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(54) A dye-transfer-type thermal printing sheet.

(57) A dye-transfer-type thermal printing sheet is disclosed which comprises a substrate and a colored layer disposed on the substrate, the colored layer comprising wax and one or more fatty acid amides. The dye-transfer-type thermal printing sheet has a high recording density when an image is recorded on an image-receiving sheet, and may readily be peeled off the image-receiving sheet once recording is complete. Its properties are largely unaffected by transport and storage.

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Description

A DYE-TRANSFER-TYPE THERMAL PRINTING SHEET

1. Field of the invention:

This invention relates to a dye-transfer-type thermal printing sheet that is used for recording by means of thermal transfer. More particularly, it relates to a transfer-type thermal printing sheet that is effective when the dye used is likely to sublimate. This printing sheet can be used for high-speed printing by electronic devices with heads through which current flows, laser elements, or the like.

2. Description of the prior art:

Dye-transfer-type printing sheets comprise a substrate and a colored layer. In the thermal recording method that uses these dye-transfer-type printing sheets, some of the sublimated dye that is contained in the colored layer is transferred to an image-receiving sheet such as a recording paper, resulting in an image on the image-receiving sheet. The colored layer is usually composed of a dye that is likely to sublimate and a bonding material that binds this colored layer on the top of the substrate.

The dye-transfer-type printing sheet composed of a substrate and a colored layer contains non-volatile granules, surfactants with aliphatic groups, silicones, or fluorides so as to prevent the sticking together of the colored layer and the image-receiving sheet and also the transfer by pressure of the dye from the colored layer to the image-receiving sheet, both of which phenomena are causes of deterioration of the image quality. This kind of transfer printing sheet has the following problems:

(1) The image-receiving sheet and the colored layer readily stick together when an image is being recorded on the image-receiving sheet.

(2) When separating agents, surfactants, and the like that have aliphatic groups or silicones are contained in the colored layer in order to help to prevent the sticking together of the colored layer and the image-receiving sheet at the time of the recording of the image on the image-receiving sheet, the separating agents and surfactants that have aliphatic groups or silicones gradually leave the surface of the colored layer with the passage of time. Because the dye is soluble to some extent in the aliphatic compounds or the silicone oils, the dye that has dissolved in the separating agents or the surfactants with the aliphatic groups or silicones that left the surface of the colored layer condenses there with time, and changes the properties of the sheet in conveyance and storage; or the dye spreads from the front surface of the printing sheet to the back surface thereof while the printing sheet is rolled up; or the dye is transferred to the image-receiving sheet even when there is no signal during recording because of pressure (namely, pressure transfer of the dye arises).

(3) In order to prevent the sticking together of the colored layer and the image-receiving sheet during the recording of an image on the image-receiving sheet, and to prevent pressure transfer of the dye, non-volatile granules are mixed in large numbers into the colored layer, which prevents the recording density from being high at the time of the transfer of the image and letters to the image-receiving sheet, and prevents the image and letters from being clear and distinct.

(4) Even if fluoride-type surfactants are added to the ink with which the colored layer is formed so as to contain a fluorine-containing polymer in the surface area of the colored layer, the removal of the image-receiving sheet from the colored layer will be unsatisfactory when the image-receiving sheet does not act as a remover.

(5) The method of incorporating a fluorine-containing polymer into the surface area of the colored layer by means of PVD and plasma polymerization makes it more complicated to manufacture the printing sheet.

SUMMARY OF THE INVENTION

The dye-transfer-type thermal printing sheet of this invention, which overcomes the above-discussed and numerous other disadvantages and deficiencies of the prior art, comprises a substrate and a colored layer disposed on said substrate, said colored layer containing wax and fatty acid amides.

In a preferred embodiment, the fatty acid amides are at least one selected from the group consisting of oleamide, stearamide, erucamide, lauramide, oxystearamide, and n-oleylpalmitamide.

In a preferred embodiment, the wax is at least one selected from the group consisting of paraffin wax, microcrystalline wax, and oxidized wax. The wax and the fatty acid amides, respectively, are contained in said colored layer in the proportion of 1 to 10% by weight.

In a preferred embodiment, the heat deformation temperature of said entire colored layer is in the range of 60 to 120°C. The colored layer contains a resin with a glass transition temperature of 65°C or more as a binding material. The binding material that constitutes said colored layer is a reactant derived from the reaction of cross-linking agents with resins with a glass transition temperature of 65°C or more.

In a preferred embodiment, an adhesive layer is disposed between said substrate and said colored layer, said adhesive layer containing an adhesive resin and dye. The dye that is contained in said adhesive layer includes dye that constitutes the portion of said colored layer corresponding to at least the upper portion of said adhesive layer. Percentages of the dye that is contained in said adhesive layer are one half or more those of the dye of said colored layer that corresponds to the upper portion of said adhesive layer. An adhesive resin that constitutes said adhesive layer is at least one selected from the group consisting of saturated polyester resin, polyurethane resin, and acrylic resin.

Thus, the invention described herein makes possible the objectives of (1) providing a dye- transfer-type thermal printing sheet with high recording density at the time of the recording of an image on an image-receiving sheet; (2) providing a dye-transfer-type thermal printing sheet, the properties of which will deteriorate only slightly in conveyance and storage; and (3) providing a dye-transfer-type thermal printing sheet that can be peeled off readily from the image-receiving sheet once recording has been accomplished.

BRIEF DESCRIPTION OF THE DRAWINGS

This invention may be better understood and its numerous objects and advantages will become apparent to those skilled in the art by reference to the accompanying drawings as follows:

Figure 1 is a sectional front view showing a dye-transfer-type thermal printing sheet of this invention that has a substrate and a colored layer.

Figure 2 is of a graph showing the relationship between the percentage of dye in the colored layer and the heat deformation temperature of the entire colored layer.

Figure 3 is of a graph showing the relationship between the heat deformation temperature of a binding resin that constitutes the colored layer and the heat deformation temperature of the entire colored layer.

Figure 4 is of a graph showing the relationship between the heat deformation temperature of the entire colored layer and the recording density.

Figure 5 is of a graph showing the results of a tensile test in which the heat deformation temperature of the entire colored layer was measured with a steady rate of temperature increase under a constant load by the use of a thermo-mechanical tester.

Figure 6 is of a graph showing the results of a needle-penetration test in which the heat deformation temperature of the entire colored layer was measured under a constant load by the use of the thermo-mechanical tester.

Figure 7 is a sectional front view showing another dye-transfer-type thermal printing sheet of this invention.

Figure 8 is a sectional front view showing an image-receiving sheet used in this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 shows a dye-transfer-type thermal printing sheet 11 of this invention, which comprises a substrate 1 and a colored layer 2. There are no particular restrictions concerning the substrate 1, provided that it supports the colored layer 2 that contains the dye to be transferred from the colored layer 2 to an image-receiving sheet (not shown). For example, a film made of PET, cellophane, polyamide, polyarylate, or the like can be used as the substrate 1. Heat-resistance and/or smoothness can be added to these materials. Materials that have conductivity can be also used as the substrate 1 so as to perform current-heating recording and induction heating recording.

The colored layer 2 is composed of, at least, dye, a binding material, fatty acid amides, and wax. The image quality becomes rough and/or the recording sensitivity is lowered if the dye has condensed, has crystallized, or the like, so the dye must be soluble in the binding material. The dye should be a dye that confers color and/or a color former.

The lower the glass transition temperature of the binding material of the colored layer, the higher the recording density at the time of the recording of the image on the image-receiving sheet. However, because the colored layer is readily deformed or melted with the application of heat, it can readily adhere to the image-receiving sheet. In order to prevent such adhesion, generally, surfactants and separating agents that have aliphatic groups or silicones are added to the colored layer. These surfactants and separating agents have a low molecular weight, so they move to the surface of the colored layer with the passage of time to thereby prevent adhesion by the incompatibility or non-adhesion of the long-chain aliphatic segment or the dimethylsiloxane segment. However, because the long-chain aliphatic segments and the dimethylsiloxane segments themselves dissolve the dye thereinto, the properties of the printing sheet can change during commercial use such as transport and storage; the dye may spread from the front surface of the printing sheet to the back surface thereof when the printing sheet is wrapped; or pressure transfer may occur. When polymers that contain fluorine are present in the surface area of the colored layer, the above problems do not arise, because the fluoroalkyl group of the polymers that contain fluorine does not dissolve the dye. Because the intermolecular energy of the fluoroalkyl group is small, which makes the surface energy small, there is incompatibility and non-adhesion between the fluoroalkyl group and the resin that forms the image-receiving sheet, so that the removability of the image-receiving sheet from the printing sheet after recording is finished is improved. However, the removability of an image-receiving sheet with good durability of the recorded image from the printing sheet is still inferior; the reason is that an image-receiving sheet with good durability has a coloration layer that does not contain substances that have parting properties such as those of silicone oil or silicone surfactants.

Moreover, when a wax that has some incompatibility with the resins that are used to form the coloration layer of the image-receiving sheet is used as a component of the colored layer of the printing sheet, it gives rise to the problems of maldistribution in the colored layer that is obtained, so that the passage of the printing sheet at the time of recording is poor, and dye transfer from the front surfaces of the printing sheet to the back surface thereof when the printing sheet is stored in a rolled-up state occurs. Moreover, the removability of the image-receiving sheet from the printing sheet is not improved.

However, the colored layer of the dye-transfer-type thermal printing sheet of this invention contains, in addition to a dye and a binding material, wax and fatty acid amides that make the wax compatible with thermoplastic resins. Thus, it is possible to suppress the movement of the wax to the surface of the colored layer, which solves the problems mentioned above. Moreover, it is possible to achieve satisfactory removal of image-receiving sheets that could not be used up until now because the removability of these image-receiving sheets from the printing sheet was unsatisfactory. These image-receiving sheets are sheets that have a coloration layer on which an image with good durability is recorded because the coloration layer does not contain substances with parting properties such as silicone oil or silicone surfactants.

The wax incorporated into the colored layer 2 is not limited to any particular wax, but can be paraffin wax, microcrystalline wax, oxidized wax, polyethylene wax, polypropylene wax, polystyrene wax, and other kinds of vinyl compounds with a low degree of polymerization. From the point of view of removability, paraffin wax, microcrystalline wax, and oxidized wax are preferable. If the proportion of wax to the entire colored layer is very large, the compatibility of the wax with the binding resin is lowered, and so the amount of wax that should be incorporated into the colored layer is from 1 to 10% by weight.

As fatty acid amides, monoamides such as stearamide, oleamide, cis-13-docosenoamide, lauramide, palmitamide, behenamide, ricinolamide, oxystearamide, methylolstearamide, methylolbehenamide and/or visamides such as methylenebisstearamide, ethylenebisstearamide, ethylenebisoleamide, and ethylenebislauramide can be used. If the solubility of the ink in solvents is considered when the ink is being prepared for use in the colored layer, oleamide, stearamide, cis-13-docosenoamide, lauramide, oxystearamide, and n-oleylpalmitamide are preferable. If the amount of fatty acid amide in the entire colored layer is very large, the stability during storage of the printing sheet is lowered. From the point of view of the compatible effect of the wax and the binding-resin material, the amount of fatty acid amide should be about one-half to two times that of wax, and it is preferable that the amount of fatty acid amide in the colored layer be 1-10% by weight.

The heat deformation of the entire colored layer should be 60-120° C. For example, when the colored layer consists of a dye and a binding material, the heat deformation temperature of the entire colored layer changes with changes in the amount of dye in the colored layer as shown in Figure 2. When the proportion of dye in the colored layer is fixed, the heat deformation temperature of the entire colored layer changes depending on the heat deformation temperature or on the glass transition temperature of the resin that is used as the binding material as shown in Figure 3. Even when wax and fatty acid amide are present, the heat deformation temperature of the entire colored layer decreases if the proportion in the colored layer are large. Moreover, when the percentage of dye in the colored layer and the kind of binding material used are changed, the relationship between the heat deformation temperature of the entire colored layer and the recording density have the relationship shown in Figure 4. If the heat deformation temperature of the entire colored layer is 120° C or less, the heat at the time of recording readily softens the entire colored layer, and the movement of the dye to the front surface of the colored layer is thereby facilitated, so that the dye is more readily transferred from the colored layer to the image-receiving sheet by sublimation, heat diffusion, and/or the like. If the heat deformation temperature of the entire colored layer is 60° C or higher, migration of dye that causes transfer to the image-receiving sheet surface or condensation of dye such as was mentioned above does not occur, because the ambient temperature during transport and storage in industrial and other uses is generally les than 60° C.

The following method can be used to keep the heat deformation temperature of the entire colored layer at 60° C or more.

(1) Resins with a glass transition temperature (ASTM D1043) of 65° C or more can be used as the binding material. However, even in this case, if the dye in the colored layer or the other additives in the colored layer are used in high proportions, the heat deformation temperature of the entire colored layer will be lower, so that the above-mentioned use of such a resin will not meet the requirement of the heat deformation temperature of the entire colored layer being 60° C or more. As resins with a glass transition temperature of 65° C or more, there are, for example, polystyrene, acrylonitrile-styrene copolymer (AS resin), ABS resin, methacrylic resin, butyral resin, polycarbonate resin, polyester resin, polyurethane resin, chlorinated polyethylene, chlorinated polypropylene, and polysulfone.

(2) A cross-linking agent that will react with the resin to be used as the binding material is used as a component of the binding material so as to cross-link to the said resin:

As the cross-linking agent to be used, substances with carbon-carbon double bonds and/or epoxy groups, alkyd resins, isocyanate, amines, and the like can be listed. With their use, it is possible to attain a heat deformation temperature of the entire colored layer of 60° C even if the glass transition temperature of the resin used to form the binding material is less than 65° C. Of course, it is possible to use a resin with a glass transition temperature of 65°C or more.

Also, it is possible to decrease the proportion of the dye in the oolored layer in order to keep the glass transition temperature of the entire colored layer at 60°C or more. However, if this is done, the resulting recording density is insufficient, so this method is not practical.

The following method can be used to make the heat deformation temperature of the entire colored layer 120°C or less.

(1) To make the percentage of dye in the colored layer high:

By this method, when the heat deformation temperature of the entire colored layer is made 120°C or less, it is necessary to have a high proportion of dye if the glass transition temperature of the binding resin is extremely high, which can cause problems such as the excessive weakening of the mechanical strength of the colored layer itself, so care is needed.

(2) Addition of additives with relatively small molecular weight including fatty acid amide and wax to the colored layer and/or of polymers with a relatively low glass transition temperature to the colored layer:

As such additives and polymers, there are dispersants and plasticizers; lubricants to lend surface lubrication; preventers that prevent the colored layer from being charged with static electricity; fatty acid amides, wax, and surfactants for improving the separation of the image-receiving sheet from the colored layer after recording; polymers with excellent adhesion to the substrate; and the like.

The heat deformation temperature of the entire oolored layer is measured with a steady rate of temperature increase in a tensile test under a constant load or a penetration test under a constant load by the use of a thermo-mechanical tester, and defined as follows:

(1) With tensile test under a constant load:

The relationship between the stretching of the sample sheet and the passage of time (or the temperature) is as shown in Figure 5. The heat deformation temperature is the temperature at the intersection of the extended line (line A) in the relatively low temperature region in which the thermal expansion coefficient is constant and the extended line (line B) in the region in which the stretching of the sample is abruptly increased. The measurement conditions are as follows:

Sample sheet: A coating used to form the colored layer is coated onto glass or the like and dried, resulting in a sample film. The length of the sample film in the direction of tension is 30 ± 5 mm, the width thereof is 5 ± 0.5 mm, and the thickness thereof is 1.5 ± 0.5 µm. The load for tension is 10 g. The rate of temperature increase is 5°C/minute, starting at room temperature.

(2) With test of insertion of a needle (With penetration test under a constant load):

The relationship between the extent to which a needle entered the sample sheet and the passage of time (or the temperature) is as shown in Figure 6. The heat deformation temperature is the temperature at the intersection of the extended line (line A) in the relatively low temperature region in which the thermal expansion coefficient is constant and the extended line (line B) in the region in which the extent to which the needle entered the sample is abruptly increased. The measurement conditions are as follows:

Sample sheet: A coating used to form the colored layer is coated onto glass or the like and dried, giving a sample film. The length of the sample film is 5 mm or more; the width thereof is 5 mm or more; and the thickness thereof in the direction of compression is 0.5 mm or more. The weight of compression is 10 g. The cross-sectional diameter of the tip of the needle used in this test is 0.5 mm. The rate of temperature increase is 5°C/minute, starting at room temperature.

When the adhesion of the substrate to the colored layer of the printing sheet is not sufficient, as shown in Figure 7, it is possible to form an adhesive layer 3 between the substrate 1 and the colored layer 2. However, in general, if there is an adhesive layer, there is some dispersion of the dye from the colored layer to the adhesive layer, so the recording sensitivity declines. Thus, it is preferable that dye be incorporated into the adhesion layer, and it is preferable that the percentage of dye to be contained in the adhesive layer be 30% or more of the percentage of dye to be contained in the colored layer, and more preferably 50% or more. As the resin that is used as the adhesion layer, there are no particular limitations, provided that the substance confers adhesion between the substrate and the colored layer. As an oil-soluble resin that is used as the adhesion layer when the substrate is made of PET, there are saturated polyester resin, polyurethane resin, modified acrylic resin, and the like. As a water-soluble resin that is used as the adhesion layer, there are ionomer resin, acrylate resin, and the like. These resins can be further hardened by cross-linking agents.

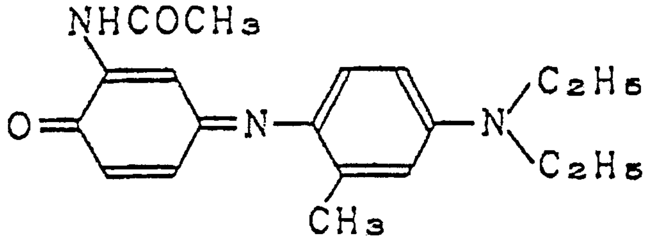
Figure 8 shows an image-receiving sheet 12 of this invention, which is composed of a substrate 4 and a coloration layer 5 disposed on the said substrate 4. As the substrate 4, it is possible to use ordinary paper, coated paper, art paper, synthetic paper, PET film, and so on. As the coloration layer 5, resin, etc., that can be colored well by the dye can be used.

Preparation of the dye-transfer-type thermal printing sheets:

Example 1

A heat-resistant and lubricating layer was disposed on the back surface of PET film with a thickness of 4 µm, resulting in a substrate. On the front surface of the PET film of the substrate, there was painted with a wire bar an ink obtained by dissolving, in a mixture of 42 g of toluene and 18 g of MEK as the solvents, 2 g of Dye A of the structural formula described below, 4 g of polyvinylbutylal (S-LEC BX-1; Sekisui Kagaku) as a binding material with a glass transition temperature of 86° C, 0.2 g of paraffin wax with a melting point of 50° C, and 0.2 g of oleamide. This was dried in a warm draft, resulting in a dye-transfer-type thermal printing sheet.

[Dye A]



Example 2

Here, 2.5 g of Dye A, 4 g of AS resin (Denki Kagaku Kogyo Co.; Denka Styrol AS-SU) as a binding material, 0,4 g of microcrystalline wax (Nihon Seiro Co.; Hi-Mic-2045), and 0.4 g of cis-13-docosenoamide were dissolved in 60 g of monochlorobenzene to make ink, which was then painted with a wire bar on the same substrate as was used in Example 1 and dried, resulting in a dye-transfer-type printing sheet.

Example 3

Here, 3.0 g of Dye A, 4.0 g of polycarbonate resin (Teijin Kasei Co.; Panlite L-1225) as a binding material, 0.2 g of paraffin wax, and 0.2 g of oleamide were dissolved in 60 g of dichloromethane to make ink, which was then painted with a wire bar on the same substrate as was used in Example 1 and dried in a warm draft, resulting in a dye-transfer-type printing sheet.

Example 4

Here, 2 g of Dye A, 3.2 g of acrylonitrilestyrene copolymer (Denki Kagaku Kogyo Co., Denka AS S-312) as a binding material, 0.8 g of a saturated polyester resin (Toyo Boseki Co.; Vylon RV-290) with a glass transition temperature of 77° C, 0.3 g of paraffin wax with a melting point of about 70° C, and 0.5 g of lauramide were dissolved in a mixture of 30 g of toluene and 30 g of MEK to make ink, which was then painted with a wire bar on the same substrate as was used in Example 1 and dried in a warm draft, resulting in a dye-transfer-type thermal printing sheet.

Example 5

Here, 3 g of Dye A, 4 g of a saturated polyester resin (Nihon Gosei Kagaku Kogyo Co.; polyester TP-236) with a glass transition temperature of 60° C, 0.4 g of isocyanate (Nihon Polyurethane Co.; Coronate L), 0.2 g of paraffin wax with a melting point of 70° C, and 0.2 g of oleamide were dissolved in 60 g of dichloromethane to make ink, which was then painted with a wire bar on the same substrate as was used in Example 1 and dried, after which it was left in a drier at a fixed temperature of 50° C for 4 hours, which hardened the colored layer, resulting in a dye-transfer-type thermal printing sheet.

Example 6

Here, 1 g of Dye A, 4 g of a saturated polyester resin (Toyo Boseki Co.; Vylon 200), and 0.3 g of isocyanate (Nihon Polyurethane Co.; Coronate L) were dissolved in 60 g of dichloromethane to form a coating, which was then painted with a wire bar on the top surface of the same substrate as was used in Example 1 and dried, giving an adhesive layer with a thickness of about 0.2 µm. On the top surface of this layer, the same ink as was used in Example 3 was painted with use of a wire bar and dried, resulting in a dye-transfer- type thermal printing sheet.

Control 1

On the same substrate as was used in Example 1, an ink that was obtained by dissolving, into a mixture of 42 g of toluene and 18 g of MEK, 2 g of Dye A, and 4 g of polyvinylbutyral (Denki Kagaku Kogyo Co.; Denkabutyral #6000-C) with a glass transition temperature of 90° C as a binding material was applied with a wire bar and dried, giving a dye-transfer-type thermal printing sheet.

Control 2

On the same substrate as was used in Example 1, an ink that was obtained by dissolving 2 g of Dye A, 4 g of polyvinylbutylal (same as above) as a binding material, and 0.2 g of paraffin wax with a melting point of 50° C into 60 g of the same solvent as was used in Control 1 was applied with a wire bar and dried with a warm draft, giving a dye-transfer-type thermal printing sheet.

Control 3

On the same substrate as was used in Example 1, an ink that was obtained by dissolving 2 g od Dye A and 4 g of polysulphone (Nissan Kagaku Kogyo Co.; P-1700) into 60 g of chlorobenzene was applied with a wire bar and dried with a warm draft, giving a dye-transfer-type thermal printing sheet.

Control 4

On the same substrate as was used in Example 1, an ink that was obtained by dissolving 5 g of Dye A dna 4 g of polysulphone (Nissan Kagaku Kogyo Co.; P-1700) into 60 g of chlorobenzene was applied with a wire bar and dried with a warm draft, giving a dye-transfer-type thermal printing sheet.

Control 5

On the same base as was used in Example 1, a coating that was obtained by dissolving 4 g of saturated polyester resin (Toyo Boseki Co.; Vylon 200) and 0.3 g of isocyanate (Nihon Polyurethane Co.; Coronate L) into 60 g of dichloromethane was applied with a wire bar and dried, resulting in an adhesive layer with a thickness of about 0.2 µm. On the top surface of this layer, the same ink that was used in Example 3 was applied, giving a dye-transfer-type thermal printing sheet.

Preparation of image-receiving sheets

Next, on the top surface of a piece of white synthetic paper made of PET, a coating that was obtained by dispersing 5 g of water-soluble polyester resin (Toyo Boseki Co.; Vylonal MD 1200; 34% solid), 1 g of an emulsion of colloidal silica complexed particles (Hoechst Gosei Co.; Movinyl 8020; 43% solid), and 0,05 g of a silicone-type surfactants (Nihon Yunika; NUC silicone L-720) in 30 g of water mixed with 15 g of ethanol was applied with a wire bar to give an image-receiving paper 1 with removability from dye-transfer-type thermal printing sheets.

In the same way, 5 g of a water-soluble polyester resin from the same source was dispersed in a mixture of 20 g of water and 10 g of ethanol and applied with a wire bar to give an image-receiving sheet 2 without removability from dye-transfer-type thermal printing sheets.

The following items were measured under the below-mentioned recording conditions for thermal heads by the use of the dye-transfer-type thermal printing sheets and the image-receiving sheets obtained above: the recording density; the force needed to remove the image-receiving sheet from the printing sheet per recording width after recording; the presence or absence of transfer of dye from the front surface of the printing sheet to the back surface of the printing sheet after storage for 200 hours at 60°C at 60% relative humidity with the printing sheets in a rolled condition; and the heat deformation temperature of the entire colored layer. The results of measurements of the above-mentioned items are shown in Table 1.

Recording conditions for thermal heads were as follows:

Line density of the main and sub-scanner: 6 dots/mm Recording electricity: 0.7 W/dot Time of heating of the head: 8 ms

Table 1

	Adhesive Layer	Image-Receiving Sheet	Recording Density at the Initial Stage	Force needed to remove the image-receiving sheet from the printing sheet	Transfer of dye from the front surface of the printing sheet to the back surface therecf	TH
Example 1	without	1 2	2.1 2.0	.5 2.0	None	65
Example 2	without	1 2	2.1 2.0	.5 2.0	None	65
Example 3	without	1 2	1.9 1.8	.3 1.5	None	80
Example 4	without	1 2	2.0 1.9	.5 2.0	None	65
Example 5	without	1 2	2.1 2.0	.5 2.5	None	65
Example 6	with	1 2	1.9 1.8	.3 1.3	None	80
Control 1	without	1 2	2.1 Not measurable	20.0 Not removable	None	73
Control 2	without	1 2	1.9 Not measurable	25.0 Not removable	Found	70
Control 3	without	1 2	1.4 1.3	3.0 15.0	None	130
Control 4	without	1 2	1.9 Not measurable	15.0 Not removable	Found	55
Control 5	with	1 2	1.7 1.6	.3 1.5	None	80

The units used to express the removal of the image-receiving sheet from the printing sheet were g/cm. The measurements of the transfer of dye from the front surface of the printing sheet to the back surface thereof were made after storage for 200 hours at 60°C at 60% relative humidity. TH is the value found for the heat deformation temperature of the entire colored layer.

As described above, the dye-transfer-type thermal printing sheet of the invention that contains wax and fatty acid amides in its colored layer results in a high recording density and satisfactory properties for storage and removability of image-receiving sheets therefrom.

It is understood that various other modifications will be apparent to and can be readily made by those skilled in the art without departing from the scope and spirit of this invention. Accordingly, it is not intended that the scope of the claims appended hereto be limited to the description as set forth therein, but rather that the claims be construed as encompassing all the features of patentable novelty that reside in the present invention, including all features that would be treated as equivalents thereof by those skilled in the art to which this invention pertains.

Claims

1. A dye-transfer-type thermal printing sheet which comprises a substrate and a colored layer disposed on the substrate, the colored layer comprising wax and one or more fatty acid amides.

2. A dye-transfer-type thermal printing sheet according to Claim 1, wherein the fatty acid amides comprise at least one of oleamide, stearamide, cis-13-docosenoamide, lauramide, oxystearamide, and n-oleylpalmitamide.

3. A dye-transfer-type thermal printing sheet according to Claim 1 or 2, wherein the wax comprises at least one of paraffin wax, microcrystalline wax, and oxidized wax.

4. A dye-transfer-type thermal printing sheet according to any one of the preceding claims, wherein the wax and the fatty acid amides, are each included in the colored layer in a proportion of 1 to 10% by weight.

5. A dye-transfer-type thermal printing sheet according to any one of the preceding claims, wherein the heat deformation temperature of the entire colored layer is in the range of 60 to 120°C.

6. A dye-transfer-type thermal printing sheet according to Claim 5, wherein the colored layer comprises, as a binding material, a resin having a glass transition temperature of at least 65°C or a reactant derived from the reaction of cross-linking agents with a resin having a glass transition temperature of at least 65°C.

7. A dye-transfer-type thermal printing sheet according to any one of the preceding claims, wherein an adhesive layer comprising an adhesive resin and a dye is disposed between the substrate and the colored layer.

8. A dye-transfer-type thermal printing sheet according to Claim 7, wherein the dye in the adhesive layer includes dye that constitutes the portion of the colored layer corresponding to at least the upper portion of the adhesive layer.

A dye-transfer-type thermal printing sheet according to Claim 7 or 8, wherein the percentage of dye included in the adhesive layer is at least one half of that of the dye of the colored layer corresponding to the upper portion of the adhesive layer.

10. A dye-transfer-type thermal printing sheet according to any one of the preceding claims, wherein the adhesive resin included in the adhesive layer comprises at least one of saturated polyester resin, polyurethane resin, and acrylic resin.

11. Use of a dye-transfer-type thermal printing sheet as claimed in any one of the Claims 1 to 10 in the recording of an image on an image-receiving sheet.

Fig. 1

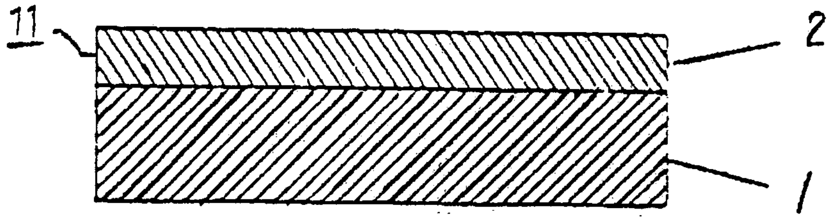

11
2
1

Fig. 2

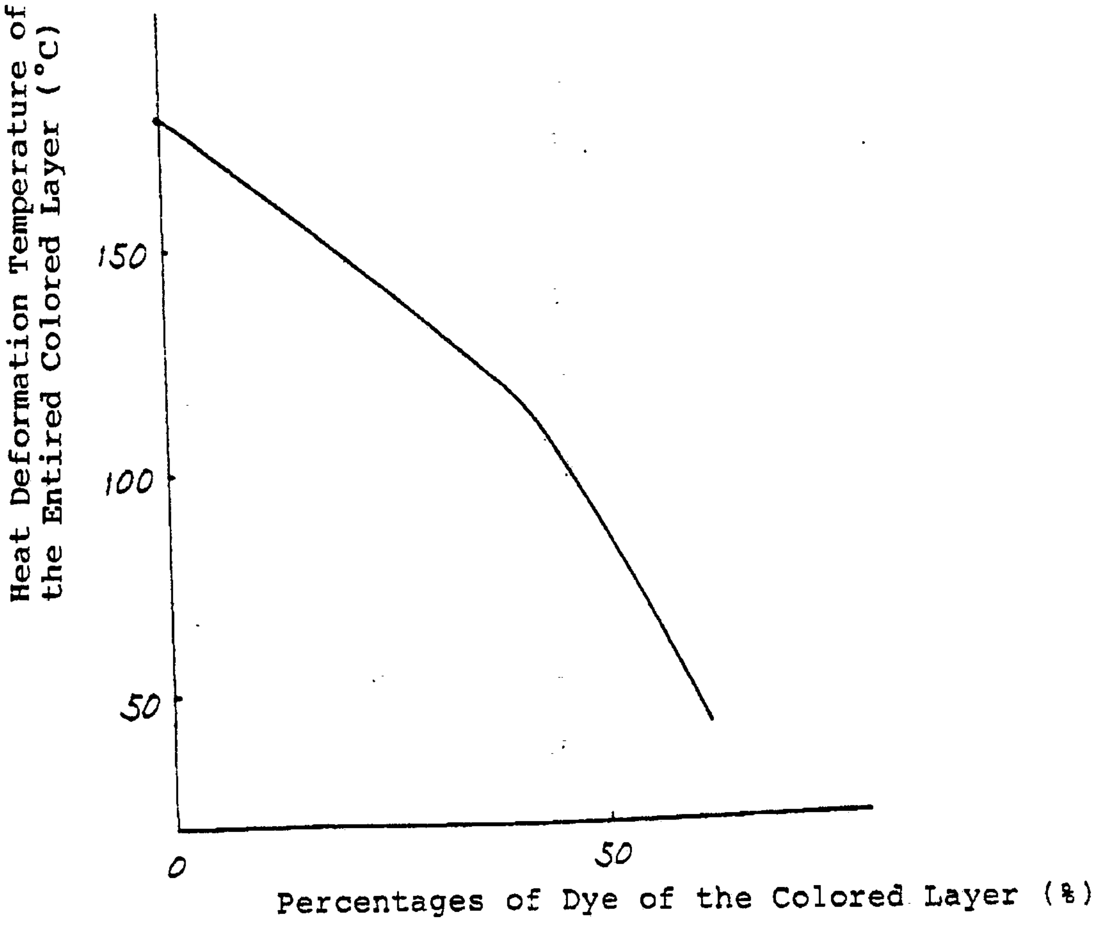

Heat Deformation Temperature of the Entired Colored Layer (°C)
150
100
50
0
50
Percentages of Dye of the Colored Layer (%)

Fig. 3

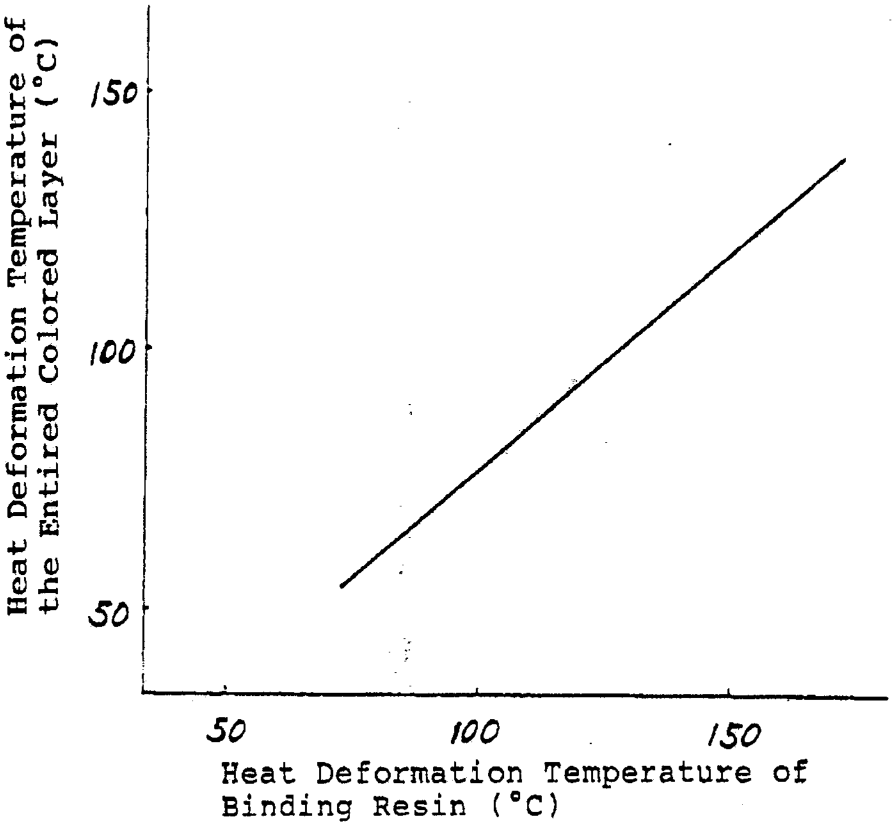

Heat Deformation Temperature of the Entired Colored Layer (°C)
150
100
50
50
100
150
Heat Deformation Temperature of Binding Resin (°C)

Fig. 4

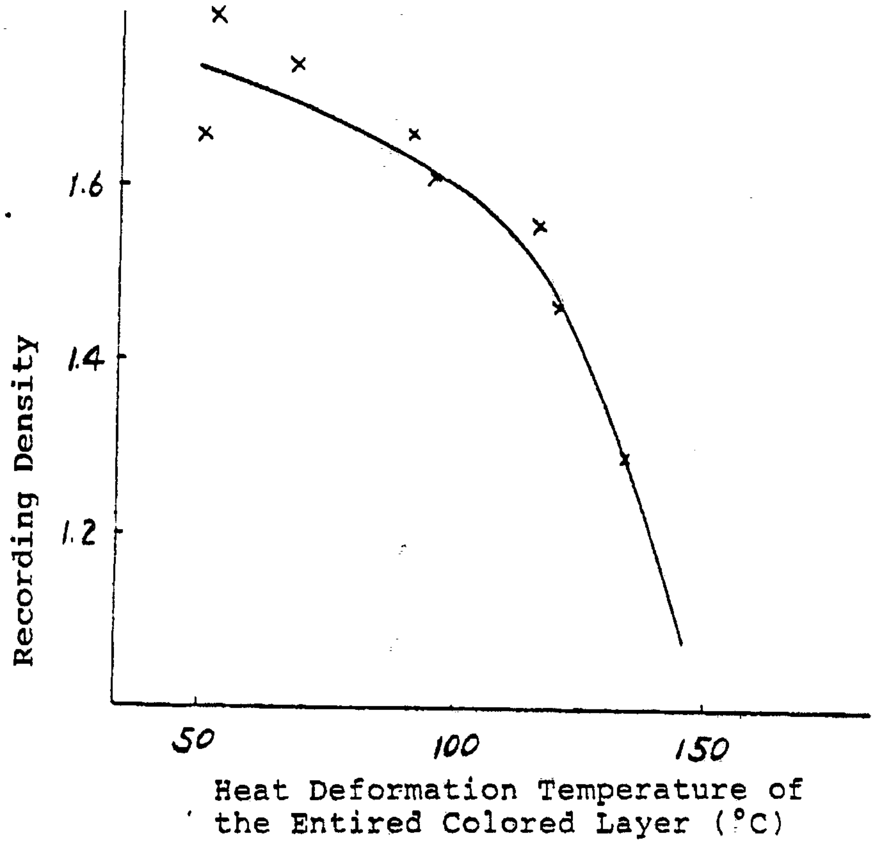

Recording Density
1.6
1.4
1.2
50
100
150
Heat Deformation Temperature of the Entired Colored Layer (°C)

Fig. 5

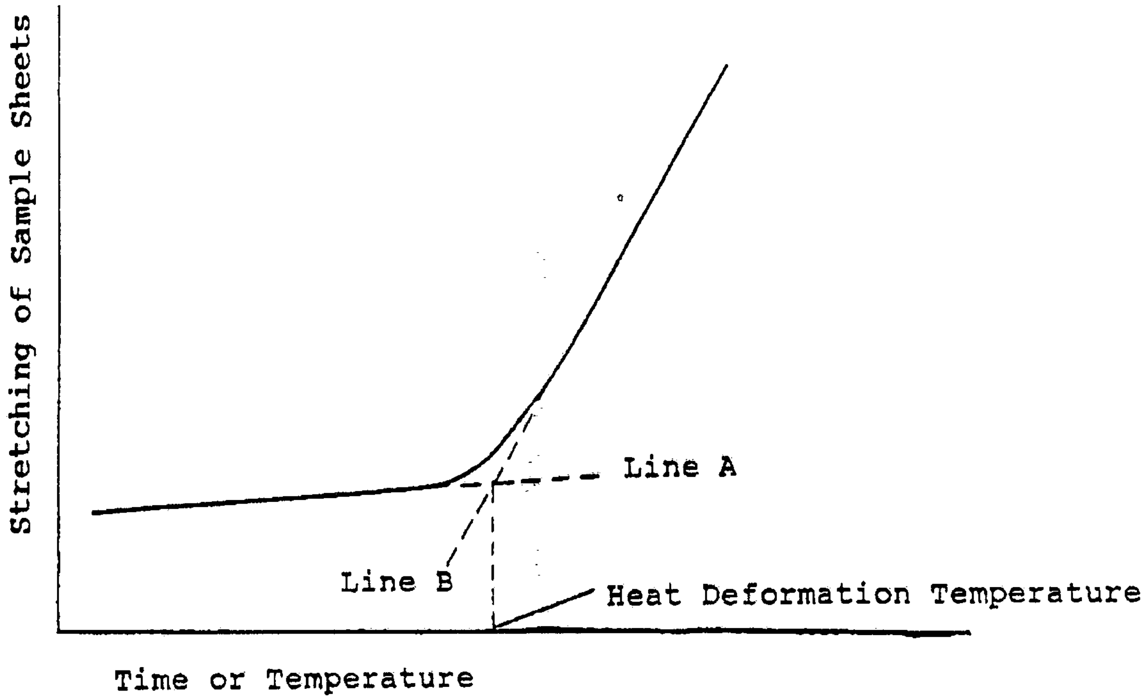

Stretching of Sample Sheets
Line A
Line B
Heat Deformation Temperature
Time or Temperature

Fig. 6

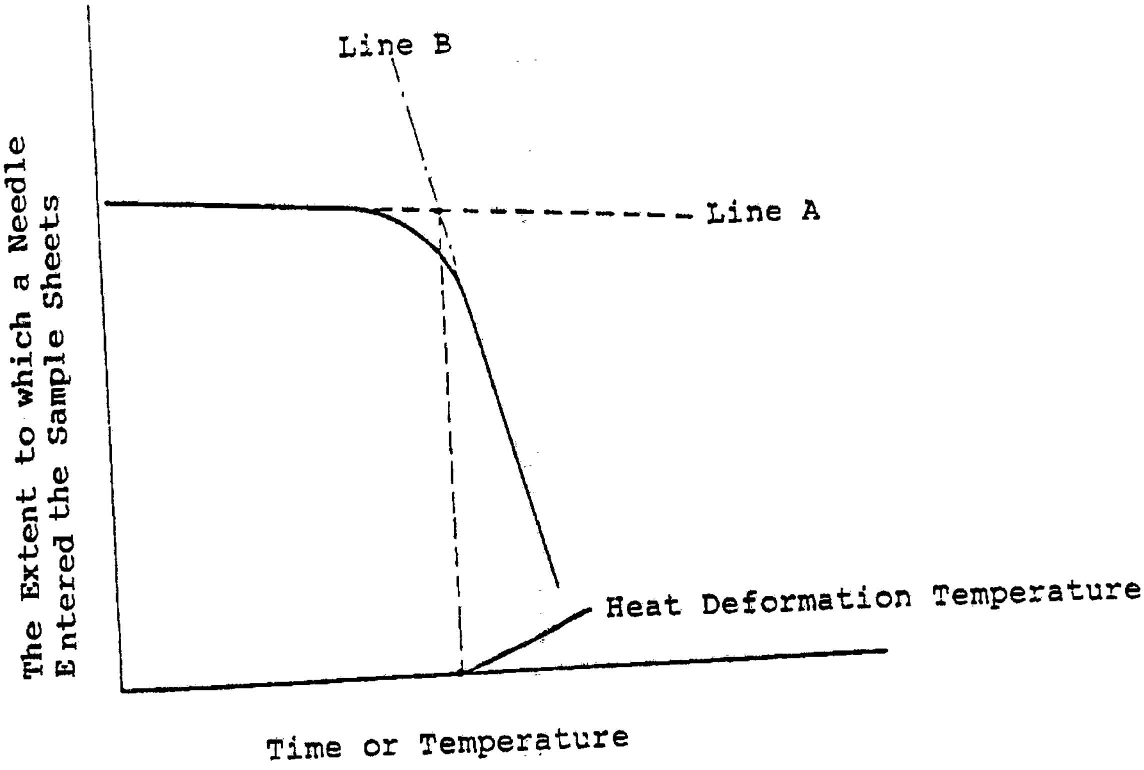

Line B
Line A
The Extent to which a Needle Entered the Sample Sheets
Heat Deformation Temperature
Time or Temperature

Fig. 7

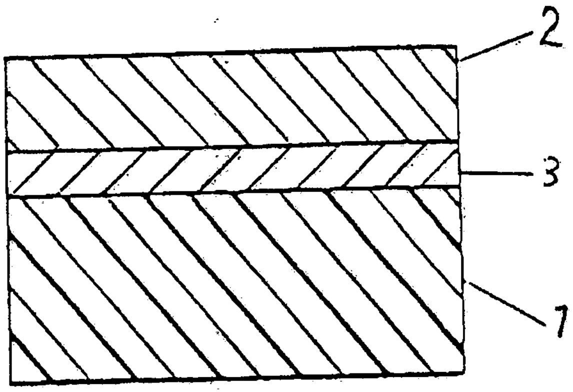


Fig. 8