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PROCESS FOR IMPROVING COLOR DEVELOPABILITY OF REVERSAL PHOTOGRAPH FILMS

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The present invention concerns a photographic process for developing color films, and more particularly, a reversal color process for increasing the amount of dye produced in the reversal image.

It is desirable in reversal color processes to have a method for increasing the amount of dye produced in the reversal image. Such an increased dye density makes a more efficient color reproduction system, a more accurate representation of the original scene or allows the use of thinner emulsion layers or less silver halide in the emulsion.

It is an object of this invention to provide a new photographic reversal color process for increasing the amount of dye produced.

It is another object of this invention to provide a novel photographic process for improving the dye density in reversal images that were color-developed with developers containing color-forming materials or color couplers.

It is likewise an object of this invention to provide a novel reversal color process particularly adapted for producing magenta dye images of improved density.

These and other objects of the invention are accomplished by color-developing photographic silver halide emulsions having a vehicle of gelatin and lower alkyl acrylate-acrylic acid copolymer, the color-forming material or color coupler being in the color developer as distinguished from being in the silver halide emulsion.

The lower alkyl acrylate-acrylic acid copolymer utilized in the photographic gelatino-silver halide emulsions processed in accordance with the invention are described in copending Houck et al. applications, U.S. Serial No. 786,227, filed January 12, 1959, now U.S. Patent 3,062,674, and U.S. Serial No. 139,313, filed September 19, 1961. The subject copolymers are water soluble compositions prepared by copolymerizing a mixture of a lower alkyl acrylate and acrylic acid. The alkyl acrylates of particular interest are those having alkyl radicals with 1 to 4 carbon atoms. A particularly useful alkyl acrylate is ethyl acrylate. The copolymers are suitably composed of 10–50 mol percent of the acrylic acid moiety. The copolymers can be utilized as such (i.e. terminating acid groups) or as water soluble salts such as ammonium salts and alkali metal salts.

The copolymer of an alkyl acrylate and acrylic acid replaces part of the gelatin utilized as the colloidal vehicle or medium for the silver halide in the emulsions processed in accordance with the invention. Suitably the subject copolymer comprises about 1–90% and preferably 10–50%, by weight based on the combined weights of the copolymer and the gelatin in the emulsion. The emulsions processed in accordance with the invention are photographic silver halide developing-out emulsions composed of such silver halides as silver chloride, silver iodide, silver bromide, silver chlorobromide, silver chloroiodide, silver bromoiodide and silver chlorobromoiodide.

Color developers that can be utilized in the present process have previously been described in the art. Color developing agents that have been found especially useful in our process comprise aromatic primary amines containing an amino (substituted or unsubstituted) or hydroxyl radicals. Excellent results are obtained with p-phenylenediamines and including substituted derivatives containing a primary amino radical. Typical color developing agents that can be employed in the process of the invention are the sulfonamide-substituted p-phenylenediamine disclosed by Weissberger in U.S. Patent No. 2,548,574, issued April 10, 1951, and the unsubstituted p-phenylenediamines disclosed by Weissberger et al. in U.S. Patent No. 2,566,271, issued August 28, 1951.

The color developers utilized in the process of the invention are aqueous alkaline compositions that contain, in addition to a color developing agent, a color coupler. Color couplers generally belong to one of three widely known types, namely, pyrazolone couplers, phenolic couplers and open-chain ketomethylene couplers which combine with oxidation products of color developing agents such as p-phenylenediamines to form magenta, cyan and yellow dyes respectively. Color-forming compounds or couplers that are soluble in aqueous alkaline developing compositions are well-known to those skilled in the present art. Typical couplers that can be suitably utilized in the color developers in the present process are listed below.

CYAN COUPLERS

(1) 5-benzenesulfoamino-1-naphthol
(2) 2,4-dichloro-5-benzenesulfamino-1-naphthol
(3) 2,4-dichloro-5-(p-toluenesulfamino)-1-naphthol
(4) 5-(1,2,3,4-tetrahydronaphthalene-6-sulfoamino)-1-naphthol
(5) 2,4-dichloro-5-(4'-bromodiphenyl-4-sulfoamino)-1-naphthol
(6) o-(β-Naphthalenesulfonamino)-phenol
(7) 5-(m-nitrobenzenesulfonamino)-1-naphthol
(8) 5-quinoline-5-sulfonamino)-1-naphthol
(9) 2-acetylamino-5-methylphenol
(10) 2-benzoylamino-3,5-dimethylphenol
(11) 2-α-(p-tert. amylphenoxy)-n-butyrylamino-5-methylphenol
(12) 2-α-(p-tert. amylphenoxy)-n-butyrylamino-4-chloro-5-methylphenol
(13) 2-(p'-tert. amylphenoxy-p-benzoyl)amino-4-chloro-5-methylphenol
(14) 2-(4''-tert. amyl-3'-phenoxybenzoylamino)-3,5-dimethyl-1-phenol
(15) 2-phenylacetylamino-4-chloro-5-methylphenol
(16) 2-benzoylamino-4-chloro-5-methylphenol
(17) 2-anilinoacetylamino-4-chloro-5-methylphenol
(18) 2-{4'-[α-(4''-tert. amylphenoxy)-n-butyrylamino]-benzoylamino}-4-chloro-5-methylphenol
(19) 2-{4'-[3''-(4''-tert. amylphenoxy)-benzoylamino]-benzoylamino}-4-chloro-5-methylphenol
(20) 2-p-nitrobenzoylamino-4-chloro-5-methylphenol
(21) 2-m-aminobenzoyl-4-chloro-5-methylphenol
(22) 2-acetamino-4-chloro-5-methylphenol
(23) 2-(4'-sec. amylbenzamino)-4-chloro-5-methylphenol
(24) 2-(4'-n-amyloxybenzamino)-4-chloro-5-methylphenol

MAGENTA COUPLERS

(25) 1-phenyl-3-acetylamino-5-pyrazolone
(26) 1-phenyl-3-propionylamino-5-pyrazolone
(27) 1-phenyl-3-dichloroacetylamino-5-pyrazolone
(28) 1-phenyl-3-benzoylamino-5-pyrazolone
(29) 1-phenyl-3-(m-aminobenzoyl)-amino-5-pyrazolone hydrochloride
(30) 1-phenyl-3-(diamylbenzoyl)amino-5-pyrazolone
(31) 1-phenyl-3-phenylcarbamylamino-5-pyrazolone
(32) 1-phenyl-3-phenoxyacetylamino-5-pyrazolone
(33) 1-phenyl-3-p-aminobenzoylamino-5-pyrazolone
(34) 1-phenyl-3-(o-carboxybenzoyl)amino-5-pyrazolone
(35) 1-phenyl-3-palmitylamino-5-pyrazolone
(36) 1-phenyl-3-(p-sec. amylbenzenesulfonylamino)-5-pyrazolone
(37) 1-phenyl-3-[p-(p'-sec. amylbenzoyl)aminobenzoylamino]-5-pyrazolone

(38) 1-m-tolyl-3-[m-(β-phenylpropionyl)aminobenzoylamino]-5-pyrazolone
(39) 1-m-tolyl-3-(2,4-di-tert. butyl-m-tolyl-oxyacetylamino)-5-pyrazolone
(40) 1-[p-(p'-tert. butylphenoxy)phenyl]-3-[p-(benzoylamino)-benzoylamino]-5-pyrazolone
(41) 1-(p-tert. butylphenoxyphenyl)-3-(p-n-amyloxybenzoylamino)-5-pyrazolone
(42) 1-[p-(p'-tert. butylphenoxy)phenyl]-3-(3,5-dimethoxybenzoyl)amino-5-pyrazolone
(43) 1-[p-(p'-tert. butylphenoxy)phenyl]-3-[m-(p-toluenesulfonylamino)benzoylamino]-5-pyrazolone
(44) 1-[p-(3,5-dimethylphenoxy)phenyl]-3-(4-n-amyloxy-3-methylbenzoylamino)-5-pyrazolone
(45) 3-(p-nitrophenoxyacetylamino)-1-(2,4,6-trichlorophenyl)-5-pyrazolone

YELLOW COUPLERS

(46) p-(ω-Benzoylacetamino)benzenesulfonamide
(47) p-(ω-Benzoylacetamino)benzensulfon-N-methylamide
(48) p-(ω-Benzoylacetamino)benzenesulfonanilide
(49) 4-benzenesulfonamino-ω-benzoylacetanilide
(50) 4-(p-toluenesulfonamino)-ω-benzoylacetanilide
(51) 4-(p-laurylbenzenesulfonamino)-ω-benzoylacetanilide
(52) 1,4-di[p-(benzoylacetamino)benzenesulfonamino]benzene
(53) N,N'-di-(p-benzoylacetaminophenyl)benzene-1,3-disulfonamide
(54) N-(p-benzoylacetaminophenyl)-4-[p-(benzoylacetamino)-benzenesulfonamido]benzenesulfonamide
(55) N^4-benzoylacetyl-N'-(2-benzothiazolyl)sulfanilamide
(56) p-Acetoacetaminobenzenesulfon-β-naphthalide
(57) p-Furoylacetaminobenzenesulfon-N-cyclohexylamide
(58) p-(4-ethoxybenzoylacetamino)benzenesulfonamide
(59) Terephthaloyl-bis[(p-N-amylsulfonamide)acetanilide]
(60) p-Quinoline-8-sulfonamino)-ω-benzoylacetanilide
(61) p-Acetoacetamino-o-methylbenzenesulfon-N-anilide
(62) N,N'-di-(p-benzoylacetaminophenol)naphthalene-1,5-disulfonamide
(63) p-(Benzenesulfonamino)benzoylacetone
(64) N-benzoylaceto-o-anisidine

The present process has utility in increasing the dye yield or density of photographic elements used for color photography, including multilayer photographic elements that usually have at least three selectively sensitive photographic silver halide emulsion layers coated on one side of a support. For example, the uppermost layer of a multilayer photographic element is generally blue-sensitive, the next layer is generally green-sensitive, and the layer nearest the support is generally red-sensitive. Between the blue- and green-sensitive emulsion layers is typically disposed a filter layer for absorbing blue radiation which may be transmitted through the uppermost blue-sensitive layer. Such multilayer photographic elements can also, of course, have other interlayers for specialized purposes. Color formers or color couplers are not utilized in the emulsion layers of the color photographic elements processed in accordance with the invention. Such multilayer materials have previously been described in the art, reference being made to Mannes et al., U.S. Patent No. 2,252,718, issued August 19, 1941.

In carrying out the photographic reversal color process of the invention with an exposed multilayer photographic element containing a plurality of differentially sensitized photographic silver halide emulsion layers as described above and containing an alkyl acrylate-acrylic acid copolymer, the photographic element is developed

in a photographic developer for producing a black-and-white negative image, given at least one more exposure and then developed at least once more in a photographic developer containing a color coupler to produce a colored image, the colored image bearing a complementary relationship to the region of the spectrum to which the photographic silver halide emulsion had been differentially sensitized. The silver produced during development is removed in the usual manner, a ferricyanide solution being suitable. The resulting color images have increased dye density as compared to images prepared from comparable multilayer photographic elements not having alkyl acrylate-acrylic acid copolymers in the silver halide emulsion layers. If the color coupler is utilized with the alkyl acrylate-acrylic acid copolymer in the silver halide emulsion layers in lieu of in the color developer composition, the resulting color images do not have increased dye density.

The invention is illustrated by the following examples of preferred embodiments thereof.

EXAMPLE I

Several gold and sulfur sensitized silver bromoiodide emulsions were prepared and coated on transparent cellulose acetate film supports. No color coupler was used in the emulsion. The vehicle for the silver bromoiodide in the coated emulsions was gelatin containing varying amounts of a copolymer of ethyl acrylate and acrylic acid. The copolymer was the water-soluble ammonium salt and contained about 20 mol percent of the acrylic acid moiety. The resulting films were then exposed for 1/25 second to a 500 watt, 3200° K. light source on an Eastman type Ib sensitometer. The resulting exposed films were then processed as follows.

Processing step:	Time
Prehardener bath ---------- minutes	1
Water wash ---------- do	1
Elon-hydroquinone development ---------- do	3
Water wash ---------- do	3
Flash with No. 2 Photoflood from 1 meter ---- second	1
Color development ---------- minutes	10
Water wash ---------- do	8
Fix ---------- do	3
Water wash ---------- do	5
Drying. (Samples taken for silver analysis.)	
Ferricyanide bleach ---------- do	3
Fix ---------- do	3
Water wash ---------- do	5
Drying. (Samples taken for dye density measurements.)	

Table A below summarizes the silver content and the magenta dye densities for film samples containing gelatin and 50/50 mixtures of gelatin and the ethyl acrylate-acrylic acid copolymer when processed as described above. A color developer containing a magenta-forming coupler was used.

Table A

Percent Copolymer in the Gelatin-Copolymer Emulsion Vehicle	Magenta D_{max}	Silver Developed in Color Developer, mg. Ag/ft.²
0	2.69	100
50	4.34	102

As can be observed from the data set out in Table A, the presence of the copolymer in the emulsion increased the magenta D_{max} about 60% although substantially no additional silver developed in the color developer. Further, spectrophotometric curves of the magenta dye indicated that the copolymer did not cause any shift in dye due. The increased magenta D_{max} resulting when the

gelatin is replaced with varying concentrations of ethyl acrylate-acrylic acid copolymer are summarized by the data set out in Table B.

Table B

Percent copolymer in the gelatin-copolymer emulsion vehicle:	Magenta D_{max}
0	2.69
10	3.46
25	4.04
50	4.34

The emulsion coatings containing the copolymer as part of the vehicle had greater reversal shoulder speeds than the emulsion coating containing only gelatin as the vehicle. The use of 50% of the copolymer in the emulsion vehicle gave 0.25 log *E* more speed than only gelatin in the emulsion vehicle. The various processing solutions had essentially the following compositions:

PREHARDENER BATH

Sulfuric acid (conc.)	g--	2.3
Sodium metaborate pentahydrate	g--	15.0
Sodium bromide	g--	2.0
Sodium sulfate	g--	200.0
Formalin	cc--	20.0
Sodium bisulfite	g--	1.0
Sodium tetraphosphate	g--	0.6

Water to make 1 liter.
pH=8.0.

ELON-HYDROQUINONE DEVELOPER (BLACK-AND-WHITE DEVELOPER)

	G.
Sodium hexametaphosphate	1.0
Sodium sulfite	72.0
N-methyl-p-aminophenol sulfate	5.0
Sodium carbonate H_2O	36.0
Hydroquinone	2.0
Sodium bromide	2.0
Sodium sulfate	15.0
Potassium iodide	0.01
Sodium thiocyanate	1.0
Hydroquinone monosulfonate	1.5

Water to make 1 liter.
pH=10.4.

MAGENTA DEVELOPER (COLOR DEVELOPER)

Sodium hexametaphosphate	g--	0.5
Sodium sulfite	g--	3.0
4-amino-N-ethyl-3-methyl-N-β-methylsulfonamido-ethylaniline	g--	6.0
Sodium carbonate H_2O	g--	30.0
Sodium bromide	g--	0.25
1.0% 6-nitrobenzimidazole nitrate	cc--	2.5
0.1% potassium iodide	cc--	2.0
Sodium sulfate	g--	25.0
Citrazinic acid	g--	3.0
Polyethylene glycol (M. Wt. 1540)	g--	1.0
Sodium thiocyanate	g--	4.0
1-(2,4,6-trichlorophenyl)-3-[α-(4-nitrophenoxy-acetamido]-5-pyrazolone	g--	2.0

Water to make 1 liter.
pH=11.0.

FIX

	G.
Sodium hexametaphosphate	10.0
Sodium sulfite	10.0
Sodium thiosulfate pentahydrate	320.0

Water to make 1 liter.

FERRICYANIDE BLEACH

	G.
Sodium hexametaphosphate	1.0
Potassium ferricyanide	80.0
Sodium bromide	34.4

Water to make 1 liter.
pH=6.8.

EXAMPLE II

Gold and sulfur sensitized silver bromoiodide emulsions coated on transparent cellulose acetate film supports were prepared, exposed in a sensitometer and processed as described in Example I except that color developers containing a cyan-forming coupler and a yellow-forming coupler were utilized in lieu of the color developer containing a magenta-forming coupler. Vehicles for the silver bromoiodide of gelatin and 50/50 gelatin/ethyl acrylate-acrylic acid copolymer were compared. The copolymer was the water-soluble ammonium salt and contained about 20 mol percent of the acrylic acid moiety. Data summarizing the increased cyan and yellow dye densities resulting by using the copolymer in the emulsions are set out in Table C below.

Table C

Percent Copolymer in the Gelatin-Copolymer Emulsion Vehicle	Cyan D_{max}	Yellow D_{max}
0	2.15	3.00
50	2.75	3.42

The emulsions containing 50% of the copolymer in the emulsion vehicles had 0.25 log *E* more speed than the emulsion containing only gelatin as the emulsion vehicle. The cyan and yellow developers had the following compositions:

CYAN DEVELOPER

Hydroxylamine sulfate	g--	0.5
Sodium hexametaphosphate	g--	1.0
Sodium sulfite	g--	10.0
4-amino-N-ethyl-N-(β-hydroxyethyl)-m-toluidine	g--	1.3
Sodium bromide	g--	2.5
Sodium sulfate	g--	60.0
0.1% potassium iodide	cc--	8.0
1.0% 6-Nitrobenzimidazole nitrate	cc--	0.03
Sodium thiocyanate	g--	1.0
2-(o-acetamido-β-phenylethyl)-1-hydroxy naphthamide	g--	1.45
Hexylene glycol	cc--	10.00
Monobenzyl-p-aminophenol	g--	0.4
Polyethylene glycol (M. Wt. 1540)	g--	1.0

Water to make 1 liter.
pH=12.4.

YELLOW DEVELOPER

Sodium hexametaphosphate	g--	1.0
Sodium sulfite	g--	10.0
2-methyl-4-(methylsulfonamide ethyl) ethyl aniline	g--	2.0
Sodium bromide	g--	0.7
Sodium sulfate	g--	64.0
0.1% potassium iodide	cc--	20.0
1.0% 6-nitrobenzimidazole nitrate	cc--	0.06
10% diethylhydroxylamine oxalate	cc--	5.0
α-Benzoyl-2-methoxyacetanilide	g--	2.0
Hexylene glycol	cc--	20.0
1-phenyl-3-pyrazolidone	cc--	0.4
Polyethylene glycol (M. Wt. 6000)	g--	1.0

Water to make 1 liter.
pH=12.5.

EXAMPLE III

Several single layer films were prepared with blue-sensitive silver bromoiodide gelatin-copolymer emulsions not having color couplers coated on transparent cellulose acetate supports. Each coating was given a sensitometric exposure and processed to a magenta color reversal as described in Example I. The copolymers utilized with the gelatin silver halide vehicle were water-soluble ethyl acrylate-acrylic acid copolymers containing about 20 mol percent of the acrylic acid moiety. Both the sodium salt of the copolymer and the acid copolymer were tested by replacing 10, 30 and 50% portions of the gelatin as the

silver halide vehicle. The results of the tests are summarized by the data set out in Table D below.

Table D

Percent Copolymer in the Gelatin-Copolymer Emulsion Vehicle	Magenta	
	D_{min}	D_{max}
0	.09	3.20
10 (as Na Salt)	.11	>4.00
30 (as Na Salt)	.12	>4.00
50 (as Na Salt)	.12	>4.00
10 (as Acid)	.11	>4.00
30 (as Acid)	.12	>4.00
50 (as Acid)	.11	>4.00

It is to be noted from the data in Table D that the ethyl acrylate-acrylic acid copolymers significantly increased the magenta dye density in the color reversal image. The copolymer which was substituted for varying amounts of the gelatin in the silver halide vehicle did not reduce the speed of the emulsion.

EXAMPLE IV

A multilayer color film comprising a cellulose acetate support containing superimposed silver gelatino-bromoiodide emulsion layers differentially sensitized to blue, green and red light as described in Mannes et al., U.S. Patent No. 2,252,718, issued August 19, 1941, is improved with respect to yellow, magenta and cyan densities respectively when 50% of the gelatin vehicle in each of the three differentially sensitized emulsion layers is replaced with the ethyl acrylate-acrylic acid copolymer described in Example I, and when processed in accordance with the Mannes et al. reversal color process.

The above examples illustrate the improved dye densities resulting when silver halide emulsions having mixtures of gelatin and alkyl acrylate-acrylic acid copolymers as vehicles are processed with reversal color processes utilizing color couplers or color formers in the color developers. However, when the color couplers are utilized in the emulsions, and the resulting emulsions are subjected to reversal color processing, increased dye densities do not result as illustrated in Example V below.

EXAMPLE V

A water-soluble sodium salt of an ethyl acrylate-acrylic acid copolymer containing about 20 mol percent of the acrylic acid moiety was incorporated in varying proportions in several high-speed silver bromoiodide emulsions differentially sensitized to blue, green and red light. The compolymer was substituted for a portion of the gelatin as the vehicle for the silver halide in the emulsion. The emulsions sensitive in the blue range contained dispersed therein an open-chain coupler having a reactive methylene group suitable for forming a yellow image with oxidized color developer, e.g. couplers Nos. I to V of McCrossen et al. U.S. Patent 2,875,057 in dibutyl phthalate. The emulsions sensitive in the green range contained dispersed therein a pyrazolone coupler suitable for forming a magenta image with oxidized color developer, e.g. couplers Nos. 7 etc. of Fierke et al. U.S. Patent 2,810,-171 (column 2). The emulsions sensitive in the red range contained dispersed therein a phenolic coupler suitable for forming a cyan image with oxidized color developer, e.g. couplers No. 1 to 6 of Fierke et al. U.S. Patent 2,801,171 (column 2) in a solvent such as tri-o-cresyl phosphate. Emulsions containing none of the copolymer addenda were also prepared. The emulsions were then coated on a transparent cellulose acetate film support, dried, exposed in an Eastman Ib Sensitometer and thereafter processed in a reversal color process as follows.

The exposed films were developed in a developer having the following composition:

Sodium hexametaphosphate	g	2.0
N-methyl-p-aminophenol sulfate	g	6.0
Sodium sulfite, anhydrous	g	50.0
Hydroquinone	g	6.0
Sodium carbonate monohydrate	g	35.0
Potassium bromide	g	2.0
Sodium thiocyanate	g	1.5
0.5% solution of 6-nitrobenzimidazole nitrate	cc	12.0
0.1% solution of potassium iodide	cc	10.0

Water to make 1 liter.

The elements were then thoroughly washed with water and treated in a hardening bath having the following composition:

Potassium chrome alum crystals	g	30.0

Water to make 1 liter.

The elements were then thoroughly washed with water and flashed with white light for a period sufficient to expose residual silver halide. The elements were then treated in a color developer having the following composition:

Benzyl alcohol	cc	6.0
Sodium hexametaphosphate	g	2.0
Sodium sulfite, anhydrous	g	5.0
Trisodium phosphate	g	40.0
Potassium bromide	g	0.25
0.1% solution of potassium iodide	cc	10.0
Sodium hydroxide	g	6.5
Color developer [1]	g	11.33
Ethylenediamine sulfate	g	7.8
Citrazinic acid	g	1.5

Water to make 1 liter.

[1] 4-amino-N-ethyl-N-(β - methanesulfonamidoethyl)-m-toluidine sesquisulfate monohydrate.

The elements were then thoroughly washed with water and treated in a clearing and fixing bath having the following composition:

	G.
Sodium thiosulfate	150.0
Sodium bisulfite	20.0

Water to make 1 liter.

The elements were then treated in a bleach bath having the following composition:

	G.
Potassium dichromate	5.0
Potassium ferricyanide	70.0
Potassium bromide	20.0

Water to make 1 liter.

The elements were again washed and treated once again with the clearing and fixing bath identified above. The elements were again washed and treated in a stabilizing bath having the following composition:

Formaldehyde (37% by weight)	cc	7.0
Dispersing agent [1]	g	0.5

Water to make 1 liter.

[1] Such as Triton X-100, i.e., an alkylaryl polyether alcohol (octylphenoxy polyethoxy ethanol).

Table E below summarizes the results of the tests, data concerning D_{min}, D_{max} and relative shoulder speed being set out for each of the three reversal images.

Table E

Percent Copolymer in the Gelatin-Copolymer Emulsion Vehicle	D_{min}	D_{max}	Relative Shoulder Speed
A. Magenta Reversal Image:			
0	.08	2.20	100
30	.08	2.05	94
50	.09	2.05	82
B. Cyan Reversal Image:			
0	.10	3.14	100
35	.10	2.84	71
C. Yellow Reversal Image:			
0	.12	2.02	100
36	.16	1.88	112

As can be observed from the data set out in Table E, the subject copolymer did not impart an increased, but rather a decreased, dye density to the reversal image when the color former or color coupler was utilized in the emulsion as distinguished from in the color developers as in the process of the invention.

Thus, the present invention provides a new and useful process in the photographic art.

Although the present invention has been described in considerable detail with reference to certain preferred embodiments thereof, it will be understood that variations and modifications can be effected within the spirit and scope of the invention as described hereinabove and as defined by the appended claims.

I claim:

1. In a photographic reversal color process wherein a photographic element containing at least one photographic silver halide emulsion layer is given a first exposure to produce a latent image therein, a development in a photographic developer for producing a black-and white negative image, exposure to light of a color to which the said first exposed silver halide emulsion layer is sensitive, and an additional development in a photographic color developer for producing a colored image, said color developer containing an aromatic primary amine color developing agent and a photographic color coupler selected from the group consisting of a magenta-forming pyrazolone color coupler, a cyan-forming phenolic color coupler and a yellow-forming open-chain ketomethylene color coupler, the improvement which comprises utilizing a vehicle for said silver halide comprised of gelatin and a water-soluble lower alkyl acrylate-acrylic acid copolymer having 10 to 50 mol percent of the acrylic acid moiety and wherein said vehicle contains about 1 to 90 percent of said copolymer based on the combined weight of said gelatin and said copolymer.

2. In a photographic reversal color process wherein a photographic element containing at least one photographic silver halide emulsion layer is given a first exposure to produce a latent image therein, a development in a photographic developer for producing a black-and-white negative image, exposure to light of a color to which the said first exposed silver halide emulsion layer is sensitive, and an additional development in a photographic color developer for producing a colored image, said color developer containing an aromatic primary amine color developing agent and a photographic color coupler selected from the group consisting of a magenta-forming pyrazolone color coupler, a cyan-forming phenolic color coupler and a yellow-forming open-chain ketomethylene color coupler, the improvement which comprises utilizing a vehicle for said silver halide comprised of gelatin and a water-soluble lower alkyl acrylate-acrylic acid copolymer having 10 to 50 mol percent of the acrylic acid moiety and wherein said vehicle contains about 10 to 50 percent of said copolymer based on the combined weight of said gelatin and said copolymer.

3. The process as described in claim 2 wherein the alkyl acrylate is ethyl acrylate.

4. The process as described in claim 2 wherein the copolymer comprises about 20 mol percent of the acrylic acid moiety.

5. The process as described in claim 2 wherein the copolymer is utilized as a water-soluble salt thereof.

6. The process as described in claim 2 wherein the copolymer is utilized in acid form.

7. The process as described in claim 2 wherein the photographic color coupler is a magenta-forming pyrazolone color coupler.

8. The process as described in claim 2 wherein the photographic color coupler is a cyan-forming phenolic color coupler.

9. The process as described in claim 2 wherein the photographic color coupler is a yellow-forming open-chain ketomethylene color coupler.

10. In a photographic reversal color process wherein a multilayer photographic element containing a plurality of photographic silver halide emulsion layers differentially sensitized to different regions of the spectrum are given a first exposure to form latent images therein, developing in a photographic developer for producing black-and-white negative images, successively exposing said silver halide emulsion layers to light of a color to which they are sensitive, and after each of the said successive exposures developing in a photographic color developer containing an aromatic primary amine color developing agent and a color coupler for producing a colored image bearing a complementary relationship to the region of the spectrum to which the said color-developed silver halide emulsion layer had been differentitially sensitized, said color coupler being selected from the group consisting of a magenta-forming pyrazolone color coupler, a cyan-forming phenolic color coupler and a yellow-forming open-chain ketomethylene color coupler, the improvement which comprises utilizing a vehicle for said silver halide comprised of gelatin and a water-soluble lower alkyl acrylate-acrylic acid copolymer having 10 to 50 mol percent of the acrylic acid moiety and wherein said vehicle contains about 10 to 50 percent of said copolymer based on the combined weight of said gelatin and said copolymer.

11. The process as described in claim 10 wherein the alkyl acrylate is ethyl acrylate.

12. The process as described in claim 10 wherein the copolymer comprises about 20 mol percent of acrylic acid moiety.

13. The process as described in claim 10 wherein the copolymer is utilized as a water-soluble salt thereof.

14. The process as described in claim 10 wherein the copolymer is utilized in acid form.

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