United States Patent [19]

Kato et al.

[11] **3,896,255**

[45] **July 22, 1975**

[54] **RECORDING SHEET**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **428/411;** 427/145; 427/146

[51] **Int. Cl.²** **B41M 5/00**

[58] **Field of Search** 117/36.7, 36.8, 36.2

[56] **References Cited**

UNITED STATES PATENTS

3,418,250	12/1968	Vassiliades	117/36.2 X
3,664,858	5/1972	Huffman	117/36.8
3,689,302	9/1972	Kubo et al.	117/36.8
3,723,156	3/1973	Brockett et al.	117/36.2
3,767,449	10/1973	Hayashi et al.	117/36.2
3,772,052	11/1973	Kimura et al.	117/36.2
3,843,383	10/1974	Ishige et al.	117/36.8

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[57] **ABSTRACT**

A recording sheet which comprises a layer of a color developer which forms a color image upon contact with a color coupler, said layer containing at least one metal compound of an aromatic carboxylic acid and a surface active agent is disclosed.

5 Claims, No Drawings

RECORDING SHEET

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a recording sheet. More particularly, it relates to a recording sheet wherein an improved color developer is used.

2. Description of the Prior Art

Recording sheets are well known in which the coloring reaction of an electron denoting colorless organic compound capable of forming a distinct color when contacted with an acid (hereinafter called color former) such as Malachite Green Lactone, Benzoyl Leuco Methylene Blue, Crystal Violet Lactone, Rhodamine-B-Lactam, 3-dialkylamino-7-dialkylaminofluorane and 3-methyl-2,2-spirobi(benzol(f)cumene) with a solid acid substance which develops a color in contact with the color former (hereinafter called color developer) is used.

As recording sheets in which the above phenomenon is practically utilized, there are pressure sensitive copying papers (for example, see U.S. Pat. Nos. 2,505,470, **2,505,489**, **2,550,471**, **2,548,366**, **2,712,507**, **2,730,456**, **2,730,457**, and 3,418,250) and heat sensitive copying papers (for example, see Japanese Pat. publication No. 4160/**68** and U.S. Pat. No. 2,939,009). Furthermore, a printing method is known where an ink containing a color coupler is applied to a sheet coated with a color developer through a medium such as stencil to yield a colored image (see German laid-open specification No. 1,939,962).

In many cases, the coloring reaction with the color coupler requires pressure from a pen or typewriter, heat or some other physical modification to initiate the reaction.

Pressure sensitive copying papers are typical examples of such recording sheets. A pressure sensitive copying paper is obtained by dissolving a color coupler in a solvent such as an alkylated naphthalene, alkylated diphenyl or alkylated diphenylmethane, dispersing the solution in a binder or encapsulating it in microcapsules, and then coating the dispersion or microcapsules on a support such as paper, plastic film or resin-coated paper.

A heat sensitive copying paper is obtained by coating a color coupler together with a heat-fusible substance such as acetanilide on a support. In this case, the term "heat-fusible substance" means a substance which is fused upon heating and solves the color coupler.

On the other hand, a color developer is usually dissolved or dispersed with a binder in water or an organic solvent and coated on or impregnated into a support. The color developer may also be so coated or impregnated just before recording.

In general, the color coupler and color developer are each coated on the same or opposite surfaces of a support or on different supports, respectively.

As color developers as mentioned above there are known, in general, clays such as Japanese acid clay, activated clay, attapulgite, zeolite and bentonite; organic acids such as succinic acid, tannic acid, gallic acid and phenol compounds; and acid polymers such as phenol resin.

Above all, the phenol resins have received attention as new color developers (see Japanese Pat. publication No. 20144/67) and a number of improvements have been proporsed therefor (see U.S. Pat. Nos. 3,516,845 and 3,540,911 and British Pat. No. 1,065,587).

The phenol resins do not have sufficient color developing power, and their colored images show poor light fastness though they are excellent in water stability on reacting with a color coupler. For example, a colored image obtained from a phenol resin and Crystal Violet Lactone discolors easily not only on exposure to light but on standing in a room, and the surface of the phenol resin which has not undergone reaction (color development) turns yellow.

Other acid polymers, such as, for example, maleic acid-rosin resin or partially or wholly hydroylsed styrene-maleic anhydride copolymers inherently have a low color development power and can not be used practically.

We, the inventors, previously proposed that a metal compound of an aromatic carboxylic acid was effective as a color developer for recording sheets. That is, the performance of a color developer can be substantially improved using a metal compound of an aromatic carboxylic acid. However, the color development power and the film surface strength of a coated layer formed from such a system are not always sufficient (depending on the conditioning of the color developer coating solution), leaving room for improvement.

SUMMARY OF THE INVENTION

Accordingly, one object of this invention is to provide a recording sheet of improved color development power and film surface strength.

A second object of this invention is to improve the coatability of coating solutions used in the manufacture of a recording sheet of improved color development power and film surface strength.

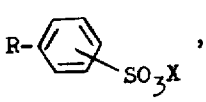
We have observed that when a coating solution containing a metal compound of aromatic carboxylic acid was prepared, not only was the viscosity of the coating solution increased but metal compound was formed in the form of particles, so that the color development power and the film surface strength of the final color developer layer were often insufficient, and that the above objects of this invention can be attained by incorporating a surface active agent in a color developer coating solution containing a metal compound of an aromatic carboxylic acid.

DETAILED DESCRIPTION OF THE INVENTION

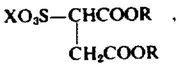
While the metal compound of an aromatic carboxylic acid can be used as a color developing component alone because it has a color development power itself, it can also be used together with other color developers.

The coating solution containing a metal compound of an aromatic carboxylic acid can be prepared by dissolving or dispersing at least one metal compound of an aromatic carboxylic acid in a solvent. The solvent which can be used in the invention includes water, an organic solvent and other liquid media for an aromatic carboxylic acid, a metal salt, and a metal compound of aromatic carboxylic acid. However, the most preferred solvent to be used in the present invention is water. If a surface active agent is not added thereto, the viscosity of the prepared coating solution increases in the course of preparation and, occasionally it cannot be coated. However, the addition of a surface active agent during or after the preparation of the coating solution does not result in an elevation of viscosity. Desirably, the surface active agent is added during the manufacture of a metal compound of an aromatic carboxylic acid because the preparation of the coating solution can be simplified without losing the effect of this invention.

The surface active agents which can be used in the present invention are anionic surface active agents such as turkey-red oil (sulfated castor oil alkylphenol-ethylene oxide adduct), alkyl sulfoacetates represented by the formula $ROOCCH_2SO_3X$, higher alcohol sulfates represented by the formula $ROSO_3S$, alkylbenzenesulfonates represented by the formula

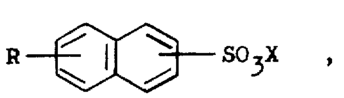


alkylsulfonates represented by the formula RSO_3X, soaps represented by the formula RCOOX, dialkylsulfosuccinates represented by the formula

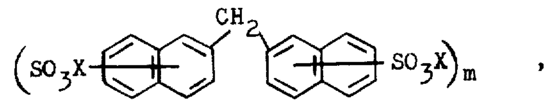


$$\begin{array}{l} XO_3S—CHCOOR \ , \\ \qquad\quad | \\ \qquad\ CH_2COOR \end{array}$$

alkylnaphthalene sulfonates represented by the formula



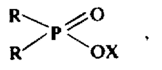
higher alcohol phosphates represented by the formula $ROP(OX)_2$, naphthalene sulfonate-formalin condensates represented by the formula



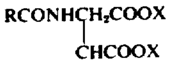
polyoxyethylene alkylsulfonates represented by the formula

$$R(OC_2H_4)_nOSO_3X,$$

dialkyl phosphates represented by the formula



sulfated olefin salts represented by the formula RR_1CHSO_3X, sulfated fatty acid ester salts represented by the formula $ROOCR_2CH_2SO_3X$, the compound of the formula



$$\begin{array}{l} RCONHCH_2COOX \\ \qquad\quad | \\ \qquad\ CHCOOX \end{array}$$

and the compound of the formula

$$CH_3(CH_2)_7CH{=}CH(CH_2)_7CON(CH_3)CH_2CH_2SO_3Na$$

wherein R and R_1 each represents an alkyl group having 1 to 30 carbon atoms, preferably 8 to 20 carbon atoms, more preferably 12 to 18 carbon atoms, and $R+R_1$ has 1 to 30 carbon atoms, preferably 8 to 20 carbon atoms, R_2 is a methylene group in such a manner that total carbon atoms of R and R_2 are 1 to 30, preferably 8 to 20, *m* is an integer of 2 to 10, preferably 6 to 9, *n* is an integer of 1 to 6, and X is an alkali metal such as Na or Ka, or an ammonium group; cationic surface active agents such a tertiary amines and ethanolamine ester salts; nonionic surface active agents such as glycerine mono-fatty acid esters and sugar fatty acid esters; and mixtures thereof.

Above all, anionic surface active agents show a great effect and alkylbenzene sulfonic acid salts, higher alcohol sulfuric acid ester salts, naphthalene sulfonic acid salt-formaldehyde condensates and alkarylsulfonic acid salts are most preferred.

The chemical structures of the above surface active agents are generally not opened but commercial products of these agents are easily accessible.

The amount of surface active agent added is more than 0.5 parts by weight, preferably 1 to 20 parts by weight, per 100 parts of the metal compound of an aromatic carboxylic acid.

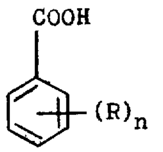
The coating solution, which is prepared as described above, may contain 5 to 50 parts by weight of a binder such as latex, polyvinyl alcohol, maleic anhydride-styrene copolymer, starch and gum arabic, per 100 parts by weight of coating solution (solids content). It is to be understood that all binders well-known as film-forming materials can be used in the invention. The binders can be classified into three groups, i.e., (1) a water soluble or hydrophilic binder, for example, a natural compound such as proteins (e.g., gelatin, gum arabic, colloid albumin, casein), celluloses (e.g., carboxymethyl cellulose, hydroxyethyl cellulose), saccharoses (e.g., agar, sodium alginate, starch, carboxymethyl starch), and a synthetic compound such as polyvinyl alcohol, poly-N-vinylpyrrolidone, polyacrylate, polyacrylamide; (2) a water-dispersible binder, for example, latex such as styrene-butadiene copolymer latex, styrene-maleic anhydride copolymer latex; and (3) an organic solvent-soluble binder such as nitrocellulose, ethyl cellulose or polyester. These binders can be used in the form of solution or dispersion in a solvent in the invention, and the binder can be varied depending upon the type of solvent. Preferably, the water-soluble or dispersible binder can be used in the aqueous solution or dispersion. Of course, the metal compound of aromatic carboxylic acid can be coated without using the binder. It is to be noted that the binder is optional because it may not be necessary in case where the solvent is organic in nature.

To the coating solution, there may be added acid resins such as phenol-formaldehyde resin such as p-phenylphenol-formaldehyde resin, p-t-butylphenol-formaldehyde resin, p-chlorophenol-formaldehyde resin, other color developers such as Japanese acid clay and active clay, attapulgite, inorganic pigments such as metal oxides and metal hydroxides or chemically or physically treated-products thereof. Examples of the metal are Zn, Mg and Al.

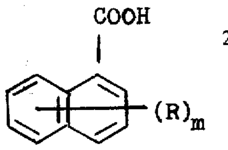
The Japanese acid clay, active clay or attapulgite is generally used in an amount not less than 1 wt%, preferably 20 to 2,000 wt%, more preferably 500 to 1,000 wt% based on the metal compound of aromatic carboxylic acid, and the metal oxide or hydroxide is generally used in an amount of from about 20 to 400 wt%, preferably 50 to 200 wt% based on the metal compound of aromatic carboxylic acid.

The metal compound of an aromatic carboxylic acid is a salt of such an acid such as zinc, tin, aluminum, nickel, magnesium or calcium salt of an aromatic carboxylic acid, and these salts can be obtained easily by stirring an aromatic carboxylic acid or an alkali metal salt thereof with a metal hydroxide, sulfate or nitrate in the presence of an alkali. In this procedure, the pH value, temperature and pressure is not critical. As described above, the addition of surface active agent during or after the reaction of the aromatic carboxylic acid or its alkali metal salt with the metal salt results in a stable and effective preparation of the color developer coating solution.

The aromatic carboxylic acid is preferably represented by the formula:

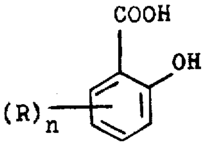


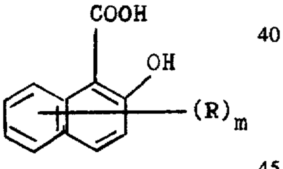
or



wherein R may be the same or different and represents a hydrogen atom, a hydroxy group, a halogen atom such as chlorine, a nitro group, an alkyl group having 1 to 10 carbon atoms (preferably 3 to 6 carbon atoms), of which total carbon atoms are less than 13, an aryl group such as phenyl group, an arylamino group such as anilino group, and an alicyclic group such as hexyl group, *m* is an integer of 0 to 7 and *n* is an integer of 0 to 5, and the aromatic carboxylic acid may be dimerized through the substituent R as a methylene group.

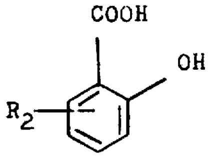
More preferable compounds are those represented by the formula,





wherein R, *m* and *n* are as defined above.

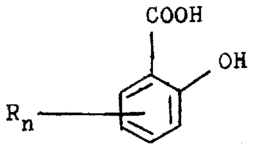
The most preferable compounds are those represented by the formula,

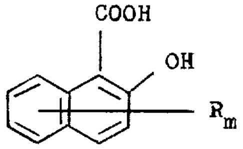


wherein R is as defined above, *n* is 1 or 2, and R is attached to the meta-position relative to the hydroxy group.

Examples of the aromatic carboxylic acids are benzoic acid, o-, m- or p-chlorobenzoic acid, o-, m- or p-nitrobenzoic acid, o-, m- or p-toluic acid, 4-methyl-3-nitrobenzoic acid, 2-chloro-4-nitrobenzoic acid, 2,3-dichlorobenzoic acid, 2,4-dichlorobenzoic acid, p-isopropyl benzoic acid, 2,5-dinitrobenzoic acid, p-t-butyl benzoic acid, N-phenyl anthranilic acid, 4-methyl-3-nitrobenzoic acid, salicylic acid, m-hydroxybenzoic acid, p-hydroxybenzoic acid, 3,5-dinitrosalicylic acid, 5-t-butyl salicylic acid, 3-phenyl salicylic acid, 3-methyl-5-t-butyl salicylic acid, 3,5-di-t-butyl salicylic acid, 3,5-diamyl salicylic acid, 3-cyclohexyl salicylic acid, 5-cyclohexyl salicylic acid, 3-methyl-5-isoamyl salicylic acid, 5-isoamyl salicylic acid, 3,5-di-sec-butyl salicylic acid, 5-nonyl salicylic acid, 2-hydroxy-3-methyl benzoic acid, 2-hydroxy-5-t-butyl benzoic acid, 2,4-cresotic acid, 5,5'-methylene disalicylic acid, o-, m- or p-acetaminobenzoic acid, 2,4-dihydroxy benzoic acid, 2,5-dihydroxy benzoic acid, 2,6-dihydroxy benzoic acid, anacardic acid, 1-naphthoic acid, 2-naphthoic acid, 1-hydroxy-2-naphthoic acid, 2-hydroxy-3-naphthoic acid, 2-hydroxy-1-naphthoic acid, thiosalicylic acid, 2-carboxybenzaldehyde and the like.

Above all, aromatic carboxylic acids having at least one hydroxyl group are especially effective and those having a hydroxyl group in the o-position, i.e., the aromatic carboxylic acids represented by the following formulae, are more effective.





wherein R, *m* and *n* are as defined above.

As the metals which form the metal compound of the aromatic carboxylic acid used in this invention, there can be mentioned metals of Group IB of the Periodic Table as, e.g., copper and silver; metals of Group II A as, e.g., magnesium and calcium; metals of Group II B, e.g., zinc, cadmium and mercury; metals of Group III B, e.g., aluminum and gallium; metals of Group IV A, e.g., tin and lead; metals of Group VI A, e.g., chromium and molybdenum; metals of Group VII B, e.g., manganese; and metals of Group VIII such as cobalt and nickel. Among these metals, zinc, tin, aluminum and nickel are especially effective.

The resulting coating solution of color developer is coated on a support such as paper, synthetic paper or a synthetic resin film so that the amount of the metal compound of an aromatic carboxylic acid is more than 0.1 g/m^2, preferably 0.5–2 g/m^2. The effect of this invention does not disappear at an amount beyond the range as given above because the amount of the solution coated is determined by economic reasons.

The recording sheet according to the invention is characterized by containing both a metal compound of an aromatic carboxylic acid and a surface active agent in the color developer layer, and various optional additives in the color developer layer, amount thereof, procedure of addition, form, kind of color coupler which couple with the color developers, their form and solvents for the same are decided using available technology in recording sheet art.

Since a color developer coating solution of uniform fine particles or in the form of an emulsion is obtained in the presence of a surface active agent, the recording sheet according to this invention shows an excellent color developing power and the thickness of the coated layer can be minimized; therefore, a colored image of high density is formed directly on contact with a color coupler. The film surface (the surface of the coated layer) is stable before and after use because of its excellent film surface strength. Further, the viscosity of the coating solution is not raised in the process of manufacturing the recording sheet according to this invention so that coatability is improved. Accordingly, not only is size-press coating by on-machine carried out advantageously, but air-knife coating is performed easily. Such advantages result in a thin coated layer as well as a reduction in product cost.

The recording sheet according to this invention is illustrated in detail by the following examples.

The effect in the examples was determined by the combination of an upper paper where microcapsules containing a color coupler (prepared as described below) were coated on a support with a lower paper in which the color developer according to this invention was coated on a support.

The microcapsules containing the color coupler may be manufactured by various known methods, but here they were manufactured according to the U.S. Pat. No. 2,800,457 as follows. In the following examples, part means part by weight.

Ten parts of acid-treated pig skin gelatin and 10 parts of gum arabic were dissolved in 400 parts of water at 40°C, 0.2 part of red turkey oil as emulsifying agent was added and 40 parts of color coupler oil were dispersed to be emulsified. The color coupler oil was prepared by dissolving 2% of Crystal Violet Lactone or 3-benzylamino-7-diethylaminofluorane in diisopropylnaphthalene. When the size of oil drops was 5 microns on the average, the emulsification was ceased. After adding water at 40°C to make the whole 900 parts, the stirring was continued for a period of, for example, 10 minutes, during which care was taken to keep the liquid temperature above 40°C. Acetic acid was then added to make the pH of the liquid 4.0–4.2 and cause coacervation.

After 20 minutes of further stirring, the system was cooled with ice water to gel the coacervate film deposited around the oil drops. Seven parts of 37% formalin were added at a liquid temperature of 20°C. An aqueous 15% caustic soda solution was added at 10°C to provide a pH of 9.

The system was then heated for 20 minutes with stirring to raise the liquid temperature to 50°C.

The resulting dispersion of microcapsules was cooled to 30°C and then coated so that the solids amount coated was 5 g/m^2 on a paper of 40 g/m^2, and dried to make a capsule sheet.

In the following Examples, all procedures were conducted at room temperature and normal pressure unless otherwise indicated.

EXAMPLE 1

60 Parts of kaolin and 2 parts of a surface active agent as mentioned below were dispersed or dissolved, respectively, in 30 parts of water and the pH of the dispersion was adjusted to 10 by a 10% aqueous caustic soda solution. 70 Parts of an aqueous 10% zinc chloride solution were added to the dispersion with slow stirring and a solution of 0.1 g-equivalent of an aromatic carboxylic acid as mentioned below in 200 parts of an aqueous 2% caustic soda solution was added with stirring to cause reaction. 50 Parts of a styrene-butadiene copolymer latex (molar ratio of styrene: butadiene = 1:1, 40% solid; hereinafter called SBR latex) were added to the dispersion to prepare a coating solution, which was coated by a coating rod so that a solids amount of 3 g/m^2 was coated on a paper of 50 g/m^2, and dried.

CONTROL 1

A color developer sheet was obtained for comparison in the same manner as in Example without using the surface active agent.

EXAMPLE 2

70 Parts of Japanese acid clay, 1 part of sodium hexametaphosphate and 4 parts of a surface active agent as mentioned below were dispersed or dissolved in 300 parts of water and the pH adjusted with an aqueous 10% caustic soda solution to 10. 107 Parts of an aqueous 10% zinc sulfate solution were added to the dispersion with slow stirring and a solution of 0.1 g-equivalent of an aromatic carboxylic acid as mentioned below dissolved in 200 g of an aqueous 2% caustic soda solution was added with stirring to cause reaction. 50 Parts of SBR latex were added to the dispersion to prepare a coating solution, which was coated by means of coating rod so that a solids amount of 3 g/m^2 was coated on a paper of 50 g/m^2, and dried.

CONTROL 2

A color developer sheet was obtained for comparison in the same manner as in Example 2 without using the surface active agent.

EXAMPLE 3

A color developer sheet according to this invention was obtained in the same manner as in Example 1 using 95 parts of an aqueous 10% tin sulfate solution instead of an aqueous zinc chloride solution as in Example 1.

CONTROL 3

A color developer sheet was obtained for comparison in the same manner as in Example 3 without using the surface active agent.

EXAMPLE 4

A color developer sheet according to this invention was obtained in the same manner as in Example 2 using 57 parts of an aqueous 10% aluminum sulfate solution instead of an aqueous zinc sulfate solution as in Example 2.

CONTROL 4

A color developer sheet was obtained for comparison in the same manner as in Example without using the surface active agent.

EXAMPLE 5

60 Parts of china clay, 5 parts of a p-phenylphenol-formaldehyde condensate (passed 325 mesh; a mixture of condensates having a condensation degree of 2 to 10) and 2 parts of a surface active agent as mentioned below were dispersed or dissolved in 300 parts of water and the pH adjusted with an aqueous 10% caustic soda solution to 11. To the dispersion were added 70 parts of an aqueous 10% zinc chloride solution with slow stirring and a solution of 0.1 g-equivalent of an aromatic carboxylic acid as mentioned below dissolved in 200 parts of an aqueous 2% caustic soda solution was added with stirring to cause reaction. 50 Parts of SBR latex were added to the dispersion to prepare a coating solution, which was coated by means of a coating rod so

that a solids amount of 3 g/m^2 was on a paper of 50 g/m^2, and dried.

CONTROL 5

A color developer sheet was obtained for comparison in the same manner as in Example 5 without using the surface active agent.

mμ was determined by a Beckmann Spectrophotometer (DB Type) and the light absorption at the maximum absorption is shown as the color density in Table 1. The viscosity of each coating solutions in Examples, 1-5 and Controls 1-5 was determined and is shown in Table 1. The determination was carried out with a BL Type viscometer (60 rpm).

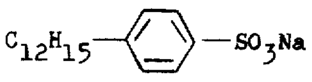
No.	Example or Control No.	Aromatic Carboxylic Acid	Surface Active Agent	Viscosity of coating solution (Cp)	Color Density of Crystal Violet Lactone (610mμ)	Color Density of 3-Benzylamino-7-diethylaminofluorane (600mμ)
1	Example 1	3,5-Di-tert-butyl salicy-lic Acid	Sodium Alkylbenzenesulfonate	5.5	1.10	0.78
2	"	"	Higher Alcohol Sulfuric Acid Ester Sodium	7.0	0.98	0.78
3	"	"	Sodium Alkylsulfonate	7.5	1.05	0.79
4	"	"	Sodium Naphthalenesulfonate-Formaldehyde Condensate	9.8	1.13	0.80
5	"	"	Sodium Dialkylphosphate	15.3	0.98	0.76
6	"	"	Polyoxyethylene Sodium Alkylsulfonate	20.5	0.97	0.77
7	"	"	Sodium Dialkylsulfosuccinate	16.5	0.99	0.78
8	"	"	Sulfated Castor Oil Alkylphenol-Ethylene Oxide Adduct	15.0	0.97	0.75
9	"	"	Alkylphenol-Ethylene Oxide Adduct	30.5	0.96	0.76
10	Control 1		—	45.0	0.95	0.73
11	Example 1	5-tert-Butyl Salicylic Acid	Sodium Alkylbenzenesulfonate	5.0	1.13	0.82
12	Control 1		—	40.3	0.98	0.76
13	Example 2	3,5-Di-tert-amyl salicylic Acid	Higher Alcohol Sulfuric Acid Ester Sodium	10.5	0.96	0.76
14	Control 2		—	53.0	0.92	0.73
15	Example 2	Salicylic Acid	Sodium Naphthelenesulfonate-Formaldehyde Condensate	3.4	1.08	0.78
16	Control 2		—	25.0	0.93	0.74
17	Example 2	Hydroxy-1-naphthoic Acid	Sodium Dialkylphosphate	28.5	0.99	0.79
18	Control 2	2-Hydroxy-1-naphthoic Acid	Sodium Dialkylphosphate	5.10	0.97	0.76
19	Example 3	3,5-Di-tert-butylsalicylic Acid	Polyoxyethylene Sodium Alkylsulfonate	21.3	1.02	0.79
20	Control 3		—	47.5	0.97	0.76
21	Example 4		Sodium Alkylbenzenesulfonate	5.0	0.82	0.63
22	Control 4		—	46.5	0.75	0.58
23	Example 5	5-cyclohexylsalicylic Acid	Sodium Alkylbenzenesulfonate	8.5	0.98	0.73
24	"	"	Sulfated Castor Oil Alkylphenol-Ethylene Oxide Adduct	20.3	0.95	0.70
25	"	"	Higher Alcohol Sulfuric Acid Ester Sodium	12.0	0.95	0.73
26	Control 5	"	—	55.0	0.93	0.69

COMPARISON TEST RESULTS

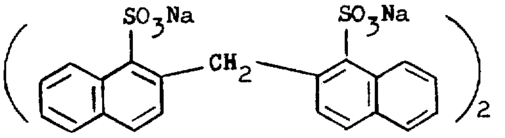
The microcapsule sheet containing Crystal Violet Lactone or 3-benzylamino-7-diethylaminofluorane was placed in contact on each color developer-coated sheet of Examples 1-5 and Controls 1-5 and color developed by a pressure load of 600 Kg/cm^2.

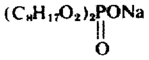
After standing over night in the dark, the reflection spectrum in the wave length region of 380 mμ to 700

The following surface active agents were used in Example 1-5.



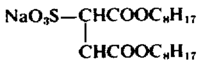
$C_{12}H_{25}OSO_3Na$



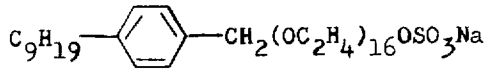


$$(C_8H_{17}O_2)_2\overset{}{\underset{\underset{O}{\|}}{P}}ONa$$

$C_8H_{17}O(C_2H_4O)_8SO_3Na$



$$\begin{array}{l} NaO_3S-\underset{|}{C}HCOOC_8H_{17} \\ CHCOOC_8H_{17} \end{array}$$

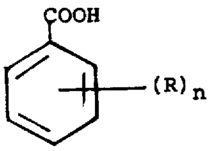


From the above comparison test results, it can be seen that the presence of a surface active agent in the coated layer of a color developer sheet containing a metal compound of an aromatic carboxylic acid improves the color developing power and provides a coating solution of highly improved coatability, that is, according to this invention, the color developing power of color developer sheet is further improved with great merits in the production thereof, the commercial value of the recording sheet is raised and lowered costs in production are achieved.

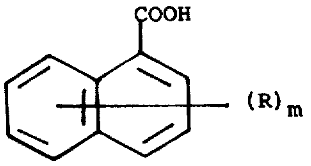
While the invention has been described in detail and with reference to specific embodiments thereof, it will be apparent to one skilled in the art that various changes and modifications can be made therein without departing from the spirit and scope thereof.

What is claimed is:

1. A recording sheet which comprises a layer of a color developer which forms a color image upon contact with a color coupler, said layer containing at least one metal compound of an aromatic carboxylic acid represented by the formula:



or



wherein R may be the same or different and represents a hydrogen atom, a hydroxy group, a halogen atom, a nitro group, an alkyl group having 1 to 10 carbon atoms, the total carbon number in the R's being less than 13, an aryl group, an arylamino group or an alicyclic group, *m* is an integer of 0 to 7 and *n* is an integer of 0 to 5, or said aromatic carboxylic acid may be dimerized through the substituent R as a methylene group, and a surface active agent.

2. A recording sheet according to claim 1 wherein the metal in said metal compound of an aromatic carboxylic acid is a member of Group I B, Group II A, Group II B, Group III B, Group IV A, Group VI A, Group VII B or Group VIII of the Periodic Table.

3. A recording sheet according to claim 1 wherein said surface active agent is contained in an amount more than 0.5 parts by weight per 100 parts by weight of said metal compound of an aromatic carboxylic acid.

4. A recording sheet according to claim 1 wherein said surface active agent is an anionic surface active agent, cationic surface active agent or monionic surface active agent.

5. A recording sheet according to claim 1 wherein said surface active agent is an anionic surface active agent.

* * * * *