate layer containing the dye image is used which has a number average molecular weight of at least 25,000. The term "polycarbonate" as used herein means a polyester of carbonic acid and a glycol or an aromatic diol. Examples of such glycols or aromatic diols are p-xylene glycol, 2,2-bis(4-oxyphenyl)propane, bis(4-oxyphenyl)methane, 1,1-bis(4-oxyphenyl)ethane, 1,1-bis-(oxyphenyl)butane, 1,1-bis(oxyphenyl)cyclohexane, 2,2-bis(oxyphenyl)butane, etc.

In an especially preferred embodiment of the invention, the above-described polycarbonate is a bisphenol A polycarbonate. In another preferred embodiment of the invention, the bisphenol A polycarbonate comprises recurring units having the formula:



wherein n is from 100 to 500.

Examples of such polycarbonates include: General Electric Lexan® Polycarbonate Resin #ML-4735 (Number average molecular weight app. 36,000), and Bayer AG, Makrolon #5705® (Number average molecular weight app. 58,000).

As noted above, the adhesives of the invention are used to laminate a cover sheet to one or both surfaces of the thermal print element. There can be used as the cover sheet, for example, various polymeric transparent films such as poly(ethylene terephthalate), polycarbonate, polystyrene, polyethylene, cellulose acetate, poly(vinyl alcohol-co-acetal), etc.

Specific copolyesters useful as the adhesive in the invention include the following materials:

Compound 1): a random copolyester formed from 1,4-butanediol; 1,6-hexanediol; and terephthalic acid (mole ratio of diols: 80% C₆, 20% C₄)

Compound 2): a random copolyester formed from 1,4-butanediol; 1,6-hexanediol; terephthalic acid; and isophthalic acid (mole ratio of diols: 65% C₆, 35% C₄; mole ratio of acids: 90% terephthalic, 10% isophthalic)

Compound 3): a random copolyester formed from diethyleneglycol; 1,4-butanediol; terephthalic acid; and glutaric acid (mole ratio of diols: 55% C₄, 45% glycol; mole ratio of acids: 70% terephthalic, 30% glutaric)

Compound 4): a blend of a random copolyester formed from 3) and a random copolyester formed from cyclohexanedimethanol; ethyleneglycol; and terephthalic acid (mole ratio of diols: 69% C₂, 31% cyclohexanedimethanol)

Compound 5): a random copolyester formed from 1,4-butanediol; 1,6-hexanediol; terephthalic acid; and isophthalic acid (mole ratio of diols: 80% C₆, 20% C₄; mole ratio of acids: 80% terephthalic, 20% isophthalic)

Compound 6): a random copolyester formed from 1,4-butanediol; sebacic acid; terephthalic acid; and isophthalic acid (mole ratio of acids: 15% sebacic, 35% terephthalic, 50% isophthalic) sold commercially as Bostik 7962 (Bostik Chemical Group, Emhart Corp.)

The support for the thermal print element of the invention may be a transparent film such as a poly-(ether sulfone), a polyimide, a cellulose ester such as cellulose acetate, a poly(vinyl alcohol-co-acetal) or a poly(ethylene terephthalate). The support may also be reflective such as baryta-coated paper, polyethylene-coated paper, white polyester (polyester with white pigment incorporated therein), an ivory paper, a condenser paper or a synthetic paper such as duPont Tyvek®. In a preferred embodiment, polyester with a white pigment incorporated therein is employed. It may be employed at any thickness desired, usually from

50 μm to 1000 μm .

A dye-donor element that is used to form the thermal print element of the invention comprises a support having thereon a dye layer. Any dye can be used in such a layer provided it is transferable to the dye image-receiving layer of the dye-receiving element by the action of heat to provide the thermal print. Especially good results have been obtained with sublimable dyes such as those disclosed in U.S. Patent 4,541,830. The above dyes may be employed singly or in combination to obtain a monochrome. The dyes may be used at a coverage of from 0.05 to 1 g/m² and are preferably hydrophobic.

The dye in the dye-donor element is dispersed in a polymeric binder such as a cellulose derivative, e.g., cellulose acetate hydrogen phthalate, cellulose acetate, cellulose acetate propionate, cellulose acetate butyrate, cellulose triacetate; a polycarbonate; poly(styrene-co-acrylonitrile), a poly(sulfone) or a poly(phenylene oxide). The binder may be used at a coverage of from 0.1 to 5 g/m².

The dye layer of the dye-donor element may be coated on the support or printed thereon by a printing technique such as a gravure process.

Any material can be used as the support for the dye-donor element provided it is dimensionally stable and can withstand the heat of the thermal printing heads. Such materials include polyesters such as poly(ethylene terephthalate); polyamides; polycarbonates; glassine paper; condenser paper; cellulose esters; fluorine polymers; polyethers; polyacetals; polyolefins; and polyimides. The support generally has a thickness of from 2 to 30 μm . It may also be coated with a subbing layer, if desired.

The reverse side of the dye-donor element may be coated with a slipping layer to prevent the printing head from sticking to the dye-donor element. Such a slipping layer would comprise a lubricating material such as a surface active agent, a liquid lubricant, a solid lubricant or mixtures thereof, with or without a polymeric binder.

As noted above, dye-donor elements are used to form a dye transfer image in the thermal print. Such a process comprises imagewise-heating a dye-donor element and transferring a dye image to a dye-receiving element as described above to form the dye transfer image in a thermal print element.

In a preferred embodiment of the invention, a dye-donor element is employed which comprises a poly(ethylene terephthalate) support coated with sequential repeating areas of cyan, magenta and yellow dye, and the above process steps are sequentially performed for each color to obtain a three-color dye transfer image. Of course, when the process is only performed for a single color, then a monochrome dye transfer image is obtained.

The following example is provided to illustrate the invention.

Example

A cover sheet laminate was prepared by coating 175 μm thick poly(ethylene terephthalate) with Compound 6, Bostik 7962® polyester adhesive described above, (0.076 g/m²) from dichloromethane. Before the adhesive layer was dry, a suspension of Cabogrip IIA® (Cabot Corp.), supplied as a 20% aqueous dispersion of colloidal (<1 μm) fumed silica, was coated at the level indicated in the Table over the adhesive layer. The fumed silica was coated from a methanol and water mixture without a binder and is thus a "wash overcoat" rather than a discrete overcoat.

Testing for tackiness was done by first clarifying the coated adhesive by heating with a hot air gun for approximately three seconds. This removes the crystallinity by melting and brings the adhesive to its tackiest state. Two clarified sheets were then laminated, adhesive-face to adhesive-face, at room temperature with rollers. The level of tack between the two sheets was then estimated using an Instron Universal Testing Machine Model TM-1122. A one-inch wide sample was cut from the composite and formed into a T-peel joint for testing at a peel rate of 20 inches/min. The results obtained are tabulated in the Table.

The adhesion testing was done by laminating two cover sheets, adhesive-face to adhesive-face in a Kodak Readyprint Laminator (adjusted so that the adhesive reached 100°C). The laminated sheets were allowed to come to room temperature and the adhesion was measured using the same test as described above. In practice, an imaged thermal transfer print would be placed between the two cover sheets. The following results were obtained:

Table

Fumed Silica (g/m ²)	Tack (g/in.)	Adhesion (g/in.)
0	>2000	>5000
.01	>2000	>5000
.05	>2000	>5000
.10	>2000	>5000
.20	<100	>5000
.30	<100	>5000
.40	<100	>1000
.50	<100	>1000
.60	<100	>1000

The above results show that at least 0.2 g/m² of the anti-tack agent is required in order to reduce the tackiness from >2000 to <100 g/in. as measured by the Instron Testing Machine. The adhesion between sheets is also reduced at levels greater than 0.4 g/m².

Claims

1. A thermal print element comprising a support having thereon a layer containing a thermally-transferred dye image, characterized in that said element has at least one layer of adhesive thereon having an anti-tack surface, said anti-tack surface comprising at least 0.2 g/m² of particulate material having a particle size up to 20 μ m.

2. The element of Claim 1 characterized in that said particulate material is fumed silica, silica, alumina or polystyrene matte beads.

3. The element of Claim 1 characterized in that said particulate material is present from 0.2 to 0.3 g/m².

4. The element of Claim 1 characterized in that said adhesive comprises a linear, random copolyester of one or more aromatic dibasic acids and one or more aliphatic diols, modified with up to 30 mole % of one or more aliphatic dibasic acids, said copolyester having a melt viscosity of between 1,000 and 20,000 poise at 150° C.

5. The element of Claim 4 characterized in that said aromatic dibasic acid is terephthalic acid, isophthalic acid, dipicolinic acid or 2,2-bis(p-carboxyphenyl)propane, said aliphatic diol is ethyleneglycol, diethyleneglycol, triethyleneglycol, 1,4-butanediol, 1,2-propanediol, 1,3-propanediol, 1,6-hexanediol, cyclohexanedimethanol, or 1,4-cyclohexanediol, and said aliphatic dibasic acid is sebacic acid, glutaric acid, adipic acid, azelaic acid, or 1,4-cyclohexanedicarboxylic acid.

6. The element of Claim 4 characterized in that said copolyester is formed from 1,4-butanediol, sebacic acid, terephthalic acid, and isophthalic acid.

7. The element of Claim 1 which has a cover sheet laminated to at least one outer surface by said adhesive.