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STABILIZING AGENT FOR SINGLE POWDER
PHOTOGRAPHIC DEVELOPERS

William J. Rogers, Rochester, N. Y., assignor to
Eastman Kodak Company, Rochester, N. Y., a
corporation of New Jersey

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This invention relates to single-powder photographic developers, and more particularly to a single-powder developer in which the ingredients of the developer are intimately mixed in the form of dry powder with powdered boric anhydride, which contains free moisture not in excess of 15.0% by weight, as a stabilizing agent to prevent disadvantageous interaction between the organic developer component and the basic component of the single-powder mixture.

Single-powder developer mixtures may contain an organic developer component or mixtures of such components, including monomethylparaminophenol sulfate (elon or metol), hydroquinone, p-aminophenol hydrochloride, p-aminophenol sulfate, pyrogallol, parahydroxyphenyl glycine, catechol, diaminophenol hydrochloride, and others, with an alkali component, a stabilizing component, an oxidizing preventer and an anti-fogging component. The alkali component may be the stable hydrate of an alkali carbonate, a desiccated alkali carbonate, an alkali metaborate, or an alkali sulfite. Generally the stable alkali carbonate monohydrate is preferred. The oxidation preventing component may be an alkali sulfite, and the anti-fogging component may be potassium bromide or iodide. Stabilizing components for such a single-powder developer are disclosed in Patent 2,384,592 of September 11, 1945 and include maleic anhydride, salicylic acid, alkali metabisulfite, benzoic anhydride, orthobenzoic sulfimide, phthalimide, and phthalic anhydride. The latter has outstanding stabilizing properties in the presence of either sodium carbonate or borax and has been employed considerably more than the other stabilizers mentioned in the patent.

While the stabilizing effect of the phthalic anhydride is very good, it has been employed most successfully in developer compositions having as the alkali component either sodium carbonate or sodium sulfite, or mixtures thereof. Less success has been attained in the case of the important class of developers containing sodium metaborate as the alkali ingredient. Also, the presence of phthalic anhydride in the single-powder developer involves other considerations which are not too desirable. In the first place, phthalic anhydride is slowly soluble in water. Furthermore, it is impossible to employ it in the presence of benzotriazole, the latter being a desirable component of certain developer mixtures. But the greatest disadvantage of employing phthalic anhydride in single-powder developer mixtures, which contain alkali carbon-

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ates and sulfite, is that phthalic anhydride may react due in part to temperature effects with these basic substances and form gas under sufficient pressure to distend the hermetically sealed can in which the developer powder is packaged, and often cause a portion of the powder to be ejected with some violence as the package is opened.

An object, therefore, of the present invention is to provide an improved stabilizing agent for single-powder developers.

Another object of the invention is to provide an improved stabilizing agent for single-powder developers which does not possess the disadvantages caused by employing phthalic anhydride as the stabilizing agent.

A further object of the invention is to provide an improved stabilizing agent which makes possible the production of single-powder developers having improved stabilizing characteristics containing as the alkali ingredient, sodium metaborate.

In accordance with the invention these and other objects are attained by employing boric anhydride as the stabilizer instead of other previously known stabilizers in such single-powder developers which contain both organic developer components and basic components. The boric anhydride employed in accordance with my invention may contain free moisture up to 15.0% by weight and when the term boric anhydride is mentioned in this specification I mean boric anhydride with a moisture content within this range.

I have found that such boric anhydride eliminates the objectionable characteristics possessed by phthalic anhydride. It appears that boric anhydride being much less acid than phthalic anhydride does not react as easily or as violently as phthalic anhydride with alkali carbonates or alkali sulfites such as Na_2CO_3 and Na_2SO_3 . In this respect it is noted that the pH of phthalic anhydride is about 2.4 while the pH of boric anhydride is about 5.4 at 3% concentrations. Boric anhydride is admirably suited as a stabilizer and has the characteristics required for a stabilizer. It is acidic, relatively colorless, odorless, and stable and has no deleterious action photographically.

A preferred embodiment of the present invention involves the use in the single-powder photographic developer mixture of either the stable hydrate of an alkali carbonate or also a desiccated alkali carbonate. The alkali carbonate hydrate appears to be more stable in the presence

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of an organic developer than a comparable quantity of the corresponding desiccated alkali carbonate.

The ingredients of a preferred single-powder developer composition may therefore consist of an organic developing agent, such as monomethyl paraminophenol sulfate, hydroquinone, p-aminophenol hydrochloride, p-aminophenol sulfate, pyrogallol, p-hydroxyphenyl glycine, catechol, diaminophenol hydrochloride, and suitable mixtures thereof, a stable alkali carbonate, such as sodium carbonate monohydrate; and boric anhydride, and may contain the other well known ingredients normally present in a developer, such as sodium sulfite and potassium bromide, the normal and known function of the alkali sulfite being that of preservative, lessening the oxidation in solution of the organic developing agent; while the known function of potassium bromide is that of a restrainer particularly inhibiting "fog" formation in the development of the silver image. These known components and their known functions in a photographic developer are not to be considered as forming part of this invention, nor is their mention herein to be construed as limiting the scope of the proposed single-powder developer mixtures.

In compounding the developer mixture, one may proceed by first mixing the stabilizer and the basic component, adding and mixing therewith the developing agent, which is followed by incorporating the other ingredients. However, one can mix all the ingredients together at the same time.

The following examples will serve further to illustrate developer mixtures within the scope of the invention and will also indicate the proportionate quantities in which the respective components can be mixed together in a dry form to make up such single-powder photographic developer mixtures.

Example 1

	Grams
Elon (monomethyl p-aminophenol sulfate)	3.1
Anhydrous sodium sulfite	45.0
Hydroquinone	12.0
Sodium carbonate monohydrate	81.3
Potassium bromide	1.9
Boric anhydride	4.2

Example 2

	Grams
Elon	1.5
Anhydrous sodium sulfite	22.5
Hydroquinone	6.3
Sodium carbonate, desiccated	15.0
Potassium bromide	1.5
Boric anhydride	1.0

Example 3

	Grams
Elon	2.2
Anhydrous sodium sulfite	96.0
Hydroquinone	8.8
Sodium carbonate monohydrate	57.5
Potassium bromide	5.0
Boric anhydride	3.4

Example 4

	Grams
Elon	2.5
Anhydrous sodium sulfite	30.0
Hydroquinone	2.5
Sodium metaborate	10.5
Potassium bromide	0.5
Boric anhydride	4.7

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Example 5

	Grams
Sodium sulfite	50
Sodium carbonate monohydrate	54
Potassium bromide	1
Boric anhydride	2.2
Pyrogallol	6.3

Example 6

	Grams
Sodium sulfite	50
Sodium carbonate monohydrate	54
Potassium bromide	1
Boric anhydride	2.2
Catechol	5.5

Example 7

	Grams
Sodium sulfite	50
Sodium carbonate monohydrate	54
Potassium bromide	1
Boric anhydride	2.2
p-Hydroxyphenyl glycine	8.4

Example 8

	Grams
Sodium sulfite	50
Sodium carbonate monohydrate	54
Potassium bromide	1
Boric anhydride	2.2
p-Aminophenol sulfate	7.3

Example 9

	Grams
Sodium sulfite	50
Sodium carbonate monohydrate	54
Potassium bromide	1
Boric anhydride	2.2
p-Aminophenol hydrochloride	7.3

Example 10

	Grams
Sodium sulfite	75
Sodium carbonate monohydrate	30
Potassium iodide	.01
Boric anhydride	2.2
Hydroquinone	9
Elon	1

Example 11

	Grams
Elon	10.0
Anhydrous sodium sulfite	100.0
Sodium metaborate	20.0
Boric anhydride	4.0

Example 12

	Grams
Elon	7.5
Sodium sulfite, desiccated	100.0
Boric anhydride	1.1

Example 13

	Grams
Sodium sulfite	96
Sodium carbonate monohydrate	56
Potassium bromide	5
Boric anhydride	1.7
Hydroquinone	8.8
Elon	2.2

Example 14

	Grams
Diaminophenol hydrochloride	34.6
Sodium sulfite	59.2
Potassium bromide	3.2
Boric anhydride	2.9

In preparing a developer solution the compositions of the above examples should be dissolved in water to make one liter of solution.

Samples of the mixtures as given in the examples have been found, even after the mixtures have been kept in hermetically sealed cans at 120° F. for prolonged periods, to be unimpaired in developing properties and to give a solution comparable in color to solutions prepared from such chemicals not previously mixed. No expansion of the package in which the compositions were stored was noted as contrasted to the developers similar in composition except that phthalic anhydride replaces the boric anhydride of the present invention. The term developing agent in the claims is to be interpreted as comprising either one or several separate organic developer compounds.

What I claim and desire to secure by Letters Patent of the United States is:

1. A stable single-powder photographic developer composition containing an organic silver halide developer, a stabilizing agent, comprising boric anhydride having free moisture content not exceeding approximately 15.0% by weight and a soluble, stable, and photographically compatible basic ingredient selected from the group consisting of alkali borates, sulfites and carbonates.

2. A stable single-powder photographic developer composition containing an organic silver halide developer, sodium carbonate monohydrate, and boric anhydride containing less than 15.0% free moisture.

3. A stable single-powder photographic developer containing an organic silver halide developer, alkali carbonate, an alkali sulfite and boric anhydride containing less than 15.0% by weight of free moisture.

4. A stable single-powder photographic developer containing an organic silver halide developer, an anhydrous alkali carbonate, an alkali sulfite and boric anhydride containing less than 15.0% by weight of free moisture.

5. A stable single-powder photographic developer composition, containing an organic silver halide developer, desiccated sodium sulfite and boric anhydride containing less than 15.0% by weight of free moisture.

6. A stable single-powder photographic developer composition containing an organic silver

halide developer, sodium sulfite, sodium metaborate, and boric anhydride containing less than 15.0% by weight of free moisture.

7. A stable single-powder photographic developer composition consisting of approximately 50 grams sodium sulfite, 54 grams sodium carbonate monohydrate, 1 gram potassium bromide, 1.1 grams boric anhydride containing less than 15.0% by weight of free moisture and 8.4 grams p-hydroxyphenyl glycine.

8. A stable single-powder photographic developer composition consisting of approximately 50 grams sodium sulfite, 54 grams sodium carbonate monohydrate, 1 gram potassium bromide, 1.1 grams boric anhydride containing less than 15.0% by weight of free moisture and 7.3 grams p-aminophenol sulfate.

9. A stable single-powder photographic developer composition consisting of approximately 50 grams sodium sulfite, 54 grams sodium carbonate monohydrate, 1 gram potassium bromide, 1.1 grams boric anhydride containing less than 15.0% by weight of free moisture and 7.3 grams p-aminophenol hydrochloride.

10. A stable single-powder photographic developer composition consisting of approximately 3.1 grams monomethyl p-aminosulfate, 12 grams hydroquinone, 45 grams anhydrous sodium sulfite, 81 grams sodium carbonate monohydrate, 1.9 grams potassium bromide, and 4.2 grams boric anhydride containing less than 15.0% by weight of free moisture.

11. A stable single-powder photographic developer composition consisting of approximately 59 grams sodium sulfite, 3.2 grams potassium bromide, 34.6 grams diaminophenol hydrochloride and 2.9 grams boric anhydride containing less than 15.0% by weight of free moisture.

WILLIAM J. ROGERS.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,384,592	Bean	Sept. 11, 1945