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PHOTOGRAPHIC DEVELOPER

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8 Claims. (Cl. 95—88)

This invention relates to photographic developers and particularly to alkalies for use in a photographic developer in the dry form.

In my prior Patent No. 1,976,299 I have described a photographic developer which may be compounded in the dry form, using sodium metaborate as the alkaline constituent. The sodium metaborate described in this patent may contain various amounts of water of crystallization. I have described in my prior patent sodium metaborate containing either four or eight molecules of water of crystallization. The alkalinity of a photographic developer prepared with one of these compounds as the alkaline constituent is limited by the solubility of borax, since a portion of the metaborate is converted into borax, in some developer solutions, by the acid constituents of the developer. The concentration of the metaborate must therefore be adjusted so that insufficient borax is formed in solution to precipitate from the developer solution. A further difficulty is that certain alkalies, such as caustic soda, when mixed in dry form with the sodium metaborate, having eight molecules of water of crystallization, absorb water from the metaborate which causes the mixture to become moist. For this reason a combination of this particular metaborate and the caustic alkali cannot be used satisfactorily in packaged developers prepared in the dry form.

It is, therefore, an object of the present invention to provide a photographic developer in dry form more alkaline than sodium metaborate. A further object is to provide a developer in dry form which does not become moist or cake when packed in a reasonably tight container.

These objects are accomplished by the present invention by mixing the sodium metaborate containing four or less molecules of water of crystallization with a more alkaline material to increase the alkalinity of the developer without increasing the tendency of the mixture to become moist or cake when packed in the dry form. I have found that while the sodium metaborate containing eight molecules of water of crystallization when mixed with powdered caustic soda will become moist, the modification containing four molecules of water of crystallization may be mixed with caustic soda or other alkali in varying amounts and will retain its dry form when packed in a reasonably tight container.

The $\text{Na}_2\text{B}_2\text{O}_4 \cdot 4\text{H}_2\text{O}$ used in the developer according to my invention may be prepared by mixing an alkali metal hydroxide and an alkali metal salt of tetraboric acid as described in my prior

Patent No. 1,976,299, or it may be prepared by heating $\text{Na}_2\text{B}_2\text{O}_4 \cdot 8\text{H}_2\text{O}$ to $70^\circ\text{--}100^\circ\text{C}$. to expel the excess water of crystallization.

The alkaline compounds which I may use in admixture with the sodium metaborate as the alkaline constituent of the developer include the soluble alkali salts, such as the sodium, lithium, potassium, and ammonium salts of acid compounds of which the dissociation constant is less than 1×10^{-9} ($K_a = 10^{-9}$). Acid compounds the alkali salts of which may be used, together with their dissociation constants, are as follows:

Compound	K_a
Amino acetic acid.....	1.8×10^{-10}
Phenol.....	1.3×10^{-10}
Furfuryl alcohol.....	1×10^{-10}
Triethanolamine.....	1×10^{-14}
Phosphoric acid (3rd H^+).....	3.6×10^{-13}
Carbonic acid (2nd H^+).....	6×10^{-11}
Meta silicic acid.....	1×10^{-12}

Caustic alkalies which may be used include sodium and potassium hydroxides. These compounds are water-soluble whereas the alkaline earth metal hydroxides are for the most part insoluble in water.

The proportion of alkaline compounds to metaborate which may be used according to my invention may vary over wide ranges. In general, the caustic alkalies will be used in proportions of about one-half of the amount of the sodium metaborate and may vary from this proportion down to a very small amount of caustic alkali with a major amount of sodium metaborate. The other alkaline compounds mentioned above may be used in amounts greater or less than the amount of the sodium metaborate.

The alkaline materials used with the sodium metaborate in addition to having preferably non-deliquescent properties should also be readily soluble in the developer solution and at least as strong an alkali as the sodium metaborate, and soluble in the fixing bath or stop bath which is used in the photographic processes. It is, of course, possible to use an alkaline material which is less alkaline than the metaborate. However, this will usually be undesirable, since the activity of the developer depends on its alkalinity and a more alkaline material will usually be desired.

As examples of developers which may be compounded according to my invention I will cite the following, which are stated by way of example only. The following developer mixtures are made up to be used with one liter of water to make a

developer solution. The developing agents are usually separated from the other ingredients in the package.

Example 1

	Grams
5 Monomethylparaminophenol sulfate-----	6
Hydroquinone-----	3
Sodium sulfite-----	30
Potassium bromide-----	1
10 Sodium metaborate.4H ₂ O-----	10
Sodium hydroxide-----	10

Example 2

	Grams
15 Monomethylparaminophenol sulfate-----	1
Hydroquinone-----	4
Sodium sulfite-----	30
Potassium bromide-----	0.5
Sodium metaborate.4H ₂ O-----	20
20 Trisodium phosphate-----	20

Example 3

	Grams
Monomethylparaminophenol sulfate-----	2.5
25 Hydroquinone-----	2.5
Sodium sulfite-----	30
Potassium bromide-----	0.5
Sodium metaborate.4H ₂ O-----	10
Sodium metasilicate-----	10

30 Developers of the above type are usually packed in a two compartment container. The developing agents are packed in one compartment and the alkali, sulfite, bromide, etc., packed in the other compartment.

35 In describing my invention I have placed special emphasis on the use of sodium metaborate containing four molecules of water of crystallization. This modification may be used in preparing developers in dry form when mixed with caustic soda or other alkali. Obviously, sodium metaborate with less than four molecules of water of crystallization could likewise be used and would not cake when mixed with more deliquescent alkaline compounds. Other metaborates which can be used are the anhydrous modification and the one containing only one molecule of water of crystallization. However, the

manufacture of sodium metaborate with less than four molecules of water of crystallization is difficult and expensive, and for this reason I prefer to use the modification containing four molecules of water of crystallization.

What I claim is:

1. A dry, non-caking alkaline material for use in photographic developers comprising essentially sodium metaborate.4H₂O and a compound selected from the group consisting of water-soluble caustic alkalis and water-soluble alkaline salts of acid compounds having a dissociation constant of less than 1×10^{-9} .

2. A dry non-caking alkaline material for use in photographic developers comprising essentially sodium metaborate.4H₂O and a water-soluble alkaline salt of an acid compound having a dissociation constant of less than 1×10^{-9} .

3. A dry, non-caking alkaline material for use in photographic developers comprising essentially sodium metaborate.4H₂O and a water-soluble caustic alkali.

4. A dry, non-caking alkaline material for use in photographic developers comprising essentially sodium metaborate.4H₂O and a water-soluble caustic alkali, the sodium metaborate and the caustic alkali being present in approximately equal proportions.

5. A dry, non-caking alkaline material for use in photographic developers comprising essentially sodium metaborate.4H₂O and sodium hydroxide.

6. A dry, non-caking alkaline material for use in photographic developers comprising essentially sodium metaborate.4H₂O and sodium hydroxide, the sodium metaborate and the sodium hydroxide being present in approximately equal proportions.

7. A dry, non-caking alkaline material for use in photographic developers comprising essentially sodium metaborate.4H₂O and trisodium phosphate.

8. A dry, non-caking alkaline material for use in photographic developers comprising essentially sodium metaborate.4H₂O and sodium metasilicate.

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