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(71) Applicant: **MITSUBISHI RAYON CO., LTD**
3-19, Kyobashi 2-chome
Chuo-ku
Tokyo(JP)

(72) Inventor: **Kushi, Kenji, c/o Central Research Lab.**
Mitsubishi Rayon Co., Ltd.,
20-1, Miyuki-cho
Otake-shi, Hiroshima-ken(JP)
Inventor: **Iseki, Takayuki, c/o Central Research Lab.**
Mitsubishi Rayon Co., Ltd.,
20-1, Miyuki-cho
Otake-shi, Hiroshima-ken(JP)
Inventor: **Fujiwara, Tadayuki, c/o Central Research Lab.**
Mitsubishi Rayon Co., Ltd.,
20-1, Miyuki-cho
Otake-shi, Hiroshima-ken(JP)
Inventor: **Jufuku, Kazuhiko, c/o Central Research Lab.**
Mitsubishi Rayon Co., Ltd.,
20-1, Miyuki-cho
Otake-shi, Hiroshima-ken(JP)

(74) Representative: **Hansen, Bernd, Dr.**
Dipl.-Chem. et al
Hoffmann, Eitle & Partner
Patent- und Rechtsanwälte,
Postfach 81 04 20
D-81904 München (DE)

(54) Image-receiving sheet for a sublimation-type heat-sensitive transfer recording process.

(57) The present invention relates to an image-receiving sheet for a sublimation-type heat-sensitive process. The purpose of the present invention is to improve eliminate disturbances in the recording image quality resulting from poor surface smoothness of the dye-receiving layer, in addition to improving the sensitivity of the image-receiving sheet. In order to achieve this objective, the image-receiving sheet for use in a sublimation-type heat-sensitive transfer recording process according to the present invention incorporates a high polymer layer in between the substrate and dye-receiving layers. Furthermore, the dye-receiving layer of the image-receiving sheet according to the present invention, possesses a surface roughness degree defined by a center line average roughness (R_a) of 0.3 μm or less, and a maximum height (R_{max}) of 5 μm or less.

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BACKGROUND OF THE INVENTION

(Field of the Invention)

The present invention relates to an image-receiving sheet for use in a sublimation-type heat-sensitive transfer recording process.

(Description of the Related Art)

A sublimation-type heat-sensitive transfer recording process is characterized by a low noise output, small-sized, low priced apparatus having a short output time and which is easily conserved. In addition, as a result of using a sublimable dye, high gradation recording characterized by such qualities as a high density and a high definition can be carried out by means of continual fluctuation of the heat generating energy amount. As a result in comparison with other recording processes, it is particularly advantageous in obtaining full color copies. Accordingly, it is widely employed as the recording process in color printers, video printers, and the like.

A prior art image-receiving sheet for use in sublimation-type heat-sensitive transfer recording processes which is comprised of a dye-receiving layer formed on top of a laminated substrate, which in turn is formed of a synthesized paper (mainly polypropylene paper) laminated on top of conventional paper, as disclosed in U.S. Patent 4,778,782, has come to be employed.

However, with this type of image-receiving sheet, because the smoothness of the synthesized paper is insufficient, the smoothness of the dye-receiving layer on top of this synthesized paper is also insufficient. Additionally, there is also a problem in that as a result of the high cost of the synthesized paper, the laminated paper is very costly. As well, it is possible to consider an image-receiving sheet formed by placing the dye-receiving layer directly on top of the conventional paper. However, as a result of the insufficient smoothness of the conventional paper surface, there exists drawbacks such as a similar insufficient smoothness of the dye-receiving layer, formed on top of the conventional paper, and a decrease in the recording sensitivity of the image-receiving sheet.

When the smoothness of the dye-receiving layer is insufficient, the image cannot be precisely transferred in accordance with the signal to be inputted to the thermal head, which leads to the occurrence of irregularities such as dot errors and dot omissions of the image, as well as disturbances in the image quality, which bring out a rough impression in the intermediate gradation.

SUMMARY OF THE INVENTION

The purpose of the present invention is to improve on the disturbances in the recording image quality caused by poor surface smoothness of the dye-receiving layer, as well as to improve the coloring sensitivity of the image-receiving sheet.

In order to achieve this objective, the image-receiving sheet for use in a sublimation-type heat-sensitive transfer recording process according to the present invention incorporates a high polymer layer in between the substrate and dye-receiving layers. The dye-receiving layer has a surface roughness degree defined by a center line average roughness (R_a) of 0.3 μm or less, and a maximum height (R_{max}) of 5 μm or less.

In the present invention, the surface roughness degree of the dye-receiving layer was measured by means of JIS-B-0601. In accordance with the image-receiving sheet for use in a sublimation-type heat-sensitive transfer recording process of the present invention, the recording sensitivity is improved, disturbances of the recording image quality can be greatly reduced, and high projection vividness, as well as superior intermediate gradation reproductivity can be obtained.

A BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a sectional view outlining an example of an image-receiving sheet for use in a sublimation-type heat-sensitive transfer recording process according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the following the present invention will be described in detail.

Figure 1 is a sectional view showing an example of an image-receiving sheet for use in a sublimation-type heat-sensitive transfer recording process according to the present invention (hereinafter referred to as

"an image-receiving sheet"). In the figure, numeral 1 represents the substrate, numeral 2 represents the high polymer layer and numeral 3 represents the dye-receiving layer. As the substrate 1, use of conventional paper such as baryta paper, art paper and coat paper having a thickness of preferably 10~200 μm. In view of the heat durability, paper with a large thickness and a smooth surface is preferred.

On one surface of this substrate 1, a high polymer layer 2 is provided. This high polymer layer 2 is formed from thermoplastic resins such as polyethylene, polypropylene, polyethylene terephthalate, polystyrene, polymethylmethacrylate, acryl-based copolymers, polyvinyl chloride, vinyl chloride-vinyl acetate copolymers, polyvinylidene chloride, ionomer resins, butyral resins, and the like, thermosetting resins such as epoxy resins, unsaturated polyester resins, and the like, ultraviolet ray curable resins, and electron ray curable resins.

When necessary, inorganic materials, dyes, pigments, stabilizing agents, fluorescent whitening agents, and the like having minute particle diameters can be incorporated into the high polymer layer 2.

It is necessary for the image-receiving sheet of the present invention, in order to have an even (smooth) surface, to possess a dye-receiving layer 3 with a surface roughness degree, as stated above, defined by an R_a of 0.3 μm or less and an R_{max} of 5 μm or less. However, in order to obtain a smooth dye-receiving layer 3 from coating, the existence of a high polymer layer 2 likewise possessing an even (smooth) surface is preferred: for example, it is preferred that the surface roughness degree of the high polymer layer 2, measured also by means of JIS-B-0601, be defined by center line average roughness (R_a) of 0.3 μm or less, and a maximum height (R_{max}) of 5 μm or less. At this time, the cut off value of is 0.8 mm and the measured length is 8 mm. If the R_a of high polymer layer 2 exceeds 0.3 μm, or if R_{max} exceeds 5 μm, obtaining a dye-receiving layer with a smooth surface tends to become difficult, and irregularities during recording, such as dot errors and dot omissions of the image, as well as disturbances in the image quality occur, bringing out a rough impression in the intermediate gradation.

The high polymer layer 2 has a thickness of preferably 1~100 μm, more preferably 5~70 μm. If the thickness of high polymer layer 2 is less than 1 μm, leveling the substrate unevenness becomes very difficult, and as a result it becomes difficult to obtain a dye-receiving layer, to be applied on top of the substrate, with a sufficient surface smoothness, and thus the image quality when recording is degraded. Additionally, the recording sensitivity has a tendency to decrease as well. On the other hand, if the thickness exceeds 100 μm, there are cases when the time required for drying as well as curing the high polymer layer 2 with ultraviolet rays or electron rays as well as for thermosetting becomes longer, and the cost becomes greater.

As the coating method for providing high polymer layer 2 on top of substrate 1, methods in which resin solutions, formed by dissolving the above mentioned thermoplastic resins, thermosetting resins, ultraviolet ray curable resins, electron ray curable resins, and the like in a suitable solvent are formed, coated on the substrate using roll coating methods, blade coating methods, flow coating methods, lip coating methods and the like, and then dried, as well as methods in which heat is applied to the above mentioned thermoplastic resins forming a melt which is then applied as a coat onto the substrate and cooled, or methods in which films formed from the above mentioned resins are pasted onto substrate 1 using an adhesive agent can be used. Among these methods, it is preferred that methods be employed in which resin solutions are coated using comma roll coating methods, lip coating methods and flow coating methods, through which a high surface smoothness as well as a high thickness precision can be obtained.

On top of this high polymer layer 2, a dye-receiving layer 3 is provided. This dye-receiving layer 3 receives and develops the sublimable dye which is transferred from the transfer sheet. The raw material for forming the dye-receiving layer 3 is not limited to anything in particular, so long as it is a material which can be well dyed with a sublimable dye, and also, at the time of recording, does not cause blocking with the transfer sheet. For example, as the dyeable resin, the following can be used: cellulose resins such as methyl cellulose, ethyl cellulose, ethylhydroxy cellulose, hydroxyethyl cellulose, hydroxypropyl cellulose, cellulose acetate and the like, vinyl resins such as polyvinyl alcohol, polyvinyl butyral, polyvinyl acetal, polyvinyl acetate, polyvinyl chloride, polyvinyl pyrrolidone, polystyrene and the like, acrylate resins such as polymethyl(meth)acrylate, polybutyl(meth)acrylate, polyacrylamide, polyacrylonitrile and the like, polyester resins, polycarbonate resins, polyurethane resins, polyamide resins, urea resins, polycarprolactone resins, polyarylate resins, polysulfone resins and the like as well as their copolymers and mixtures. Among these resins, since polyester resins are well dyed by the sublimable dye and the maintenance stability of the projection image which can be obtained is excellent, it is preferred that at least one component of the dyeable resin be a polyester resin.

As the above mentioned polyester resin, there can be mentioned linear thermoplastic polyester resins obtained by polycondensation between a dicarboxylic acid and a diol, and/or unsaturated polyester resins obtained by polycondensation between an unsaturated polybasic acid having a reactive double bond and a

polyhydric alcohol. In view of the solubility in an organic solvent, the dyeing ease and the light resistance, a linear thermoplastic polyester resin having a molecular weight of 2,000 to 40,000 and a crystallization degree of not higher than 1%, which is obtained by polycondensation between at least one dicarboxylic acid and at least one diol, is preferred.

As specific examples of the linear thermoplastic polyester resin obtained by polycondensation between at least one dicarboxylic acid and at least one diol, there can be mentioned a polyester resin obtained from terephthalic acid, isophthalic acid, ethylene glycol and neopentyl glycol, a polyester resin obtained from terephthalic acid, isophthalic acid, ethylene glycol and a bisphenol A/ethylene oxide adduct, a polyester resin obtained from terephthalic acid, isophthalic acid, ethylene glycol and 1,6-hexanediol, a polyester resin obtained from terephthalic acid, isophthalic acid, sebacic acid, ethylene glycol and neopentyl glycol, a polyester resin obtained from terephthalic acid, sebacic acid, ethylene glycol and neopentyl glycol, and a polyester resin obtained from terephthalic acid, isophthalic acid, adipic acid, ethylene glycol and neopentyl glycol. These polyester resins can be used singly, or in the form of mixtures of two or more thereof. In order to improve the stability against light, heat, water or others, preferably two or more of these polyester resins are used in combination. For example, when two polyesters A and B are used, preferably the A/B weight ratio is from 20/80 to 80/20.

Additionally, in place of terephthalic acid, isophthalic acid, and the like, it is also possible to use esterificated dimethylterephthalate, dimethylisoterephthalate, and the like in the condensation polymer raw material.

As the unsaturated polyester resin obtained by the polycondensation of an unsaturated polybasic acid possessing a reactive double bond, and a polyalcohol, there can be mentioned resins obtained from the following: maleic anhydride/phthalic anhydride/propylene glycol, maleic anhydride/isophthalic acid/propylene glycol, maleic acid/fumaric acid/isophthalic acid/1,3-butane diol, maleic acid/isophthalic acid/neopentyl glycol, maleic anhydride/tetrahydrophthalic anhydride/dipropylene glycol, and the like.

In order to further improve the releasing property between the dye-receiving layer 3 and the transfer sheet, incorporation of a crosslinking component into the dye-receiving layer 3 of the present invention is preferred. For example, a thermosetting component of isocyanate and polyol are incorporated, and the formation of the dye-receiving layer is carried out followed by thermocrosslinking, or the dye-receiving layer can be obtained by coating a crosslinking agent which can be cured with active energy rays, as disclosed in Japanese Patent Application (Kokai) 62-46689 and in EP-0261505-A2, for example the dye-receiving layer can be obtained by coating a resin composition incorporating a monomer or oligomer possessing an acryloyloxy group or a methacryloyloxy group on top of the substrate, followed by curing with active energy rays. In particular, the method in which the dye-receiving layer is obtained by incorporating a component which can be crosslinked with active energy rays, followed by curing with active energy rays, has a high productivity. Moreover, the dye-receiving layer which can be obtained is easily dyed with a sublimable dye, has a superior stability and an excellent luster maintenance, and thus this method is more preferred.

The amounts of the dyeable resin and the crosslinking agent to be used are not in particular limited, however it is preferred that the amount of the dyeable resin incorporated range from 40~95% by weight, and the amount of the crosslinking agent incorporated range from 60~5% by weight per 100 parts by weight of the total amount of the dyeable resin and crosslinking agent. If the amount of the dyeable resin incorporated is less than 40% by weight, it becomes difficult to both dye the dye-receiving layer obtained with the sublimable dye, and to obtain a sufficient dyeing density. On the other hand, if the amount incorporated exceeds 95% by weight, the dye-receiving layer obtained adheres easily to the transfer sheet during heat transfer.

As specific examples of the crosslinking agent, in the case of thermosetting, there can be mentioned reactive setting silicon oils such as cured amino modified silicon oils and epoxy modified silicon oils. In the case of lightsetting, there can be mentioned light setting silicon oils and polyfunctional monomers or polyfunctional oligomers possessing (meth)acryloyloxy groups, however, among these, polyfunctional monomers or polyfunctional oligomers possessing (meth)acryloyloxy groups are preferred. Ultraviolet rays that can be easily handled as the active energy rays can be used for these agents, and these agents can be set in a short time period, and are therefore advantageous from a productivity standpoint.

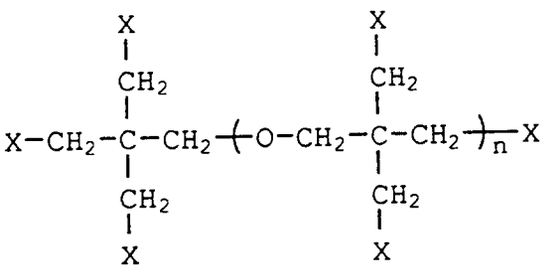
As specific examples of monomers possessing (meth)acryloyloxy group there can be mentioned polyether acrylate-based or polyether methacrylate-based (hereinafter, "acrylate or methacrylate" will be abbreviated singly as "(meth)acrylate"), polyester (meth)acrylate-based, polyol (meth)acrylate-based, epoxy(meth)acrylate-based, urethane amide (meth)acrylate-based, urethane (meth)acrylate-based, spiroacetal (meth)acrylate-based, polybutadiene (meth)acrylate-based monomer or oligomers.

As specific examples of this type of monomer or oligomer, there can be mentioned polyether (meth)-acrylates such as those synthesized from 1,2,6-hexanetriol, propylene oxide and acrylic acid and from

trimethylolpropane, propylene oxide and acrylic acid; polyester (meth)acrylates such as those synthesized from adipic acid, 1,6-hexanediol and acrylic acid and from succinic acid, trimethylolethane and acrylic acid; (meth)acrylates or polyol (meth)acrylates such as triethylene glycol diacrylate, hexapropylene glycol diacrylate, neopentyl glycol diacrylate, 1,4-butane diol dimethacrylate, 2-ethylhexyl acrylate, tetrahydrofurfuryl acrylate, 2-hydroxyethyl methacrylate, ethylcarbitol acrylate, trimethylolpropane triacrylate, pentaerythritol tetra-acrylate, dipentaerythritol tetra-acrylate, dipentaerythritol penta-acrylate, 2,2-bis(4-acryloyloxydiethoxyphenyl)propane, and 2,2-bis(4-acryloyloxydipropoxyphenyl)propane; epoxy (meth)acrylates such as those synthesized from diglycidyl-etherified bisphenol A and acrylic acid, from diglycidyl-etherified polybisphenol A and acrylic acid, and from triglycidyletherified glycerol and acrylic acid; amideurethane (meth)acrylates such as those synthesized from γ-butyrolactone, N-methylethanolamine, bis(4-isocyanatocyclohexyl)methane and 2-hydroxyethyl acrylate, and from γ-butyrolactone, N-methylethanolamine, 2,6-tolylenediisocyanate, tetraethylene glycol and 2-hydroxyethyl acrylate; urethane acrylates such as 2,6-tolylenediisocyanate diacrylate, isophorone diisocyanate diacrylate, and hexamethylenediisocyanate diacrylate; spiroacetal acrylates such as those synthesized from diallylidene pentaerythritol and 2-hydroxyethyl acrylate; and acrylated polybutadienes such as those synthesized from epoxidized butadiene and 2-hydroxyethyl acrylate. These monomer and oligomers may be used singly or in the form of mixture of two or more thereof.

Of the above-mentioned monomers and oligomers, compounds represented by the following general formulae (I),(II) and (III) are especially preferred as the crosslinking agent because they have an excellent quick-drying property in air when ultraviolet rays are used as the active energy rays.

Compounds represented by the following general formula (I):

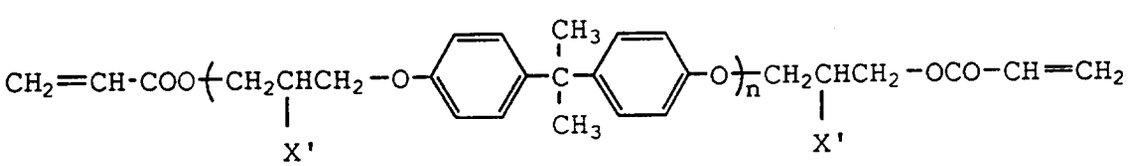


----- (I)

(in which n is an integer from 1 to 4, at least three of the groups X are groups represented by the general formula $CH_2=CH\text{-}COO\text{-}R_1\text{-}$(in which R_1 represents single bond, an alkylene group having 1 to 8 carbons or a polyoxyalkylene group having an alkylene group having 1 to 8 carbon atoms), and the remaining groups X are selected from an alkyl group having 1 to 8 carbon atoms, a hydroxyl group, an amino group, a group represented by the formula $-(OR_2)_m\text{-}H$ (in which R_2 represents an alkylene group having 1 to 8 carbon atoms and m is positive integer), a group represented by the formula-$(OR_2)_m$-OH (in which R_2 and m are as defined above), or a group represented by the formula $-(OCOR_2)_m\text{-}H$ (in which R_2 and m are defined above).

As specific examples of this type of compound, there can be mentioned dipentaerythritol tetra-acrylate, dipentaerythritol penta-acrylate, dipentaerythritol hexa-acrylate, tripentaerythritol penta-acrylate, tripentaerythritol hexa-acrylate and tripentaerythritol hepta-acrylate.

Polybisphenol A polyacrylates represented by the following general formula (II):

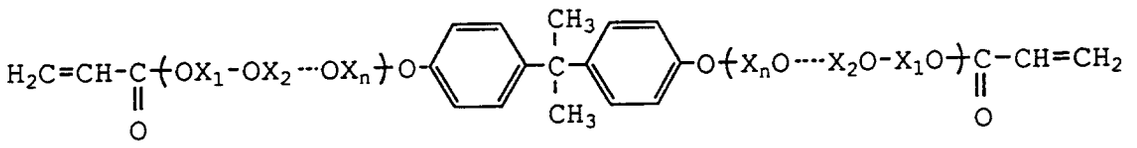


----- (II)

(wherein n is a positive integer from 1 to 10 and X' is optionally -OH or $-OCOCH=CH_2$). As specific examples of this type of compound, there can be mentioned diglycidyletherified bisphenol A diacrylate and

a diacrylate of Epikote #1001 (n = 3, supplied by Shell Chemicals).

Compounds represented by the following general formula (III):



----- (III)

(wherein X_1,X_2,...and X_n, which may be the same or different, represent an alkylene group having up to 6 carbon atoms, in which one hydrogen atom may be substituted by a hydroxyl group, and n is an integer from 0 to 5). As specific examples of this type of compound, there can be mentioned 2,2-bis(4-acryloyloxydiethoxyphenyl)propane, 2,2-bis(4-acryloyloxytriethoxyphenyl)propane and 2,2-bis(4-acryloyloxydipropoxyphenyl)propane.

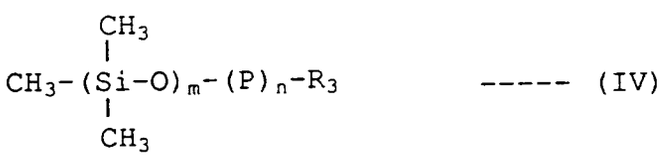
Additionally, in the present invention in order to further improve the anti-blocking property between the recording media and the transfer sheet (anti-sticking property), it is preferred that a releasing agent be incorporated into the dye-receiving layer. As the releasing agent to be used, there can be mentioned at least one member selected from the group consisting of silicon-containing surface active agents, fluorine-containing surface active agents, and graft polymers with polyorganosiloxane in the main stem or in a branch. These aforementioned compounds can also be used jointly as well.

The amount of releasing agent incorporated is 0.01 to 12 parts by weight, preferably 0.05 to 10 parts by weight, per 100 parts by weight of the total amount of the dyeable resin and the crosslinking agent.

If the amount of releasing agent incorporated is less than 0.01 parts by weight, improvement of the anti-blocking property is decreased, while on the other hand, if the amount incorporated exceeds 12 parts by weight, the dye-receiving layer becomes opaque.

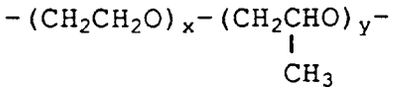
As the silicon-containing surface active agents, a polydimethylsiloxane/polyoxyalkylene block compound (which may be modified with another functional group) is effective, in particular silicon-containing surface active agents in which the ratio of the group CH_3-$(SiO)_{1/2}$- to the group -OR- (in which R represents an alkylene residue) is CH_3-$(SiO)_{1/2}$- / -OR- = 1/10 ~ 1/0.1, preferably from 1/5 ~ 1/0.2, are effective in improving the anti-blocking property, leveling property and dyeing density.

As specific examples of the silicon-containing surface active agent, there can be mentioned compounds represented by the following general formulae (IV) and (V):



----- (IV)

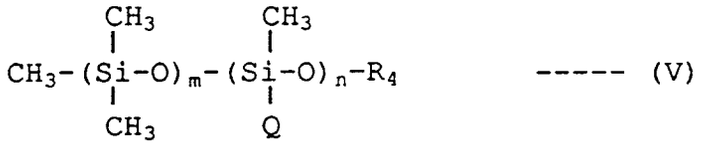
wherein P is:



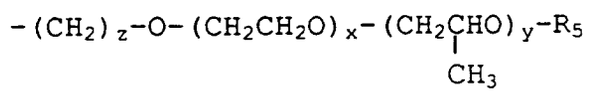
and m and n represent a positive integer, x and y represent 0 or a positive integer, with the proviso that m, n, x and y satisfy the requirement of

$1/10 \leqq (2m + 1) / (nx + ny) \leqq 10$,

and R_3 represents a hydrogen, an alkyl group, an acyl group, or an aryl group.)



wherein Q is:



wherein m and n represent a positive integer, x and y represent 0 or a positive integer, with the proviso that m, n, x and y satisfy the requirement of

$1/10 \leqq (2m + n + 1) / (nx + ny) \leqq 10$,

and z is 0 or an integer from 1 to 5. Additionally, R_4 represents $-Si(CH_3)_3$, a hydrogen, an alkyl group, an acyl group or an aryl group, and R_5 represents a hydrogen, an alkyl group, an acyl group, or an aryl group.)

One or more members selected from non-ionic, anionic, cationic, or amphoteric fluorine-containing surface active agents which are soluble to some extent in the mixture of the dyeable resin and the crosslinking agent can be used as the fluorine-containing surface active agent. For example, there can be mentioned anionic surface active agents such as fluoroalkoxypolyfluoroalkyl sulfates, fluorocarbon-sulfonic acid salts and fluorocarbon-carboxylic acid salts; cationic surface active agents such as N-fluoroalkylsulfonamide alkylamine quaternary ammonium salts, N-fluoroalkylsulfonamide alkylamine salts, N-fluoroalkylamide alkylamine quaternary ammonium salts, N-fluoroalkylamide alkylamine salts and N-fluoroalkylsulfonamide alkylhalomethyl ether quaternary ammonium salts; non-ionic surface active agents such as fluorocarbon sulfonamides, fluorocarbon aminosulfonamides, fluorocarbon carboxysulfonamides, fluorocarbon hydroxysulfonamides, fluorocarbon sulfonamide/ethylene oxide adducts, fluorocarbon hydroxysulfonamide sulfates, fluorocarbon amino acid amides, fluorocarboxylic acid amides, fluorocarbon hydroxy-acid amides, fluorocarbon acid amide/ethylene oxide addition condensates, fluorocarbon hydroxy-acid amide sulfates, fluorocarbon sulfonic acids, fluorohydrocarbon carboxylic acids, fluorohydrocarbon alkyl esters, fluorohydrocarbon alkyl ethers, fluorohydrocarbon carboxyalkyl esters, fluorohydrocarbon hydroxyamides, fluorohydrocarbon alkyl sulfates and fluoroalkyldiamines; and amphoteric surface active agents such as alkylamines having a betaine type fluorocarbon sulfonamide linkage and alkylamines having a betaine type fluorocarbon acid amide linkage. When considering such things as the leveling property and the improvement of the blocking property of the dye-receiving layer, even among the above mentioned surface active agents, non-ionic surface active agents are preferred.

As the graft polymer possessing polyorganosiloxane in the main stem or in a branch, there can be mentioned graft polymers having in the main stem polymers or copolymers obtained from vinyl polymerization, condensation polymerization, ring-opening polymerization, and the like, and polyorganosiloxane in a branch. As specific examples of these graft polymers there can be mentioned, graft polymers obtained from the polymerization of at least one monomer such as alkyl (meth)acrylate, (meth)acrylic acid, (meth)acrylic acid derivatives possessing functional groups, vinyl acetate, vinyl chloride, (meth)acrylonitrile, styrene and the like to a polysiloxane (macromonomer), to which a single terminal metacryloyloxy group, vinyl group or mercapto group has been added; graft polymers obtained from the reaction of a dicarboxylic acid and a diol with a macromonomer, possessing two hydroxyl or carboxyl groups near the polysiloxane end; and graft polymers obtained from the reaction of a diepoxy or a diisocyanate compound with a macromonomer possessing two hydroxyl or carboxyl groups near the polysiloxane end.

As the other graft polymer possessing polyorganosiloxane in the main stem or in a branch, there can be mentioned graft polymers having polyorganosiloxane in the main stem, and polymers or copolymers obtained from vinyl polymerization, condensation polymerization, ring-opening polymerization, and the like, in a branch. As specific examples of these graft polymers there can be mentioned graft polymers obtained from the polymerization of at least one monomer such as alkyl (meth)acrylate, (meth)acrylic acid, (meth)-

acrylic acid derivatives possessing functional groups, vinyl acetate, vinyl chloride, (meth)acrylonitrile, styrene and the like to a polysiloxane having a methacryloyloxy group in its side chain, synthesized by the condensation of organosilane and silane possessing vinyl polymerizable groups such as 3-methacryloylxypropyl-dimethoxymethylsilane, methylvinyldimethoxysilane, ethylvinyldiethoxysilane, and the like; graft polymers obtained from the polymerization of a monomer possessing a (meth)acryloyloxy group which was obtained through the reaction of (meth)acrylic acid and a polysiloxane possessing a glycidyl group in its side chain, synthesized by the condensation of organosilane and diethoxy-3-glycidoxypropylmethylsilane; and graft polymers obtained by polycondensation of a dicarboxylic acid and a polysiloxane possessing a hydroxyl group in its side chain, synthesized by polycondensation of organosilane and hydroxyethylmethyldimethoxysilane.

When synthesizing a polysiloxane to be incorporated into the main stem or a branch of the graft polymer, it is best to perform the polymerization at a temperature of 70~150 °C using a cyclic silane as the main raw material, in particular a cyclic dimethylpolysiloxane with 3~8 repeating units, and a silane compound as the molecular weight modifier such as a trimethylmethoxysilane or a trimethylethoxysilane with one alkoxy group per molecule, and reacting this cyclic silane and a silane compound with a silane possessing a functional group under strong acid or strong base catalyst.

By incorporating these graft polymers into the dye-receiving layer, there is a tendency for the blocking to a transfer sheet to be drastically eliminated together with the improvement of the dark color fastness of the dye-receiving layer.

The weight ratio of the polyorganosiloxane component to polymers or copolymers other than polyorganosiloxane is preferably (polyorganosiloxane component)/(polymer or copolymer component) = 95/5 to 10/90, more preferably from 90/10 to 20/80. If this ratio exceeds 95/5, there is a tendency for the dark color fastness to be degraded, and if the ratio is less than 10/90, there is a tendency for both the anti-blocking property as well as the dark color fastness to be degraded. Additionally, it is preferred that the polyorganosiloxane containing graft polymer having a molecular weight of 1000 or greater be used. If the molecular weight of the graft polymer is less than 1000, it becomes difficult to improve the dark color fastness.

Where a compound having a high polymer solubility and a low viscosity, such as tetrahydrofurfuryl acrylate monomer, is used as a component of the crosslinking agent, the resin composition to form the dye-receiving layer 3 can be directly coated using coating methods such as roll coating, bar coating or blade coating. However, in order to improve the adaptability to the coating operation, preferably a solvent such as ethyl alcohol, methyl ethyl ketone, toluene, ethyl acetate or dimethylformamide is incorporated to adjust the viscosity to an adequate level. In this case, the composition can be easily coated by spray coating, curtain coating, flow coating or dip coating.

Additionally, fine inorganic particles having a particle size smaller than several μm, such as those of silica, alumina, talc and titanium oxide, may be incorporated in the resin composition in accordance with usage objectives.

The resin composition incorporating a crosslinking agent curable with active energy rays, can be cured by active energy rays such as electron rays, ultraviolet rays, and the like. When ultraviolet rays are used as the active energy rays, preferably a widely known photopolymerization initiator is incorporated into the composition. The amount of the photopolymerization initiator is not in particular limited, however 0.1 to 10.0 parts by weight per 100 parts by weight of the total amount of the above mentioned dyeable resin and the crosslinking component, to form the dye-receiving layer, is preferred.

As specific examples of the photopolymerization initiator, there can be mentioned carbonyl compounds such as benzoin, benzoin isobutyl ether, benzyldimethylketal, ethylphenyl glyoxylate, diethoxyacetophenone, 1,1-dichloroacetophenone, 4'-isopropyl-2-hydroxy-2-methylpropiophenone, 1-hydroxycyclohexyl-phenylketone, benzophenone, benzophenone/diethanolamine, 4,4'-bisdimethylamino-benzophenone, 2-methylthioxanthone, tert-butylanthraquinone and benzyl; sulfur compounds such as tetramethylthiuram monosulfide and tetramethylthiuram disulfide; azo compounds such as azobisisobutylonitrile and azobis-2,4-dimethyl-valeronitrile; and peroxides such as benzoyl peroxide and di-tert-butyl peroxide. These compounds can be used singly or in the form of mixture of two or more thereof.

The dye-receiving layer is formed after the aforementioned resin composition is coated on top of the high polymer layer 2 using the aforementioned coating method, followed by drying of the solvent and curing with heat and light as necessary. The thickness of the dye-receiving layer obtained is appropriately 1 μm or greater. If the thickness is less than 1 μm, it becomes difficult to deeply dye the dye-receiving layer.

It is necessary that the dye-receiving layer formed in this manner have a surface roughness degree as defined in JIS-B-0601 wherein the center line average roughness R_a and maximum height R_{max} are shown as 0.3 μm or less and 5 μm or less, respectively. When the surface roughness degree falls outside of this

range, dot errors and dot omissions of the image, as well as disturbances in the image quality occur during recording, bringing out a rough impression in the intermediate gradation. The cut off value at this time was 0.8 mm, and the measured length was 8 mm.

In order to form this type of dye-receiving layer, among the aforementioned coating methods for the dye-receiving layer, comma roll coating, lip coating and flow coating methods are preferred.

In the image-receiving sheet of the present invention obtained in this manner, due to the smooth surface of the dye-receiving layer, the recording image quality and the projection vividness are improved.

In the following, examples will be given: note, all of the "parts" in the examples and comparative examples are by weight. Further, in the examples the following are represented:

2P6A is dipentaerythritol hexa-acrylate;

2P5A is dipentaerythritol penta-acrylate;

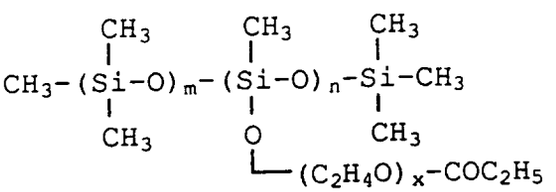
2P4A is dipentaerythritol tetra-acrylate;

A-DEP is 2,2-bis(4-acryloyloxydiethoxyphenyl)propane;

Resin A is a polyester resin obtained by polycondensation of terephthalic acid, isophthalic acid and sebacic acid with ethylene glycol and neopentyl glycol (molecular weight: 20,000 to 25,000, Tg: 10 °C); and

Resin B is a polyester resin obtained by polycondensation of terephthalic acid, isophthalic acid and sebacic acid with ethylene glycol, neopentyl glycol and 1,4-butane diol (molecular weight: 20,000 to 25,000, Tg: 47 °C).

Silicon containing surface active agent A is represented by the following structural formula (VI):



----- (VI)

$$\frac{2m + n + 1}{nx} = 1.3$$

Example 1

To the surface of one side of a coat paper of thickness 150 μm, a solution of polymethylmethacrylate and acetone (resin portion 30% by weight) was coated using a comma roll coater, and then dried to produce a high polymer layer of thickness 30 μm. The surface roughness degree of this high polymer layer showed an R_a of 0.09 μm, and an R_{max} of 1.5 μm. On top of this high polymer layer, a composition consisting of 3 parts of 2P6A, 4 parts of 2P5A, 3 parts of 2P4A, 10 parts of A-DEP, 20 parts of Resin A, 60 parts of Resin B, 0.1 parts of silicon-containing surface active agent A, 5 parts of 1-hydroxycyclohexyl-phenylketone, 300 parts of methylethylketone and 100 parts of toulene was coated using the comma roll coating method, the solvent was removed, followed by curing of the composition by irradiation with ultraviolet rays to produce a dye-receiving layer of thickness 7 μm, with an R_a of 0.05 μm and an R_{max} of 1.2 μm, thereby completing the formation of an image-receiving sheet.

Example 2

To the surface of one side of an art paper of thickness 100 μm, a solution consisting of 20 parts of a methylmethacrylate/methylacrylate copolymer in a weight ratio of 90/10, 2 parts of 2P6A, 2 parts of 2P5A, 1 part of 2P4A, 2 parts of benzyldimethylketal and 73 parts of methylethylketone was coated by a lip coating method, dried and cured with ultraviolet rays to produce a high polymer layer of thickness 40 μm, with an R_a of 0.11 μm and an R_{max} of 2.0 μm. A dye-receiving layer was formed on top of this high polymer layer in the same manner as example 1, and an image-receiving sheet was obtained. The dye-receiving layer obtained had a thickness of 6 μm, with an R_a of 0.09 μm and an R_{max} of 1.7 μm.

Example 3

To the surface of one side of a coat paper of thickness 150 μm, a solution consisting of 20 parts of a copolymer of vinyl chloride/vinyl acetate in a weight ratio of 85/15, 40 parts of methyl ethyl ketone and 40 parts of toulene was coated using the flow coating method, and dried to produce a high polymer layer of thickness 25 μm, with an R_a of 0.22 μm and an R_{max} of 3.8 μm. Onto the top of this high polymer layer, a composition consisting of 10 parts of a polyester resin (VYLON #200 manufactured by Toyobo Co., Ltd.), 0.5 parts of an amino-modified silicon (KF-393 manufactured by Shin-Etsu Chemical Co., Ltd.), 0.5 parts of an epoxy-modified silicon (X-22-343 manufactured by Shin-Etsu Chemical Co., Ltd.) and 89 parts of a solvent (toulene/methylethylketone: in a weight ratio of 1/1) was coated using a dipping method and dried to produce a dye-receiving layer of thickness 6 μm, with an R_a of 0.26 μm and an R_{max} of 4.6 μm. In this manner the image-receiving sheet was formed.

Example 4

An image-receiving sheet was obtained in the same manner as in example 3 except that the high polymer layer of thickness 25 μm, with an R_a of 0.26 μm and an R_{max} of 4.8 μm, was formed from polyethylene on the surface of one side of a coat paper using a melt coating method. The dye-receiving layer obtained had a thickness of 6 μm, with an R_a of 0.28 μm and an R_{max} of 4.8 μm.

Comparative example 1

An image-receiving sheet was obtained in the same manner as in example 1 except that a high polymer layer was not formed. The dye-receiving layer obtained had a thickness of 7 μm, with an R_a of 1.2 μm and an R_{max} of 9.5 μm.

Comparative example 2

An image-receiving sheet was obtained in the same manner as in example 3 except that a high polymer layer was not formed. The dye-receiving layer obtained had a thickness of 6 μm, with an R_a of 2.2 μm and an R_{max} of 11.7 μm.

Comparative example 3

Using an adhesive agent, polypropylene synthetic paper YUPO FPG (thickness 60 μm) manufactured by Ozi Yuka Synthetic Paper Co., Ltd. was laminated onto one surface of an art paper of thickness 100 μm. The surface roughness degree of the polypropylene synthetic paper was defined by an R_a of 0.62 μm and an R_{max} of 11.8 μm. The dye-receiving layer was then formed on top of this polypropylene synthetic paper and an image-receiving sheet was obtained in the same manner as in example 1. The dye-receiving layer obtained had a thickness of 7 μm, with an R_a of 0.51 μm and an R_{max} of 8.5 μm.

Using the image-receiving sheets obtained from these examples and comparative examples, the anthraquinone-based sublimable dispersing dye was sublimated under conditions in which 13 V of impressed voltage was applied by a 6 dot/mm thermal head for 5~20 ms, following which a color image was recorded. In the image-receiving sheet of examples 1~4, smooth intermediate gradations lacking a rough impression were obtained, in addition to a superb projection vividness. However, in comparative examples 1~3, disturbances of the image, as well as a rough impression of the image quality were observed. Furthermore, in comparative examples 1 and 2, the image dyeing density was remarkably degraded.

Claims

1. An image-receiving sheet for use in a sublimation-type heat-sensitive transfer recording process comprising:

a substrate;

a dye-receiving layer; and

a high polymer layer provided in between said substrate and said dye-receiving layer;

wherein said dye-receiving layer possesses a surface roughness degree defined by a center line average roughness (R_a) of 0.3 μm or less, and a maximum height (R_{max}) of 5 μm or less.

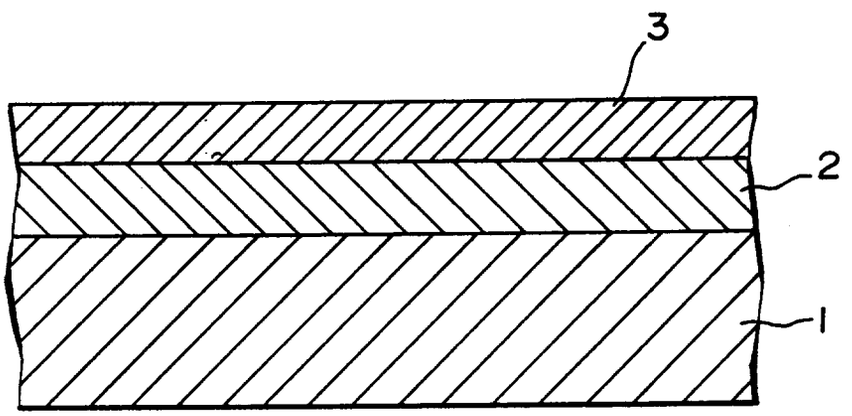
2. An image-receiving sheet for use in a sublimation-type heat-sensitive transfer recording process according to claim 1, wherein said high polymer layer is formed from a resin selected from the group consisting of thermoplastic resins, thermosetting resins, ultraviolet ray curable resins, and electron ray curable resins.

3. An image-receiving sheet for use in a sublimation-type heat-sensitive transfer recording process according to claim 2, wherein said high polymer layer is formed from a thermoplastic resin selected from group consisting of polyethylene, polypropylene, polyethylene terephthalate, polystyrene, polymethyl methacrylate, acryl-based copolymers, polyvinyl chloride, vinyl chloride-vinyl acetate copolymers, polyvinylidene chloride, ionomer resins and butyral resins.

4. An image-receiving sheet for use in a sublimation-type heat-sensitive transfer recording process according to claim 2, wherein said high polymer layer is formed from a thermosetting resin selected from the group consisting of epoxy resins and unsaturated polyester resins.

5. An image-receiving sheet for use in a sublimation-type heat-sensitive transfer recording process according to claim 1, wherein said substrate is conventional paper.

FIG.1



European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 11 4307

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.5)
L,X	DATABASE WPIL,nØ92-369078,Derwent Publications Ltd,London,GB;& JP-A-4269588 (MITSUBISHI RAYON)25-09-1992 *The entire abstract*	1-5	B41M5/00
A	DATABASE WPIL,nØ 92-178148,Derwent Publications Ltd,London,GB;& JP-A-4105994 (TORAY IND.)07-04-1992 *The entire abstract*	1-5	
A	EP-A-0 454 428 (OJI PAPER) * claims 1-25 *	1-5	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B41M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	12 MAY 1993	FOUQUIER J.

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