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(54) An image receiving material for use in a silver salt diffusion transfer process.

(57) The present invention discloses an image receiving material comprising on a support an image receiving layer containing physical development nuclei and a top layer free of physical development nuclei on top thereof, the total solid coverage of both layers being at most 2.5g/m^2 characterized in that said top layer comprises a matting agent having a solubility such that 0.2g of matting agent can be completely dissolved in 10ml of an aqueous solution containing 1 mol/l of sodium hydroxide at room temperature within 10s or less.

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1. Field of the invention.

The present invention relates to an image-receiving material suitable for use in the silver complex diffusion transfer reversal process.

2. Background of the invention.

The principles of the silver complex diffusion transfer reversal process, hereinafter called DTR-process, have been described e.g. in US-P 2,352,014 and in the book "Photographic Silver Halide Diffusion Processes" by André Rott and Edith Weyde - The Focal Press - London and New York, (1972).

The DTR-process initially only intended for office copying purposes has found now wide application in the graphic art field, more particularly in the production of screened prints from continuous tone originals. In said production continuous tone information is transformed into halftone information using graphic art screen exposure techniques. Essential in screening is the transformation of continuous tone values into black dots of different size and different % dot covering, also called % dot value.

In order to meet the high quality demands of screened copies with regard to screen dot definition and tonal reproduction measures have to be taken in the image-receiving material, hereinafter also called positive material, to obtain utmost image acutance and neutral black image density.

From many experiments which have been carried out the following factors influence the image tone : (ref. the already mentioned book of A. Rott and E. Weyde, p. 58) :

1. The properties, the number and the concentration of the development nuclei in the positive material,
2. The time for which the positive material and light-sensitive material remain in contact,
3. The nature of the binding agent in the image-receiving layer,
4. The quantity of complexing agent present, and
5. The presence of additives which influence the image-tone.

Most of the DTR-positive materials now available on the market are composed of two or even three layers. Such materials normally contain on top of the nuclei containing layer a layer which itself contains no nuclei and otherwise has the same composition as the nuclei containing layer and mainly serves to ensure good contact between the negative and positive material during transfer. Moreover, after drying this layer provides a protective coating for the image receiving layer containing the silver image. It further prevents bronzing or plumming of the black image areas in preventing the protruding of silver from the image receiving layer in the form of a glossy silver mirror (ref. the above mentioned book p. 50).

The transfer behaviour of the complexed silver largely depends on the thickness of the image-receiving layer and the kind of binding agent or mixture of binding agents used in the nuclei containing layer. In order to obtain a sharp image with high spectral density the reduction of the silver salts diffusing into the image receiving layer must take place rapidly before lateral diffusion becomes substantial. Therefore, the thickness of the nuclei containing layer and layers on top thereof is kept minimal.

However during storage and handling these image receiving materials are easily damaged. This problem may be solved by putting a paper sheet between two image receiving sheets in a package. A disadvantageous hereof is that additional paper waste is produced and the cost of the package is increased. Alternatively a matting agent may be included in the top layer of the image receiving layer to keep a certain distance between two image receiving materials in a package.

As matting agent it is known to use for example an inorganic matting agent e.g. silica or hydrophobic polymer particles as e.g. polymethyl methacrylate particles. These matting agents cause a dramatic decrease of the image quality in a number of respects as e.g. the density is decreased, the number of pinholes increases etc..

Japanese patent applications laid open to public inspection no. 45243/86 and 45244/86 disclose the use of an alkali soluble matting agent in an image receiving element for use in a silver salt diffusion transfer process. However even the there disclosed matting agents were found unsuitable for use in an image receiving material having a thin layer package of image receiving layer and top layer.

Further, because the thickness of the image receiving layer and top layer is kept to a minimal including a matting agent in the top layer results in a disturbance of the image receiving layer during coating due to penetration of the matting agent into the image receiving layer. As a consequence thereof there will be pinholes in the image obtained with such an image receiving material because at the places where matting agents have penetrated the image receiving layer there will be no more nuclei or less nuclei.

3. Summary of the invention.

It is an object of the present invention to provide an image receiving material for use in the silver salt diffusion transfer process that can yield images of high quality i.e. high density, sharpness, resolution and no or little pinholes and that can be stored without the need for intermediate sheets between two image receiving materials.

It is a further object of the present invention to provide a method for obtaining images of high quality using an image receiving material having the above described properties.

Further objects of the present invention will become clear from the description.

According to the present invention there is provided an image receiving material comprising on a support an image receiving layer containing physical development nuclei and a top layer free of physical development nuclei on top thereof, the total solid coverage of both layers being at most 2.5g/m^2 characterized in that said top layer comprises a matting agent having a solubility such that 0.2g of matting agent can be completely dissolved in 10ml of an aqueous solution containing 1 mol/l of sodium hydroxide at room temperature within 10s or less.

According to the present invention there is provided a method for obtaining an image comprising the steps of:

- image-wise exposing an imaging element containing a silver halide emulsion layer,
- developing said imaging element whilst in contact with an image receiving material as described above in the presence of developing agent(s) and silver halide solvent(s) and
- separating said imaging element and image receiving material from each other.

4. Detailed description of the invention.

It has been found that images of high density and practically free of pinholes can be obtained in a DTR-process using an image receiving material according to the present invention. There is only a small drop in the density of the image with respect to an image receiving material that does not contain a matting agent in the top layer. Further the image receiving material is especially suitable for use in alkaline processing baths containing alkanolamines as the main compounds for providing the alkalinity.

The matting agents to be used in connection with the present invention are preferably copolymers of one or more hydrophobic monomers and one or more hydrophilic monomers containing an acid group. Suitable hydrophobic monomers are e.g. (meth)acrylate esters e.g. methylmethacrylate, ethylmethacrylate, methylacrylate, stearylmethacrylate, stearylacrylate, butyl(meth)acrylate, styrene, vinyl chloride, vinylidene chloride, etc.. Preferred hydrophilic monomers are those having a carboxylic group e.g. methacrylic acid or acrylic acid.

The molar ratio of the hydrophobic to hydrophilic monomers in said copolymers is preferably between 1:1 and 1:3 and more preferably between 1:1 and 1:2 and most preferably between 1:1 and 4:5. By increasing the content of hydrophilic monomers in said copolymer one can increase the rate of dissolution of the matting agent in the alkaline processing bath.

The volume average diameter (d_{mv}) of the matting agents is preferably larger than the thickness of the top layer. By the volume average diameter is understood the median diameter representing 50% by volume of matting agents having a diameter less than said median diameter. Preferably the volume average diameter is between 1.5μm and 6μm and more preferably between 1.8μm and 3.8μm. The best results in connection with the present invention are obtained when the size of matting agents approaches a homogeneous distribution. A homogeneous distribution in connection with the present invention means that the ratio of the volume average diameter (d_{mv}) to the number average diameter (d_{mn}) is between 1 and 1.1 and more preferably between 1 and 1.05. The number average diameter (d_{mn}) is the median diameter representing 50% by number of the matting agents having a diameter less than said median diameter.

The matting agents used in connection with the present invention can be prepared according to the method described in DE-A-3331542.

The amount of matting agent contained in an image receiving material in connection with the present invention is preferably between 1 mg/m^2 and 100mg/m^2, more preferably between 4 mg/m^2 and 40mg/m^2 and most preferably between 8 mg/m^2 and 20mg/m^2.

The support of the image receiving material may be opaque or transparent, e.g. a paper support or resin support.

The image receiving layer comprises for best imaging results physical development nuclei normally in the presence of a protective hydrophilic colloid, e.g. gelatin and/or colloidal silica.

Preferred development nuclei are sulphides of heavy metals e.g. sulphides of antimony, bismuth, cadmium, cobalt, lead, nickel, palladium, platinum, silver, and zinc. Especially suitable development nuclei are NiS.Ag_2S nuclei as described in US-A 4,563,410. Other suitable development nuclei are salts such as e.g. selenides, polyselenides, polysulphides, mercaptans, and tin (II) halides. Heavy metals or salts thereof and fogged silver halide are suitable as well. The complex salts of lead and zinc sulphides are active both alone and when mixed with thioacetamide, dithiobiuret, and dithiooxamide. Heavy metals, preferably silver, gold, platinum, palladium, and mercury can be used in colloidal form.

The image-receiving element may contain in operative contact with the development nuclei thioether compounds, e.g. those described in DE-P 1,124,354, in US-P 4,013,471 and 4,072,526, and in published European Patent Application (EP-A) 0 026 520.

The transfer behaviour of the complexed silver largely depends on the thickness of the image-receiving layer and the kind of binding agent or the mixture of binding agents used in the nuclei containing layer. In order to obtain a sharp image with high spectral density the reduction of the silver salts diffusing into the image receiving layer must take place rapidly before lateral diffusion becomes substantial. For this reason the total solid coverage of the image receiving layer and top layer is preferably not more than 2.5g/m^2 and most preferably not more than 2g/m^2.

The top layer contained in an image receiving material in accordance with the present invention contains a hydrophilic colloid. The total solid coverage of the top layer is preferably between 0.1g/m^2 and 1.5g/m^2.

According to a preferred embodiment of the present invention the image receiving material contains on a support (1) an image-receiving layer containing physical development nuclei dispersed in a waterpermeable binder and (2) a waterpermeable top layer according to the invention free from development nuclei and containing a hydrophilic colloid wherein:

(i) the total solids coverage of said two layers (1) and (2) is at most 2 g/m^2,
(ii) in layer (1) the coverage of said nuclei is in the range of 0.1 mg/m^2 to 10 mg/m^2, and the coverage of binder is in the range of 0.4 to 1.3 g/m^2, and
(iii) in said top layer (2) the coverage of hydrophilic colloid is in the range of 0.1 to 0.9 g/m^2.

According to a particular embodiment the nuclei containing layer (1) is present on a nuclei-free underlying hydrophilic colloid undercoat layer or undercoat layer system having a coverage in the range of 0.1 to 1 g/m^2 of hydrophilic colloid, the total solids coverage of layers (1) and (2) together with the undercoat being preferably at most 2.5 g/m^2.

The undercoat optionally incorporates substances that improve the image quality, e.g. incorporates a substance improving the image-tone or the whiteness of the image background. For example, the undercoat may contain a fluorescent substance, silver complexing agent(s) and/or development inhibitor releasing compounds known for improving image sharpness.

According to a special embodiment the image-receiving layer is applied on an undercoat playing the role of a timing layer in association with an acidic layer serving for the neutralization of alkali of the image-receiving layer. By the timing layer the time before neutralization occurs is established, at least in part, by the time it takes for the alkaline processing composition to penetrate through the timing layer. Materials suitable for neutralizing layers and timing layers are disclosed in Research Disclosure July 1974, item 12331 and July 1975, item 13525.

In the image-receiving layer (1) and/or in said top layer (2) and/or in an undercoat gelatin is used preferably as hydrophilic colloid. In layer (1) gelatin is present preferably for at least 60 % by weight and is optionally used in conjunction with an other hydrophilic colloid, e.g. polyvinyl alcohol, cellulose derivatives, preferably carboxymethyl cellulose, dextran, gallactomannans, alginic acid derivatives, e.g. alginic acid sodium salt and/or watersoluble polyacrylamides. Said other hydrophilic colloid may be used also in the top layer for at most 10 % by weight and in the undercoat in an amount lower than the gelatin content.

The image-receiving layer and/or a hydrophilic colloid layer in water-permeable relationship therewith may comprise a silver halide developing agent and/or silver halide solvent, e.g. sodium thiosulphate in an amount of approximately 0.1 g to approximately 4 g per m^2.

The image-receiving layer or a hydrophilic colloid layer in water-permeable relationship therewith may comprise colloidal silica.

In at least one of the layers of the present image-receiving material substances can be contained, which play a role in the determination of the colour tone of the diffusion transfer silver image. Substances providing a neutral colour tone are called black-toning agents, e.g. as described in GB A 561,875 and BE A 502,525.

According to a preferred embodiment the processing liquid that will be described in detail below and/or the image-receiving material contains at least one image toning agent. In said case the image toning agent-

(s) may gradually transfer by diffusion from said image-receiving element into the processing liquid and keep therein the concentration of said agents almost steady. In practice such can be realized by using the silver image toning agents in a coverage in the range from 1 mg/m^2 to 20 mg/m^2 in a hydrophilic waterpermeable colloid layer.

A survey of suitable toning agents is given in the above mentioned book of André Rott and Edith Weyde, p. 61-65, preference being given to 1-phenyl-1H-tetrazole-5-thiol, also called 1-phenyl-5-mercapto-tetrazole, tautomeric structures and derivatives thereof such as 1-(2,3-dimethylphenyl)-5-mercapto-tetrazole, 1-(3,4-dimethylcyclohexyl)-5-mercapto-tetrazole, 1-(4-methylphenyl)-5-mercapto-tetrazole, 1-(3-chloro-4-methylphenyl)-5-mercapto-tetrazole, 1-(3,4-dichiorophenyl)-5-mercapto-tetrazole. Further particularly useful toning agents are of the class of thiohydantoins or of phenyl substituted mercapto-triazoles

Still further toning agents suitable for use in accordance with the preferred embodiment of the present invention are the toning agents described in the European patent applications 218752, 208346, 218753 and US-P-4683189.

According to a practical embodiment in the image-receiving element the development nuclei containing layer and/or hydrophilic colloid layer in waterpermeable relationship or a back layer at the side of the support opposite to that carrying the image receiving layer contains at least part of the silver image toning agents. Such procedure results actually in automatic replenishment of toning agent in the processing liquid. The same applies at least partially for the replenishment of the developing agent(s) and silver halide complexing agent(s).

When applying an optical brightening agent in the present image-receiving material preference is given to an optical brightening agent that is inherently by its structure resistant to diffusion or is made resistant to diffusion by use in conjunction with another substance wherein it is dissolved or whereto it is adsorbed.

For example, to make an optical brightening agent resistant to diffusion one of the following techniques may be applied.

According to a first technique known from colour photography the optical brightening compound is substituted with a long chain aliphatic residue and ionomeric residue as is known in the synthesis of diffusion resistant colour couplers.

According to a second technique an optical brightening agent of the oleophilic type is incorporated in droplets of a water-immiscible solvent, so-called "oilformer", e.g. dibutylphthalate.

According to a third technique the optical brightening agent is used in conjunction with a polymeric hydrophilic colloid adsorber, a so-called trapping agent, e.g. poly-N-vinylpyrrolidinone as described e.g. in US-P 3,650,752, 3,666,470 and 3,860,427 and published European patent application 0 106 690.

According to a fourth technique latex compositions are used wherein latex particles are loaded, i.e. contain in dissolved and/or adsorbed state an optical brightening agent as described e.g. in German Offenlegungsschrift (DE-OS) 1,597,467 and in US-P 4,388,403.

The image-receiving layer and/or other hydrophilic colloid layer of the present image-receiving material may have been hardened to achieve enhanced mechanical strength. Appropriate hardening agents for hardening the natural and/or synthetic hydrophilic colloid binding agents in the image-receiving layer include e.g. formaldehyde, glyoxal , mucochloric acid, and chrome alum. Hardening can also be effected by incorporating a hardener precursor in the image-receiving layer, the hardening of the hydrophilic colloid therein being triggered by the treatment with the alkaline processing liquid. Other suitable hardening agents for hardening the hydrophilic colloid binding agents in the image-receiving layer are vinylsulphonyl hardeners, e.g. as described in Research Disclosure 22,507 of Jan. 1983.

The image-receiving material according to the present invention can be used in the form of roll film or sheet film or in the form of a filmpack e.g., for in-camera-processing.

The present image-receiving material can be used in conjunction with any type of photographic silver halide emulsion material suited for use in diffusion transfer reversal processing, preference being given to silver halide emulsion layers the silver halide of which is mainly silver chloride because of its relatively easy complexing with thiosulphate ions. The silver halide grains can have any size or shape and may be prepared by any technique known in the art, e.g. by single-jet or double jet precipitation. Negative type or direct-positive type silver halide grains may be used. Negative and positive working type silver halide emulsions are known in the art and are described e.g. in Research Disclosure, November 1976, item 15162.

The binder of the photographic silver halide emulsion layer in the photographic material is preferably gelatin. But instead of or together with gelatin, one or more other natural and/or synthetic hydrophilic colloids e.g. albumin, casein, zein, polyvinyl alcohol, alginic acids or salts thereof, cellulose derivatives such as carboxymethyl cellulose, modified gelatin, etc. can be used. The weight ratio of hydrophilic colloid to silver halide expressed as equivalent amount of silver nitrate in the silver halide emulsion layer(s) of the photosensitive element usually is between 1:1 and 10:1.

In addition to the binder and the silver halide, the photosensitive element may contain in the photographic silver halide emulsion layer and/or in one or more layers in water-permeable relationship therewith any of the kinds of compounds customarily used in such layers for carrying out the DTR-process. Such layers may comprise e.g. one or more developing agents, coating aids, stabilizing agents or fog-inhibiting agents e.g. as described in GB A 1,007,020 and in the above-mentioned Research Disclosure N° 24236 , plasticizers, development-influencing agents e.g. polyoxyalkylene compounds, onium compounds, and thioether compounds as described e.g. in US A 2,938,792; US A 3,021,215; US A 3,038,805; US A 3,046,134; US A 4,013,471; US A 4,072,523; US A 4,072,523; US A 4,072,526; US A 4,292,400; and in DE A 1,124,354, spectral sensitizing agents, hardeners e.g. vinylsulphonyl hardeners such as those described e.g. in DE A 2,749,260; DE A 1,808,685; DE A 2,348,194 and in Research Disclosure 22,507 of Jan. 1983.

In case developing agents are to be incorporated into the silver halide emulsion, they are added to the emulsion composition preferably after the chemical ripening stage following the washing of the emulsion.

The silver complex diffusion transfer reversal processing is by nature a wet processing including development of the exposed silver halide in the emulsion layer of the photosensitive element, the complexing of residual undeveloped silver halide and the diffusion transfer of the silver complexes into the image-receiving material wherein physical development takes place.

The processing proceeds in alkaline aqueous medium.

The developing agent or a mixture of developing agents can be incorporated into an alkaline processing solution and/or into the photosensitive element comprising a photographic silver halide emulsion layer. When incorporated into the photosensitive element, the developing agent(s) can be present in the silver halide emulsion layer or are preferably present in a hydrophilic colloid layer in water-permeable relationship therewith, e.g. in the anti-halation layer adjacent to the silver halide emulsion layer of the photosensitive element. In case the developing agent or a mixture of developing agents is contained in the photosensitive element, the processing solution is merely an aqueous alkaline solution that initiates and activates the development.

Suitable developing agents for the exposed silver halide are e.g. hydroquinone-type and 1-phenyl-3-pyrazolidone-type developing agents as well as p-monomethylaminophenol.

The silver halide solvent, preferably sodium thiosulphate, may be supplied from the non-light-sensitive image-receiving element as mentioned above, but it is normally at least partly already present in the alkaline processing solution. When present in the alkaline processing solution, the amount of silver halide solvent is in the range of e.g. 10 g/l to 50 g/l.

The alkaline processing solution usually contains alkaline substances preserving agents e.g. sodium sulphite, thickening agents e.g. hydroxyethylcellulose and carboxymethylcellulose, fog-inhibiting agents such as potassium bromide, silver halide solvents e.g. sodium or ammonium thiosulphate, black-toning agents especially heterocyclic mercapto compounds. The pH of the processing solution is preferably in the range of 10 to 14.

Preferred alkaline substances are inorganic alkali e.g. sodium hydroxide, potassium carbonate or alkanolamines or mixtures thereof. Preferably used alkanolamines are tertiary alkanolamines e.g. those described in EP-A-397925, EP-A-397926, EP-A-397927, EP-A-398435 and US-P-4.632.896. A combination of alkanolamines having both a pk_a above or below 9 or a combination of alkanolamines whereof at least one has a pk_a above 9 and another having a pk_a of 9 or less may also be used as disclosed in the Japanese patent applications laid open to the public numbers 73949/61, 73953/61, 169841/61, 212670/60, 73950/61, 73952/61, 102644/61, 226647/63, 229453/63, US-P-4,362,811, US-P-4,568,634 etc.. The concentration of these alkanolamines is preferably from 0.1 mol/l to 0.9 mol/l.

For particulars about exposure and developing apparatus, which may be applied in the DTR-process according to the present invention reference is made e.g. to the above-mentioned book by A. Rott and E. Weyde and to patent literature cited therein.

The image receiving elements according to the present invention are particularly suited for the reproduction of line and screen images. They can be used likewise for the production of identification documents according to the DTR-process. Such identification documents contain a photograph and/or identification data formed by diffusion transfer in an image-receiving layer on a water-impermeable resin support, e.g. polyvinyl chloride resin support or polyethylene-covered paper support, which to exclude any forgery by alteration of the identification data and/or photograph, is laminated to a transparent protective cover sheet. The transparent protective cover sheet usually is a thermoplastic resin sheet such as a polyester film sheet, e.g. a polyethylene terephtalate film sheet, which is coated with polyethylene at the side that is to be laminated against the image-receiving-layer carrying the identification data.

The invention is illustrated by the following examples without the intention however to limit it thereto. All percentages are by weight unless otherwise specified.

EXAMPLE

Preparation of the matting agents

The following reaction mixture was introduced into a 15 liter stirrer vessel, which serves as a receiver, with constant stirring:

- methanol as set out in table 1 below
- an amount of electrolyte-free water corresponding to 6kg minus the amount of methanol
- 450g of an aqueous solution containing 10% of the sodium salt of an alternating copolymer of styrene and maleic acid anhydride with a limit viscosity number of 0.574 dl/g (see table 1)
- an amount of n-laurylmercaptane as set out in table 1
- 450g of electrolyte-free water
- 1500g of a monomer mixture as set out in table 1
- an amount of potassium persulfate as set out in table 1
- 2% by weight with respect to the total amount of monomer of a polyethylene-oxide type wetting agent (Hostapal W from Hoechst)
- 2% by weight with respect to the total amount of monomer of a sodium alkane sulphonate type wetting agent (Mersolat H obtainable from Bayer AG)

2250g of the above mixture was firstly introduced into a 12 liter steel autoclave which was provided with a blade stirrer. The autoclave is then sealed, subjected to a low nitrogen excess pressure and heated to a temperature of 65 °C. After a reaction time of 30min. the remainder of the reaction mixture from the receiver vessel was metered into the autoclave over a period of 2 hours by means of a reciprocating pump. On completion of the pumping operation, the mixture was stirred for a further 3 hours at 75 °C at a speed of 100 rpm. The resulting suspension was cooled to room temperature.

Table 1

no.	CH_3OH (g)	I (%M)	MA (mol/kg)	MMA (mol/kg)	STM (mmol/kg)	$K_2S_2O_8$ (%M)	LSH (%M)	A/B
1	1577	5.0	0.8936	0.7697	9.50	0.25	2.0	0.872
2	1714	3.0	0.4155	1.2138	9.48	0.25	0.5	2.943
3	1714	3.0	0.4155	1.2138	9.48	0.50	-	2.943
4	1371	3.0	1.4886	1.5065	16.8	1.0	0.5	1.023
5	1714	3.0	0.1625	1.4312	9.49	0.5	0.5	8.866
6	1714	3.0	0.4147	1.2106	9.46	2.0	0.5	2.942
7	1714	3.0	0.4150	1.2116	9.47	2.0	-	2.942
8	1714	3.0	0.1625	1.4312	9.48	1.5	-	8.866
9	1885	3.0	0.8393	0.8500	9.49	0.25	0.5	1.024
10	1433	2.0	0.7805	0.8950	9.46	0.5	0.5	1.159
11	1885	3.0	0.8857	0.8258	4.74	0.25	0.5	0.938

I = sodium salt of an alternating copolymer of styrene and maleic acid anhydride
MA = methacrylic acid
MMA = methylmethacrylate
STM = stearylmethacrylate
LSH = laurylmercaptane
A/B = molar ratio of MMA + STM over MA
%M = % by weight with respect to the total amount of monomers (MA + MMA + STM)

Preparation of the image receiving materials

A polyethylene terephthalate film support (provide with a hydrophilic adhesion layer) was coated on both sides at a dry coverage of 2.0 g/m^2 with an image-receiving layer containing silver-nickel sulphide nuclei and gelatin. This layer was applied by slide hopper coating so that the nuclei were in an undermost coating of 1.3 g gelatin per m^2. A top layer was provided from the coating solution shown hereafter such that the amount of gelatin in the top layer corresponded to 0.7 g of gelatin per m^2. coating solution for the top layer:

- 17g/l of an aqueous dispersion containing:
  7% of one of the matting agents prepared as above shown (except for a control sample which does not include a matting agent)
  7% of gelatin
  7% of methanol
- 50g/l of gelatin

The image receiving material was hardened with formaldehyde which was contained in an amount of 0.02mg/m^2 in the image receiving material.

Preparation of the imaging element

To a polyethyleneterephthalate film support (with a hydrophilic adhesion layer) was coated an antihalation layer containing carbon black in such an amount that the optical density for visual light corresponded to 0.6 and gelatin in an amount of 3.9 g/m^2. To this layer was coated a gelatino silver chlorobromide emulsion (98.2mol% of chloride and 1.8 mol% of silver bromide) spectrally sensitized with an ortho sensitizer at a coverage of 2.5g/m^2 of silver halide expressed as $AgNO_3$. The weight ratio of gelatin to silver halide expressed as $AgNO_3$ was 1.2. The silver halide emulsion layer further contained hydroquinone and 1-phenyl-4-methyl-pyrazolidone at a coverage of 0.9g and 0.25 g/m^2 respectively. The silver halide layer was then covered with a gelatin layer containing 0.5g/m^2 of gelatin.

Composition of the processing liquid:

Hydroxyethylcellulose (g)	1
EDTA (g)	2
Na_2SO_3 (anhydrous) (g)	45
$Na_2S_2O_3$ (anhydrous) (g)	14
KBr (g)	0.5
1-Phenyl-5-mercapto-tetrazole (g)	0.08
1-(3,4 dichlorophenyl)-1-H-tetrazole-5-thiol (g)	0.04
DMEA (ml)	30
MDEA (ml)	35
Water up to 1 litre	

EDTA = ethylenediaminetetraacetic acid tetrasodium salt
DMEA = dimethylethanolamine
MDEA = methyldiethanolamine

Image forming procedure:

Each of the image receiving materials listed in table 2 was contacted with an image-wise exposed imaging element as described above and processed in a transfer processor Copyproof CP380 (commercially available from Agfa-Gevaert N.V.) using the above described processing liquid. The transfer contact time was 60s and a temperature of 22 ° C was used to carry out the processing. Image-wise exposure of the imaging elements proceeded through the back of their support.

Evaluation

The maximum transmission density of each of the obtained images was measured and the difference of the measured density with the measured density of the control sample, that did not include a matting agent, was calculated.

The stickiness of each of the receiving materials was evaluated by putting two sheets (A4 size) thereof under a weight of 2 kg for 5 days at 35 ° C and 80% relative humidity. They were then peeled apart and the stickiness was measured and a number between 0 and 10 was assigned to indicate the level of stickiness (a higher number indicating an increasing level of stickiness, i.e. a value of 5 already indicates an unacceptable level).

The number of pinholes was visually evaluated by means of a magnifying glass and by holding the image receiving material against the light. A number between 0 and 10 was assigned to indicate the level of pinholes (a higher number indicates a higher level of pinholes).

In the following table 2 the results are shown obtained for each of the receiving materials comprising a matting agent as indicated:

Table 2

matting agent	soluble*	d_{mn} (μm)	d_{mv} (μm)	d_{mv}/d_{mn}	ΔD_{max}	stick.	pinholes
1	+	2.43	2.47	1.02	-0.22	0	0
2	-	1.92	1.95	1.02	-0.22	5	3
3	-	1.78	1.81	1.02	-0.26	10	3
4	+	1.33	4.82	3.62	-0.28	0	8
5	-	1.26	2.68	2.13	-0.65	0	10
6	-	1.64	2.78	1.70	-0.39		10
7	-	2.16	2.65	1.23	-0.33	0	10
8	-	1.80	2.06	1.14	-0.40		6
9	+	2.26	2.30	1.02	-0.20	0	0
10	+	2.34	2.36	1.01	-0.06	0	0
11	+	2.74	2.80	1.02	-0.32	0	0

*soluble = (+) indicates that 0.2g of the matting agent could be dissolved in 10ml of an aqueous solution containing 1 mol/l of sodium hydroxide at roomtemperature within 10s; (-) indicates that it could not be dissolved.
d_{mn} = average diameter based on number fraction (measured on a Coulter Multisizer)
d_{mv} = average diameter based on volume fraction (measured on a Coulter Multisizer)
stick. = level of stickiness
pinholes = level of pinholes
ΔD_{max} = D_{max} of the sample - D_{max} of the control sample

It can be seen from the above table 2 that all image receiving materials including a matting agent show a drop of the maximum density with respect to a control image receiving material not including a matting agent. However the image receiving materials according to the invention show less decrease in the maximum density. Further no or little pinholes are observed with image receiving materials according to the invention.

Claims

1. An image receiving material comprising on a support an image receiving layer containing physical development nuclei and a top layer free of physical development nuclei on top thereof, the total solid coverage of both layers being at most 2.5g/m^2 characterized in that said top layer comprises a matting agent having a solubility such that 0.2g of matting agent can be completely dissolved in 10ml of an aqueous solution containing 1 mol/l of sodium hydroxide at room temperature within 10s or less.

2. An image receiving material according to claim 1 wherein said matting agent is a copolymer of one or more hydrophobic monomers and one or more hydrophilic monomers containing an acid group.

3. An image receiving material according to claim 2 wherein the molar ratio of said hydrophobic to hydrophilic monomers in said copolymer is between 1:1 and 1:2.

4. An image receiving material according to any of claims 1 to 3 wherein said matting agent has an average diameter based on the volume fraction that is larger than the thickness of said top layer.

5. An image receiving material according to claim 4 wherein said average diameter based on the volume fraction is between 1.8μm and 3.8μm.

6. An image receiving material according to any of the above claims 1 to 5 wherein the total solid coverage of said image receiving layer and top layer is not more than 2g/m^2.

7. An image receiving material according to any of the above claims wherein the ratio of the average diameter based on the volume fraction and the average diameter based on the number fraction is between 1.0 and 1.1.

8. A method for obtaining an image comprising the steps of:
- image-wise exposing an imaging element containing a silver halide emulsion layer,
- developing said imaging element whilst in contact with an image receiving material as described in any of the above claims in the presence of developing agent(s) and silver halide solvent(s) and
- separating said imaging element and image receiving material.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 20 2602

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)
Y	EP-A-0 306 561 (AGFA-GEVAERT) * claims * ---	1-8	G03C8/28 G03C8/52
Y,D	DATABASE WPIL Section Ch, Week 8616, Derwent Publications Ltd., London, GB; Class A89, AN 86-102424 & JP-A-6 145 244 (KONISHIROKU PHOTO) 5 March 1986 * abstract * ---	1-8	
A	FR-A-2 111 321 (FUJI PHOTO FILM) ---		
A	US-A-3 257 206 (L.M. DE HAES) -----		
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			G03C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	07 APRIL 1993	PHILOSOPH L.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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