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LATENSIFICATION OF PHOTOGRAPHIC IMAGES

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9 Claims. (Cl. 95—88)

This invention relates to the latensification of photographic images, particularly by means of perborate compounds.

Various methods have been proposed for intensifying the latent image and effectively increasing the sensitivity and speed of photographic emulsions. These methods have included the use of chemical agents such as mercury vapor, peroxides, organic acids and sulfites. Some of these previously proposed methods have been objectionable for one reason or another and have not met with any notable commercial success partly because of the relative complexity of equipment or technique required and in certain cases because of the nuisance connected with using the latensifying agent in the manner proposed, but perhaps more because the results have not always been reproduceable nor as satisfactory as would be desired.

We have discovered a class of compounds, the alkali metal perborates, which possess superior properties as latensifiers for photographic images and which are devoid of many of the objections to previous latensifying agents. Therefore, one object of our invention is to provide perborate compounds which intensify photographic latent images. A further object is to provide the conditions under which the novel compounds are most effective as latensifying agents. Other objects will become apparent from the following description of our invention.

The objects of our invention are in general accomplished by treating a photographic emulsion layer, prior to development and subsequent to exposure, with a solution of an alkali metal perborate and then developing the latent image.

The perborate compounds comprising the preferred embodiment of our invention are the alkali metal perborates such as sodium or potassium perborate. These compounds may be used as latensifying agents for a variety of photographic silver halide emulsions under a wide variety of conditions but optimum results are obtained under controlled conditions of pH, concentration or in the presence of antifoggant compounds as will be seen from the following description of our invention.

The mechanism by which the perborates intensify the latent image is not clearly understood; however, it is likely that the effect is obtained as a result of the deposition of silver ions on existing sub-image centers on the silver halide grains and the effect is more pronounced with the more sensitive grains as evidenced by a reduction in gamma. There is some evidence that the fact that optimum results with perborates as intensifiers are obtained under controlled conditions of pH, is connected with the oxidation-reduction behavior of solutions of the compounds. That is, the perborates appear to exist in solution as an equilibrium of structures which is shifted by pH. High pH values of the order of 10 seem to favor the true perborate ion and at lower pH values of the order of 8, a borate-peroxide structure may exist. This behavior seems consistent with the observed effects of the perborates as latensifying agents. At pH values of from about 10 to 11, the perborate ion species appears to be responsible for the latensifying effect and at pH values below 9, the borate-peroxide structure may be functioning, as a result of which appreciable fog is obtained when the compounds are used as latensifying agents at this range of pH. Thus at pH values of about 6 to 9, especially pH of about 6, it is preferred to use an antifoggant such as 6-nitrobenzimidazole-nitrate together with the perborate compound in the latensifying solution in order to reduce fog. Therefore the range of pH over which the compounds are most useful is from about 6 to 11, preferably about 10 to 11 since the latter range represents the conditions under which only negligible amounts of fog are obtained in absence of antifoggant compounds.

The concentration of the perborate compounds in the latensifying bath, as well as pH, should also be considered for optimum results. While concentration as well as pH will be found to vary somewhat when optimum results are desired when using different emulsions and operating conditions, we find that concentrations of the order of about 2 to 10 grams of the perborate compound per liter of solution is satisfactory. However, as is shown in the following examples it is preferred with the fast emulsions of the negative type, such as the bromoiodide emulsions, to use about 10 grams of the compound per liter of intensifying solution, concentrations of the order of 50 grams per liter having been found to produce excessive fog in the absence of antifoggant compounds. When latensifying slower emulsions of the positive type, it is preferred to use from about 2 to 5 grams of perborate compound per liter, especially about 2 grams per liter. Of course we may operate within these concentration and pH limits with or without antifoggant in the latensifying bath.

The following examples are provided as illustrations of the preferred embodiments of our invention and typical means and results of carrying out our invention.

Example 1

Samples of a fast bromoiodide negative type of film were exposed in an Eastman type Ib intensity scale sensitometer for $\frac{1}{25}$ second using a 500-watt light source. The exposed samples were then treated with latensification baths 0.01 normal in potassium bromide, containing 10 grams of sodium perborate per liter, adjusted to pH 6 and containing the amounts of 6-nitrobenzimidazole-nitrate antifoggant compound indicated in the table following. The exposed samples (Nos. 2–4) were treated with the bath for one minute, following which all exposed samples were developed for 9 minutes at 20° C. in a developer of the following composition:

Water	cc	1000
p-Methylaminophenol sulfate	grams	2
Hydroquinone	do	5
Sodium sulfite (des.)	do	100
Potassium bromide	do	0.25
Borax	do	8
Boric acid	do	8

Data obtained from the above tests are shown in the following table:

Sample No.	Gms. Antifoggant/Liter	30/E speed at Density 0.2 over fog	Gamma	Fog
1	Control	2270	0.74	0.01
2	0	3860	0.64	0.10
3	0.01	3360	0.67	0.10
4	0.03	3780	0.71	0.04

The effect of using perborate in the latensification bath as well as the effect of varying concentrations of antifoggant is apparent from these examples.

Example 2

Samples of a standard positive film emulsion were exposed in a sensitometer in the manner described above for $\frac{1}{10}$ second and then subjected for one minute to latensifying baths 0.01 normal in potassium bromide, containing 2 grams of sodium perborate per liter at a pH of 6 and containing varying amounts of 6-nitrobenzimidazole-nitrate antifoggant as indicated in the following table wherein sample 1 is the control and sample 2 was latensified with a bath containing no antifoggant. All samples were then developed for 5 minutes in a developer of the following composition:

Water	cc	750
p-Methylaminophenol sulfate	grams	0.3
Hydroquinone	do	6.0
Sodium sulfite (des.)	do	38.0
Sodium bisulfite	do	1.2
Sodium carbonate (des.)	do	19.0
Potassium bromide	do	0.9
Citric acid	do	0.7

Water to 1 liter.

The characteristics of the samples thus treated are tabulated in the following table:

Sample No.	Gms. Antifoggant/Liter	30/E speed at Density 0.2 over fog	Gamma	Fog
1	Control	169	2.09	.01
2	0	337	1.74	.10
3	0.003	300	1.86	.05
4	0.01	314	1.77	.07
5	0.1	217	2.0	.02

The effect of using perborate as well as antifoggant in the latensifying bath in connection with emulsions of this type is apparent from these examples.

Our invention is subject to other variations. For example, we have discovered that the latensification effect can be obtained using baths of reduced concentrations of perborate if the photographic material is dried after latensification and before development. Multiple treatments of the photographic material in the baths, drying between treatments, produces further speed increases. However, it is ordinarily sufficient to treat the exposed material only once in the latensifying bath.

It will be apparent to those skilled in the art that, as in most photographic processes, results will vary somewhat depending upon the technique used, the emulsions under consideration and other factors. Therefore, it is to be understood that the disclosure herein is by way of example and that we consider as included in our invention all modifications and equivalents falling within the scope of the appended claims.

What we claim is:

1. The method of intensifying a latent image of a photographic silver halide emulsion layer which comprises treating said emulsion layer, subsequent to exposure and prior to development, with an aqueous solution of an alkali metal perborate, and developing the latent image.

2. The method of intensifying a latent image of a photographic silver halide emulsion layer which comprises treating said emulsion layer, subsequent to exposure and prior to development, with an aqueous solution of an alkali metal perborate at a pH of from approximately 6 to 11, and developing the latent image.

3. The method of intensifying a latent image of a photographic silver halide emulsion layer which comprises treating said emulsion layer, subsequent to exposure and prior to development, with an aqueous solution of an alkali metal perborate at a pH of from approximately 10 to 11, and developing the latent image.

4. The method of intensifying a latent image of a photographic silver halide emulsion layer which comprises treating said emulsion layer, subsequent to exposure and prior to development, with an aqueous solution of an alkali metal perborate and an antifoggant compound at pH of from about 6 to 9, and developing the latent image.

5. The method of intensifying a latent image of a photographic silver halide emulsion layer which comprises treating said emulsion layer, subsequent to exposure and prior to development, with an aqueous solution of sodium perborate and an antifoggant compound at pH of from about 6 to 9, and developing the latent image.

6. The method of intensifying a latent image of a photographic silver halide emulsion layer which comprises treating said emulsion layer, subse-

quent to exposure and prior to development, with an aqueous solution of sodium perborate and potassium bromide at a pH of about 6, and developing the latent image.

7. The method of intensifying a latent image of a photographic silver halide emulsion layer which comprises treating said emulsion layer, subsequent to exposure and prior to development, with an aqueous solution containing from about 2 to 10 grams of an alkali metal perborate per liter, and developing the latent image.

8. The method of intensifying a latent image of a photographic silver halide emulsion layer which comprises treating said emulsion layer, subsequent to exposure and prior to development, with an aqueous solution containing from about 2 to 5 grams of sodium perborate per liter, and developing the latent image.

9. The method of intensifying a latent image of a photographic silver halide emulsion layer which comprises treating said emulsion layer, subsequent to exposure and prior to development, with an aqueous solution having a pH of about 6 and containing about 10 grams of sodium perborate per liter and an antifoggant compound, and developing the latent image.

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