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(54) Process for curing and setting emulsified particles and carbonless pressure-sensitive recording sheet using the same.

(57) The present invention relates to a process for curing and setting emulsified particles by irradiating the emulsion comprising a photo or radiation curable material with light or radiation.
The invention relates also to carbonless pressure-sensitive recording sheets using the process of the invention.

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The present invention relates to a process for curing and setting emulsified particles using a new coating solution in which a remarkably superior productivity is achieved. More specifically, the present invention relates to a carbonless pressure- sensitive recording sheet using this process.

Hitherto, microcapsule formation is known as an effective means for curing and setting emulsified particles. The content, the so-called core material, of microcapsules includes pharmaceuticals, agricultural chemicals, perfumes, dyestuffs, liquid crystals, temperature-indicating materials, adhesives and the like. The microcapsules are used in a broad field with the view to the curing of a core material, the control of the release of a core material, the control of a reaction, the solidification of a liquid and the like. One of the applications in large scales lies in the field of carbonless pressure-sensitive recording sheets, wherein the process for producing microcapsules requires high control techniques.

As the microcapsule-formation by a chemical method, the two following processes are known.

(1) Coacervation process using a phase separation of a water-soluble polymer, such as gelatin, etc. Only a capsule dispersion of a low consistency is obtained, and there are difficulties in the complicate steps, the long production time, the stability, decomposition and water-resistance.

(2) Interfacial polymerization process or in situ polymerization process forming capsule walls composed of synthetic resin films such as polyurethane resin films, polyurea resin films, polyamide resin films, urea-formaldehyde resin films, melamine-formaldehyde resin films and the like.

The obtained synthetic resin film of capsules has a sufficient hardness and compactness, and is superior in heat, humidity and solvent resistance. This film allows a high consistency coating, which causes a wide applicability. In the reaction for forming a synthetic resin film, the unreacted monomer, such as formaldehyde, isocyanates, polyamines, etc. remains in the microcapsule slurry, and therefore much time and labor is required to remove the unreacted monomers, involving the risk of injuring the capsule film properties. In any conventional capsule-forming method, an emulsification, a capsule-forming reaction and a capsule treating step are necessary.

Then, the coating solution produced from the microcapsules, is applied onto a flexible substrate by using various coating means. For example, however, air knife coater, bar coater, curtain coater, blade coater and the like are useful if a large amount of coating is to be applied but are not suitable for a partial coating matching to a minor production of various kinds. The partial printing with silkscreen system, gravure system, flexo system, etc. does not provide a sufficient performance in point of the coating characteristics of the microcapsule dispersion formed in a hydrophilic medium, and is not suitable for the minor production of many kinds. As a result, these are not suitable to meet various quality requirements of a minor production in using microcapsule-forming process.

The transfer recording papers using no microcapsule-forming process are employed in wide fields, as seen in back-carbon papers. These socalled carbonless pressure-sensitive recording sheets using no microcapsule-forming process are as follows. In the use of a carbonless dye precursor as a recording agent, for example, Japanese Patent Laid-Open Application No. 57-77410 discloses a process for producing a carbonless pressure-sensitive recording material providing, between a flexible substrate and an upper coating layer of a curing layer, an intermediate layer of porous filling substances impregnated in a liquid medium in which a colorless or pale-colored dye precursor is dissolved or dispersed. Further, Japanese Patent Laid-Open Application No. 54-74111 discloses a process for producing a carbonless pressure-sensitive recording material which uses a coating solution composed of both a wax or a mixture of waxes dissolving a carbonless dye precursor and an oily and/or fatty-substance as a fluidizing agent. Japanese Patent Laid-Open Application No. 56-60289 discloses a process for producing a carbonless pressure-sensitive recording paper which is produced by the application of an aqueous dispersed coating solution composed of both a high oil-absorbing powder impregnated with a hydrophobic liquid dissolving a carbonless dye precursor and a higher fatty acid amide or a mixture of other waxes therewith.

However, the above-described carbonless pressure-sensitive recording papers exhibit the following disadvantages in comparison with the carbonless pressure-sensitive recording papers using a microcapsule-forming process:

(1) Insufficient preservability,

(2) Waxy luster on the coating surface,

(3) Slow coating speed, and the like.

Therefore, they are not brought to the market, and not put into practical use.

As examples of photopolymerization curable capsules, Japaneses Patent Laid-Open Application No. 60-7931 discloses a process for a microcapsule-forming reaction in a short time by irradiating a reaction vessel with light, in which the time is too long to achieve a practically useful capsule production (production of 100 kg/hr)

The present invention, which changes remarkably the conception about curing and setting the conven-

tional emulsified particles, provides both a process for curing and setting the emulsified particles efficiently and a pressure-sensitive recording paper obtainable in high productivity by using this process.Practically, the present invention has following advantages.

(1) The microcapsule-forming process does not require a complicated and high-level control.

(2) Superior curing and release control without a microcapsule -forming process.

(3) Applicability of various coating methods.

The above subjects are achieved by a process for curing and setting emulsified particles contained in an emulsion comprising a photo- or radiation- curable material, which process comprises curing the photo- or radiation- curable material by the irradiation with light or radiation in a coating process.

Further, the carbonless pressure-sensitive recording sheet of the present invention is obtained by the application of the above process for curing and setting emulsified particles in an emulsion containing a carbonless dyestuff, a coat-surface treating agent composed of at least a white color pigment or filler, a buffer agent for a pressure-sensitive recording paper and a binder. The carbonless pressure-sensitive recording sheet of the present invention allows a partial printing, which was only insufficiently possible with the conventional carbonless pressure-sensitive recording sheets.

Fig. 1 shows a process-diagram indicating the process-time of the Examples and the Comparative Example.

In the present invention, a photo- or radiation- curable material is cured by the irradiation with light or radiation in a coating process. In this case, "the coating process" means "before, in, or after" adhesion of the emulsion on a substrate. The photo- or radiation-curable material of the present invention includes any of the well-known photo- or radiation curable materials, and is preferably at least one of monomers and oligomers having following properties.

(1) Soluble or dispersible in emulsified particles.

(2) Compatible with the ingredients in the emulsified particles.

(3) Very slight toxity and odor after curing by light or radiation.

(4) Film formability, and possibility of enclosing a liquid as emulsified particles in the film.

In applying the process of the present invention to a carbonless pressure-sensitive recording sheet, the following points must be satisfied.

(5) Neither coloring hinderance nor desensitized function for a color-developing agent.

(6) Almost no skin irritation.

Practically, taking the use and its condition of the emulsion into consideration, the following compounds are used, for example, aliphatic methacrylate, cyclic aliphatic di(meth)acrylate, aliphatic di(meth)acrylate, aliphatic tri(meth)acrylate, aliphatic tetra(meth)acrylate, aromatic (meth)acrylate, epoxy(meth)acylate, glycerol(meth)acrylate, 2-hydroxyalkyl(meth)acrylate,methoxyalkylene (meth)acrylate, methoxydialkylene-(meth)acrylate, methoxy-tri-alkylene (meth)acrylate, methoxytetraalkylene (meth)acrylate, methoxy polyalkylene (meth)acrylate, oligoester (meth)acrylate, pentaerythritol (meth)acrylate, pentaerythritol tetra(meth)-acrylate, alkylmodified dipentaerythritol tetra(meth)acylate, alkylmodified dipentaerythritol penta (meth)-acrylate,

phenoxyalkyl(meth)acrylate, polyalkylene glycol (meth)acrylate, polyalkyleneglycol di(meth)acrylate, phenoxy dialkylene glycol (meth)acrylate, alkyleneoxide modified phosphoric acid di(meth)acrylate, alkyleneoxide modified phosphoric acid tri(meth)acrylate, alkylene modified phthalic acid (meth)acrylate, polybutadiene (meth)acrylate, polybutadiene urethane (meth)acrylate, polyester (meth)acrylate, polyoxyalkyl di(meth)acrylate, alkylene oxide modified trimethylol alkyl(meth)acrylate, alkylene oxide modified trimethylol alkyl di(meth)acrylate, alkylene oxide modified trimethylol alkyl tri(meth)acrylate, urethane (meth)acrylate, polyester (meth)acrylate, epoxy (meth)acrylate, alkylene modified bisphenol A, di (meth)acrylate, metal di-(meth)acrylate, N-vinyl pyrrolidone.

The above compounds are used alone or in combination.

The addition amount of a photo- or radiation- curable material varies with the intended use , but is in the range of 1-20 % by weight, based on the emulsified particles, in the carbonless pressure- sensitive recording sheet. In using light for cure-action, a photo-curing initiator and a sensitizer must be used in addition to the above photo- or radiation curable material. The photo-curing initiator, which is the conventional agent for UV curing,includes, for example, acrylated benzophenone, benzil, benzoylalkylether, benzophenone, xanthone thioxanthone, acetophenone, hydroxy phenyl ketone and the like. The addition amount of the photo-curing initiator is in the range of 0.1-20 % by weight, based on the photo- or radiation-curable material. In using radiation for cure-action, the above photo-or radiation- curable material can be employed, wherein the amount used is in the range of 1-20 % by weight, based on the hydrophobic substance. If necessary, the photo-curing initiator and sensitizer used for the above photo-curing can be applicable again.

In carbonless pressure-sensitive recording sheets, the emulsified particles are formed by dissolving a colorless dyestuff for carbonless pressure-sensitive recording sheets in a hydrophobic liquid composed of the usual oil for carbonless pressure-sensitive recording sheets, and the emulsion is obtained by emulsifying the above particles in the aqueous solution of a water soluble emulsifier as a hydrophobic core substance. In this case, the photo- or radiation-curable material is preferably added to the hydrophobic core substance by dissolution, but it can also be added to the continuous phase of the emulsion or to both.

The water-soluble emulsifier, which is preferably that for the usual process of pressure-sensitive recording capsules, includes, for example, an acrylic acid polymer, maleic anhydride copolymer, styrene-sulfonic acid copolymer ,polyvinyl alcohol, gelatin,carboxy methylcellulose, casein, starch, gum arabic and the like. If necessary, a small amount of a surface active agent can be used.

The size of the emulsified particles varies with the uses,but is most preferably in the range of 0.1-5μ. In the use of carbonless pressure-sensitive recording papers, a size of less than 0.1μ provides an inferior color-forming effect, which tends to cause troubles in obtaining multiple copies. A size of more than 5μ causes troubles in stabilizing the emulsified particles in the coating, so that an uniform coating is difficult to achieve. Further, a particle size of more than 5μ on a substrate is not preferable, since it causes a smudge in the color-formation by unusual pressure.

In a process for producing a carbonless pressure-sensitive recording sheet obtained by the process for curing and setting the emulsified particles of the present invention, a coat-surface-treating agent must be added into the continuous phase of the emulsion.

The coat-surface-treating agent has the five following functions.

(1) Effective prevention of the permeation of the emulsified substance into a substrate,

(2) Improvement of the film-forming effect by light or radiation,

(3) Acquirement of printability,

(4) Improvement of whiteness,

(5) Control of sheet formation,

For this purpose, coating pigments and paper fillers are effectively used. The above pigments and fillers include, for example, kaolin, calcium carbonate, magnesium carbonate, titanium dioxide, aluminum hydroxide, aluminum oxide, amorphous silica and silicate, satin white, talc, zinc oxide, barium sulfate and plastic pigment. These pigments and fillers can be used alone,but preferably in combination. Practically, the use of at least 10% of titanium dioxide, based on pigment and filler, provides the aimed sheet.

In the process for producing carbonless pressure-sensitive recording sheets, a buffer agent must be added thereto. The buffer agent, which is that for a pressure-sensitive recording sheet, includes, for example, pulp powder, starch particles, glass beads, plastic beads, polyolefine particles, etc. These agents are appropriately added thereto for the purpose of preventing the rupture of the emulsified particles after forming films by the irradiation with light or radiation.

As binders, photo- or radiation-curable binders are effective, in addition to binders for pressure-sensitive recording sheets. The usual binders include, for example, water-soluble natural polymers such as gelatin, albumine, caseins, starch powder, celluloses, gums and the like; and water-soluble synthetic polymers such as polyvinyl alcohol, polyvinyl pyrrolidone, polyacrylic acid copolymers, maleic anhydride copolymers,polyacrylic amide and the like. Further, binders include latexes, such as styrene-butadiene copolymer, acrylonitrile-butadiene copolymer, acrylic ester-base latex, vinyl acetate-base latex, methyl methacrylate butadiene-base latex and carboxylated latex thereof, etc.

The photo- or radiation-curable binders include, for example, partial cinnamoyl esters of polyvinyl alcohol, amylose, starch, alginic acid and the like; cinnamylidene acetic ester; cyanocinnamylidene acetic ester; water-soluble acrylic esters; polyalkylene glycol acrylamides; and the like. The above binders can be used alone or in combination.

To the binder, there are added, optionally, dispersing agents, surface active agents, antifoamers, antiseptics, fluorescence dyestuffs, cross-linking agents, photo initiators, sensitizers and the like.

The obtained emulsified substance can be applied onto a substrate by mass production coaters, for example, air knife coater, roll coater, blade coater, bar coater, curtain coater, etc. In printing systems, the coating can be applied by a printer, such as gravure-, flexo-, screen- or letterpress-printers fitted with a light-irradiation or radiation installation.

In the process for coating a substrate with the emulsified substance containing a photo- or radiation-curable material, these curable material is promptly polymerized to form a cure-film, which cures and sets emulsified particles in an emulsion.

(Examples)

Examples for carbonless pressure-sensitive recording sheets are described in order to explain the present invention . However, the present invention is in no way limited to these Examples.

Hereinafter, parts and % mean parts by weight and % by weight, respectively.

Example 1

(Preparation of an emulsion containing both a color-forming agent and a photo- or radiation-curable material)

85 parts of a 10% aqueous polyvinyl alcohol(trade name:Gosenol GL-05, manufactured by The Nippon Synthetic Chemical Industry., Ltd.) and 30 parts of water were charged in a vessel with an agitator to prepare a hydrophilic medium for the emulsification. 132 parts of isopropyl naphthalene (trade name: KMC oil, manufactured by Kureha Chemical Industry Co., Ltd.), and 4 parts of crystal violet lactone were dissolved in the hydrophilic medium. On the other hand, a hydrophobic solution was prepared by dissolving 10 parts polyurethane acrylate(trade name: Beam Set 575, manufactured by Arakawa Kagaku Kogyo Co.) as a photo-curable material and 1 part of hydroxymethyl propiophenone(trade name:Daro Cure 1173, manufactured by Merck Co.) as a photo-curing initiator. The obtained hydrophobic solution was added to the hydrophilic medium, and was emulsified to an average particle size of 2.1 μ to prepare a stable hydrophilic emulsion.

(Preparation of a coating solution)

A coat-surface-treating agent was prepared from 10 parts of a 60% aqueous dispersed titanium dioxide solution and 25 parts of a 60% aqueous dispersed aluminum hydroxide solution. 35 parts of wheat starch as a buffer agent were added to the coat-surface-treating agent with agitation. After complete dispersing, 10 parts (as solid) of styrene-butadiene base latex, 167 parts of the beforehand prepared emulsion containing both a color-forming agent and a photo-curable material and 60 parts of water were further added thereto to produce a coating solution.

(Coating and film-curing processes)

The above coating solution was coated on a fine paper of 40g/m^2 by means of a Meyer bar to prepare a coated paper having a coating amount of 3.4 g/m^2. Then, the coated paper was irradiated with UV rays in an irradiation distance of 10 cm and in a ccnveyer speed of 1.5 m/min. by means of a 3 kW high voltage metal halide lamp to cure the film. Thus, a top sheet for carbonless pressure-sensitive recording sheets was obtained. The process and test results are summarized in Fig. 1 and Table 1.

Example 2

(Preparation of an emulsion containing a color-forming agent and a photo- or radiation-curable material)

The emulsion of Example 2 was prepared in the same manner as the emulsion of Example 1 but without the photo-curing initiator.

(Preparation of a coating solution)

A coating solution was prepared in the same procedure as in Example 1.

(Coating and film-curing process)

The above coating solution was coated on a fine paper of 40 g/m^2 by means of a Meyer bar to prepare a coated paper having a coating amount of 3.5 g/m^2. Then, a film curing treatment was made using an acceleration voltage of 175 kV, an electron beam amount of 5 M rad and an irradiation speed of 20 m/min. to prepare a top sheet for carbonless pressure-sensitive recording papers. The process and test results are summarized in Fig. 1 and Table 1.

Example 3.

(Preparation of an emulsion containing a color-forming agent and a photo- or radiation-curable material)

35 parts of a 25% aqueous acrylic acid-styrene sulfonic acid-acrylic ester copolymer and 80 parts of water were charged in a vessel with an agitator to prepare a hydrophilic medium for the emulsification. 132 parts of phenylxylylethane (main ingredient of HYSOL SAS 296-trade name-, manufactured by NIPPON PETROCHEMICALS CO., LTD.), 4 parts of crystal violet lactone were dissolved in the hydrophilic medium, and further a solution (as a hydrophobic substance) dissolving 10 parts of a polyfunctional oligoester (trade name: Aronix M-400, manufactured by Toagosei Chemical Industry Co., Ltd.) as an electron beam-curable material was added thereto. Then, the obtained solution was emulsified to an average particle size of 1.5μ to prepare a stable hydrophile emulsion.

(Preparation of a coating solution)

A coat-surface treating agent was prepared from 10 parts of a 60% beforehand dispersed titanium dioxide solution and 25 parts of a 60% aqueous calcium carbonate dispersion. 35 parts of wheat starch as a buffer agent were added to the coat-surface-treating agent with stirring. After complete dispersing, 10 parts (as solid) of acrylic ester base latex, 167 parts of the above hydrophilic emulsion containing a color-forming agent and a radiation- curable material and 60 parts of water were added thereto to prepare a coating solution.

(Coating and film-curing process)

The coating and film-curing processes were made according to the same procedure as in Example 2 to prepare a top sheet for pressure-sensitive recording papers.

The processes and test results are summarized in Fig. 1 and Table 1.

Example 4

(Preparation of an emulsion containing a color-forming agent and a photo- or radiation-curable material)

The emulsion of Example 4 was prepared in the same manner as in Example 1 except that the hydrophilic emulsion of Example 1 was emulsified to an average particle size of 0.5μ .

(Preparation of a coating solution)

A coat-surface-treating agent was prepared by mixing 20 parts of a 60% aqueous dispersed titanium dioxide solution and 35 parts of a 60% aqueous calcium carbonate dispersion having an average particle size of 1.7μ with stirring. After complete dispersing, 15 parts of acrylic ester base latex as a binder, 167 parts of the beforehand prepared emulsion containing a color-forming agent and a photo-curable material and 20 parts of water were added thereto to prepare a coating solution.

(Coating and film-curing process)

The above coating solution was coated on a fine paper of 40 g/m^2 in a coating amount of 1.5g/m^2 by means of a flexo printer installed with an UV-irradiation equipment (Irradiation condition: 3 kW metal halide lamp) under a coating speed of 5 m/min. The coating was irradiated with UV rays in an irradiation distance of 7 cm to cure a film. Thus, a particle coated top sheet for carbonless pressure-sensitive recording papers was obtained. The process and test results are summarized in Fig. 1 and Table 1.

Comparative Example 1.

(Preparation of an capsule emulsion containing a color-forming agent)

150 parts of a 3% aqueous ethylene maleic anhydride copolymer solution (trade name:EMA-31, manufactured by Monsanto Chemical Co.) were adjusted to a pH-value of 4 with a 20% aqueous sodium hydroxide solution to prepare a hydrophilic medium. 100 parts of alkylnaphthalene (trade name: KMC oil, manufactured by Kureha Chemical Co.) and 37 parts of crystal violet lactone were dissolved in the hydrophilic medium, and then emulsified to an average particle size of 4.5μ .

(Encapsulating reaction)

A melamine-formaldehyde prepolymer , which was produced from 30 parts of formalin and 10 parts of melamine at 60 ° C, was added to the above emulsion. The temperature of the system was held at 60-70 ° C for 3 hours. After cooling to room temperature, the system was adjusted to a pH-value of 7.5 by adding a 28% aqueous ammonia solution thereto to prepare a microcapsule dispersion. The time required for preparing this solution was 5 hours.

(Preparation of the coating solution)

35 parts of wheat starch, 15 parts(as solid) of styrenebutadiene base latex and 2 parts (as solid) of polyvinyl alcohol were added to 100 parts of the microcapsule dispersion. The obtained dispersion (the system) was diluted to 15% solids with water.

(Coating process)

The coating solution was coated on a base paper of 40 g/m^2 in a coating amount of 3.5 g/m^2 by means of a Meyer bar, and dried in an oven at 105 ° C for 60 sec. to prepare a top sheet for pressure-sensitive recording papers. The process and test results are summarized in Fig. 1 and Table 1.

(Comparative test of qualities)

(1) Color-forming ability

An experimental top sheet was laid on a bottom sheet (manufactured by JUJO PAPER CO., LTD., No. 40) in such a way that the coated surfaces faced each other. The sheets were treated by means of a supercalender to produce a color. After one hour, the image density was measured by a Macbeth densitometer. (High value means a better color formation)

(2) Smudge caused by wearing

The experimental top sheet was laid on the above bottom sheet in such a way that the coated surfaces faced each other. Then , the sheets were rubbed with each other 5 times under a load of 4kg/cm^2 . The color density of the coated surface of the bottom sheet caused by the smudge was measured by means of color-difference meter.

(A lower value means a slight smudge)

(3) Smudge caused by static pressure

An experimental top sheet was laid on a bottom sheet in such a way that the coated surfaces faced each other. The sheets were loaded under a pressure of 20 kg/cm^2 for 30 sec. The color density of the coated surface of the bottom sheet caused by the smudge was measured by means of color-difference meter.

(A lower value means a slight smudge)

(4) Printability

In the coated part and the uncoated part of the experimental top sheet , shrinkage and curl of the coated sheet were observed visually.

Table 1

	Example 1	Example 2	Example 3	Example 4	Comparative Example 1
Color-forming ability	0.70	0.75	0.73	0.67	0.66
Smudge caused by wearing	3.8	3.6	3.6	3.4	3.3
Smudge caused by static pressure	5.8	5.3	5.4	5.6	5.7
Printability	good	good	good	good	bad
Total process-time	2Hr12m	2Hr11m	2Hr11m	2Hr13m	7Hr13m

(Effects of the Invention)

A process for curing and setting emulsified particles contained in an emulsion by irradiating with light or radiation was impossible hitherto.

The setting of the emulsified particles, which had been achieved only by an encapsulation process, was performed very simply in the present invention. The present invention provides carbonless pressure-sensitive recording papers which, as compared to conventional pressure-sensitive recording paper have equal copying suitablity and can be prepared in a simpler process and in a shorter time.The partial coating of the carbonless pressure-sensitive recording sheet is possible owing to the improvement of printability.

From the above facts, the present invention provides the following effects:

(1) Simple preparation process and short preparation time owing to the omission of a microencapsulating process which requires complicate and high-level control and

(2) a broad field of application in, for example, curing, release-control, reaction-control, solidification of liquids, and the like with regard to pharmaceuticals, agricultural chemicals, perfumes, dyestuffs, liquid crystals, temperature-indicating materials, adhesives, etc. since the present invention provides a process for curing and setting the emulsified particles.

Claims

1. A process for curing and setting emulsified particles contained in an emulsion comprising a photo- or radiation-curable material, characterized in setting said emulsified particles on a substrate by curing said photo- or radiation-curable material under the irradiation with light or radiation in a coating process.

2. The process according to claim 1, characterized in that the amount of said photo- or radiation-curable material is in a range of 1-20% by weight, based on said emulsified particles.

3. The process according to claims 1 or 2, characterized in that said emulsion comprises a photo-curing initiator and a sensitizer, in addition to said photo- or radiation-curable material.

4. A carbonless pressure-sensitive recording sheet characterized in that said sheet is obtainable by setting

emulsified particles on a substrate by curing a photo- or radiation-curable material under the irradiation with light or radiation in a coating process, wherein the emulsified particles comprise a colorless dye for carbonless pressure-sensitive paper and the continuous layer in said emulsion comprises a coat-surface-treating agent composed of at least one white pigment or filler, a buffer agent for pressure-sensitive recording sheets and a binder.

5. The carbonless pressure-sensitive recording sheet according to claim 4, characterized in that the amount of said photo- or radiation-curable material is in a range of 1-20% by weight, based on said emulsified particles.

6. The carbonless pressure-sensitive recording sheet according to claims 4 or 5, characterized in that said emulsion comprises a photo-curing initiator and a sensitizer, in addition to said photo- or radiation-curable material.

7. The carbonless pressure-sensitive recording sheet according to claim 6, characterized in that the amount of said photo-curing initiator is 0.1-20% by weight , based on said photo-curable material.

8. The carbonless pressure-sensitive recording sheet according to anyone of claims 4 to 7, characterized in that said that emulsfied particles have an average particle size of 0.1-5μ.

9. The carbonless pressure-sensitive recording sheet according to anyone of claims 4 to 8, characterized in that said binder is a photo- or radiation-curable binder.

10. The carbonless pressure-sensitive recording sheet according to anyone of claims 4 to 9, characterized in that said pigment comprises at least 10% by weight of titanium dioxide, based on said pigment and filler.

Fig. 1

Example--whole processing time (2hr 11-13 min.)

1. Preparation of emulsion (1hr 40 min.)
   (1) Preparation hydrophobic solution containing a color-forming agent (1hr)
   (2) Preparation of hydrophobic medium for emulsifying (30 min.)
   (3) Emulsification (10 min.)
2. Preparation of coating solution (30 min.)
3. Coating and film curing (1-3 min.)

Comparative Example

--whole processing time (7hr 12 min.)

1. Preparation of emulsion (1hr 40 min.)
   (1) Preparation hydrophobic solution containing a color-forming agent (1hr)
   (2) Preparation of hydrophobic medium for emulsifying (30 min.)
   (3) Emulsification (10 min.)
2. Encapsulation
   (1) Preparation of melamine-formaldehyde prepolymer→Addition to an emulsion (1hr)
   (2) Heating (20 min.)
   (3) Encapsulation (3hr)
   (4) Cooling (20 min.)
   (5) Treating with ammonia soln. (20 min.)
3. Preparation of coating solution (30 min.)
4. Coating and drying (3 min.)

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 10 2117

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)
X	FR-A-2 350 206 (THE MEAD CORPORATION) * page 17, line 36 - page 21, line 13; claim 12 *	1-10	B 41 M 5/124 G 03 F 7/00
X	GB-A-1 161 934 (THE MEAD CORPORATION) * page 2, line 124 - page 3, line 29 * * page 3, lines 84 - 111 *	1-10	
X	PATENT ABSTRACTS OF JAPAN vol. 11, no. 321 (M-633)(2768) 20 October 1987, & JP-A-62 103186 (TEIKOKU INK SEIZO K.K.) 13 May 1987, * the whole document *	1-10	
A	US-A-3 535 140 (T.W.BUSCH) * the whole document *	1-10	
A	DE-B-1 127 377 (FA. GUENTHER WAGNER) * the whole document *	1-10	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B 41 M
G 03 F

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	22 May 91	BACON,A.J.

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
Y: particularly relevant if combined with another document of the same catagory
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