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(54) A toner imageable film.

(57) A toner imageable film for use with an overhead projector which provides a transparent clear projected image,comprising a transparent film substrate bearing on one major surface thereof a toner receiving layer, wherein the toner receiving layer has a lower softening point than the toner with which it is used.

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The present invention relates to an imageable transparent film for use with an overhead projector and in particular, to a toner imageable transparent film preferred for color toner imaging and projection of a high quality color image.

With the recent developments in the reprographic arts, reprographic processes are now used for forming color images on transparent films intended for projection via an overhead projector (hereinafter "OHP"). In these processes, black or colored toner is deposited patternwise onto the transparent film by using a reprographic apparatus, commonly called a copier, commercially available from a variety of manufacturing companies.

The toner imaged film for projection prepared accordingly in a copier suffers from lack of clarity in the projected image. Particularly when a color toner image is applied on the transparent film, dark blurred areas in the image are directly observable when the image is projected on the screen.

To solve this problem and to improve clarity and transparency of a projected image,

JP-A- 61-36756 and 61-36762 disclose a process comprising overlaying a thin film to a toner image deposited onto a transparent film; and removing the thin film after melting the toner image by applying heat and pressure. Transparency of color image projection is improved by the above described process, however, an additional apparatus for melting the toner is required, and the process is more complicated.

JP-A- 2-38090 discloses a process comprising overlaying a thermoplastic resin film 20 μm or less in thickness, preferably 10 μm or less, on a toner image deposited onto a transparent film, and laminating the overlapped resin films under heat and pressure. In the above disclosed process, the thermoplastic resin film must have a higher softening point than the toner. This process however does not provide remarkable improvement in transparency or clarity of a toner image projected on a screen, and is a more complicated and expensive process using two film layers for each image desired.

One major reason that a transparent clear projection image is not provided by the prior art procedure is believed to be that the toner image which is formed using a copier has a rough surface. Light incident on the transparent film bearing such an image is scattered and diffused by the rough surface of the toner image, and the amount of light passed through the toner image is decreased. As a result, a dark blurred image is projected on the screen.

The present invention overcomes the above described prior art problems, and provides a toner imageable film which is imageable on commercial copiers, and provides a transparent clear projection image on the screen.

The present invention provides a toner imageable film comprising a transparent film substrate bearing on one major surface thereof a toner receiving layer, wherein the toner receiving layer has a lower softening point than the toner with which it is imaged.

The transparent film substrate employed in the present invention is not limited, but includes any transparent material generally used for imageable sheets. Materials having good transparency, heat-resistance, strength and rigidity are preferred. The preferred thickness of such materials is from 25-175 μm thick. Specific examples of suitable materials include polyesters such as polyethylene terephthalate and cellulose esters.

The toner receiving layer of the present invention comprises a resin having good transparency and good compatibility with a toner resin. A resin having an approximately equal refractive index with a toner resin is preferably employed, since such a resin does not inhibit light transmittance of the toner image.

The resin employed for the toner receiving layer must have a lower Softening point than the toner. By applying pressure at elevated temperature to a softened toner receiving layer with unmelted rigid toner, a surface of the toner image is leveled while retaining its good resolution. Preferred toner receiving layers of the present invention have a softening point of 100 °C or less, more preferably from 40-80 °C, since most of toners generally employed at the present reprographic art have softening points ranging from approximately 8 °C to 120 °C, preferably 80 °C to 120 °C.

The term "softening point" as used in this specification means a temperature at which a rigid resin softens to a rubber-like state, or at which crystal portions of the resin molecules melt. The softening point may be determined using a ring and ball test method or a needle intrusion test method.

Preferred examples of resins employed in toner receiving layers of the invention include phenoxy resins, cyanate resins, polyester resins may be employed in the present invention. Epoxy resins having a number average molecular weight of not more than 2000 are preferred resins. Since such an epoxy resin is sensitive to heat, it immediately melts upon heating and easily engulfs a toner particle therein, resulting in a toner image with a more smooth and level surface.

Specific examples of these resins include "EPIKOTE 1001", having a molecular weight of about 900, and a softening point of 64 °C, "EPIKOTE 1003", having a softening point of 51.2 °C and "EPIKOTE 1004", having a molecular weight of 1600 and a softening point of 59.8 °C, all of which are commercially available

from Shell Chemical Co.

While the epoxy resins above described may become turbid under low temperature conditions, this may be overcome by controlling the thickness of the toner receiving layer or by employing a low molecular weight diluent such as ethylene glycol and propylene glycol.

A variety of additives such as antioxidants, viscosity controlling agents and UV absorbers may be included in a resin employed in the present invention, in such amounts that the additive will not interfere with required features of the toner receiving layer such as transparency and softening point.

UV absorbers are preferred additives because in recent years, toner particles have been finely ground in order to provide higher resolution and improved transparency to a toner image. Such fine toner particles may cause light susceptibility of the toner image. The use of a toner receiving layer including a UV absorber can remarkably improve light resistance of the toner image against ambient light or irradiation from the OHP light source.

Generally, a UV absorber is employed in an amount 0.005-0.10, preferably 0.05-5 parts by weight based on 100 parts by weight of a resin for the toner receiving layer.

Useful toners are not limited, but include conventional thermoplastic toners known to those skilled in the art. For example, toners formed from styrene-(meth)acrylic acid copolymers, styrene-acrylate copolymers, bisphenol-A epoxy resins and polyester resins may be employed with imageable sheets of the invention. Average particle size of the toner varies, but preferably is in the range of about 7-30 μm, for good resolution of the resulting toner image.

The use of colored toners such as cyan, magenta or yellow provides a color toner image useful in the present invention.

A toner imageable film of the present invention is produced by applying a toner receiving layer onto a major surface of a transparent film substrate. The toner receiving layer can be applied by various coating procedures which include, for example, Mayer bar coating followed by drying the coating or knife coating.

Dry thickness of the toner receiving layer is preferably more than 50% of the toner particle size. If the layer thickness is less than 50% of the toner particle size, the image surface may not be smooth enough. Since an average particle size of toner generally employed is in the range of 6-7 μm, thickness of the toner receiving layer is preferably at least 3 μm, more preferably at least 10 μm.

If the image receiving layer is too thick, it may interfere with light transmittance through the final image. Maximum thickness of the toner receiving layer is preferably up to 100 μm, more preferably up to 75 μm.

A toner imaged film of the present invention which can provide a transparent clear projected image may be produced by the following process. A thermoplastic toner is imagewise deposited onto a toner receiving layer surface of an imageable film of the present invention in the copier. The toner may be black or colored. The resulting film bearing a toner image thereon is then passed through the heat pressure roll of the copier to engulf the toner image in the resin of the toner receiving layer, and "fix" the image. Alternatively, an "unfixed" image can be removed from the copier, and separately heat pressed, although this is less desirable.

During this heat-pressing step, since the toner receiving layer is softened by heat while the toner particles are kept rigid, the toner particles are easily pressed by the heat pressure roll into the toner receiving layer. Gaps between the individual toner particles are filled with the softened toner receiving layer, and the formerly rough surface of the toner image is now smooth an level. As a result, scattering and diffusing of light incident on the imaged film is prevented, and a clear transparent projection image is obtained. The heat pressure roll preferably has a maximum temperature higher than the softening point of the toner receiving layer and lower than the softening point of the toner. If the temperature of the heat pressure roll is lower than the softening point of the toner receiving layer, toner particles will not be properly enveloped and covered by the toner receiving layer by pressing, and the surface of the toner image may still be too rough. If the temperature of the heat pressure roll is higher than the softening point of the toner, the toner will flow from the desired position, and a blurred toner image results.

Examples

The invention is further illustrated by the following non-limiting examples. The term "parts", as used herein, means parts by weight, unless otherwise indicated.

Example 1

First, a solution for a toner receiving layer was prepared by mixing an epoxy resin blend (T_g = -1.2 °C) comprising 200 parts of "EPIKOTE 1001" available from Shell Chemical Co. and 100 parts of "EP4901E"

available from Asahi Denka K.K., with 5% by weight THF, based on the epoxy resin blend. The solution for the toner receiving layer was then applied to a surface of the polyethylene terephthalate (PET) film having 80 μm (4 mil) thickness using a #10 Mayer bar, and the sheet was then dried for 10 minutes at 65° C.

Red and blue toner images were independently formed on the resulting transparent film by using a "KONICA 8010 MULTI COLOR COPYING MACHINE" available from Konica K.K. Each transparent film bearing a toner image was heat-pressed by passing through the reproductive apparatus again at a copying mode. The toner employed was a pigmented bisphenol-A epoxy resin having an average particle size of about 19 μm and a melting point of 100-105° C.

For comparison, red and blue toner images were independently formed on PET film having no toner receiving layer thereon by using the above identified copier.

The light transparency of all the resulting toner images were evaluated using transparent visible light spectroscopy, employing a model 330 spectrophotometer available from Hitachi K.K. The results are indicated in Table 1.

Table 1

Light Transmittance %		
Toner Color	With TRL^{-1}	Without TRL
Blue (500 nm^{-2})	47	43
Red (650 nm^{-2})	60	49

$^{-1}$ Toner receiving layer.
$^{-2}$ A wavelength of a light incident to a toner image.

Comparative Examples 1 and 2

Red and blue toner images were independently formed on PET film having no toner receiving layer thereon by using "KONICA 8010 MULTI COLOR COPYING MACHINE" available from Konica K.K. as described in Example 1. A polyester film of 10 μm thick was overlaid atop the resulting toner image. The overlapped film was then laminated by using a laminator available from Ushio K.K. to melt the toner between the two films. Transfer speed of the laminator was set at 9.5 mm/sec, and laminating temperatures were set at 190° C and 130° C, respectively.

Light transparency of the resulting toner image were evaluated as described in Example 1. The results were indicated in Table 2.

Table 2

Light Transmittance %		
Toner Color	Laminating Temp. of 130° C	Laminating Temp. of 190° C
Blue (500 nm*)	24.9	33.9
Red (650 nm*)	26.0	35.0

*A wavelength of a light incident to a toner image.

Claims

1. A toner imageable film suitable for use with an overhead projector, comprising a transparent film substrate bearing on at least one major surface thereof a toner receiving layer wherein said toner receiving layer has a softening point of not more than 100° C.

2. The toner imageable film according to claim 1, wherein the toner receiving layer has a softening point of 40-80° C.

3. The toner imageable film according to claim 1 or 2, wherein the toner receiving layer comprises an epoxy resin having a number average molecular weight of not more than 2000.

4. The toner imageable film according to any one of claims 1 to 3, wherein the toner receiving layer has a thickness of from 3 μm to 100 μm.

5. The toner imageable film according to any one of claims 1 to 4, wherein the toner receiving layer comprises a UV absorber.

6. A process for producing a toner imaged film capable of providing a clear image when projected comprising the steps of:

depositing thermoplastic toner onto a toner receiving layer surface of the toner imageable film according to any one of claims 1 to 5 to form a toner image; and

applying pressure to the surface bearing toner image at elevated temperature to engulf the toner image in the toner receiving layer.

7. The process according to claim 6 wherein the thermoplastic toner has a higher softening point than the toner receiving layer.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 11 9450

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	EP-A-0 501 360 (CANON) * page 3, line 38 - page 4, line 58 * * page 8, line 40 - page 10, line 50; figures 1-6 *	1,2	G03G7/00
Y		3,6,7	

Y	PATENT ABSTRACTS OF JAPAN vol. 13, no. 89 (P-836) 2 March 1989 & JP-A-63 271 357 (MATSUSHITA ELECTRIC) 9 November 1988 * abstract * & DATABASE WPI Section Ch, Week 8851, Derwent Publications Ltd., London, GB; Class A89, AN 88-363204 & JP-A-63 271 357 (MATSUSHITA ELECTRIC) 9 November 1988 * abstract *	3	

Y	PATENT ABSTRACTS OF JAPAN vol. 16, no. 386 (P-1404) 18 August 1992 & JP-A-04 125 567 (TOSHIBA) 27 April 1992 * abstract * & DATABASE WPI Section Ch, Week 9223, Derwent Publications Ltd., London, GB; Class A89, AN 92-189509 & JP-A-4 125 567 (TOSHIBA) 27 April 1992 * abstract *	6,7	TECHNICAL FIELDS SEARCHED (Int.Cl.6) G03G G03F

A	EP-A-0 474 278 (ARKWRIGHT) 11 March 1992 * page 3, line 27 - line 43 * * page 4, line 8 - line 13 *	1,2,6	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	30 January 1995	Manntz, W

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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E : earlier patent document, but published on, or after the filing date
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