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NITROSODISULFONATE LATENSIFIER

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The field of this invention is the intensification of the latent photographic image in exposed silver halide emulsion material, and more particularly the intensification of such images after exposure and before development.

The principal objects of this invention are to provide an improved latensifying method which is more closely reproducible than previous methods, which produces a lower fog level and which effectively latensifies X-ray film to reduce the necessary exposure time of patients and technicians.

The concept latensification refers to the treatment of an exposed silver halide emulsion film after exposure but before development, to intensify the latent image and thereby to reduce the exposure time necessary to obtain a required picture quality. Latensification with previously known agents such as hydrogen peroxide, sodium perborate or potassium metabisulfite has been carried out by bathing the film strips in solutions of these agents, drying and then developing. The drying period was an essential part of the procedure. However with latensification according to this invention drying is not required. Handling is thereby minimized and undesirable effects such as streaking of the film due to uneven drying are avoided.

In a brief summary of this invention, improved latensification is obtained in the process of developing an exposed photographic silver halide emulsion by the step which comprises treating the film after exposure and before development with a solution containing nitrodisulfonate ions of the following formula:

$$[(SO_3)_2NO\cdot]=$$

Preferably the nitrosodisulfonate ions in water are buffered to have a pH between about 10 and 11. The photographic emulsion is first exposed, then latensified with the above solution and preferably developed thereafter while still wet.

These and other objects and aspects of the invention will appear from the following description of several typical embodiments illustrating its novel characteristics.

The description of practical embodiments of the invention involves the following examples of film and developers:

Examples

No.	Type of Film	Conditions	Speed		Percent Speed Increase
			Unlatensified	Latensified	
1	Plus X	pH 10.5, 0.0125 M sol'n, 2 minutes prebath; 4 min. development in D 19.	76	93	22
2	Plus X	pH 10.5, 0.00125 M sol'n, 16 minutes prebath; 4 min. development in D 19.	71	111	58
3	Plus X	pH 10.5, 0.0125 M sol'n, 2 min. prebath; 16 min. development in Microdol.	42	63	50
4	Plus X	pH 10.5, 0.0125 M sol'n, 2 min. prebath; 4 min. development in D-76.	33	63	90
5	Tri X	pH 10.5, 0.0125 M sol'n, 2 min. prebath; 4 min. development in DK 50.	82	106	31
6	Tri X	pH 10.5, 0.0125 M sol'n, 16 min. prebath; 4 min. development in D 19.	98	176	79
7	Super XX	pH 10.5, 0.0125 M sol'n, 4 min. prebath; 4 min. development in D 19.	47	117	150
8	X-ray—Type F	pH 10.5, 0.0125 M sol'n, 2 min. prebath; 8 min. development in Kodak X-ray developer.	60	90	50
9	X-ray—Type M	pH 10.5, 0.0125 M sol'n, 12 min. prebath; 8 min. development in Kodak X-ray developer.	----------	----------	38

All of the film and developers in the above examples are products of the Eastman Kodak Company. Developers D–19, D–76 and DK–50 are hydroquinone—"Elon" (p-methyl aminophenol sulfate) combinations whose compositions are disclosed in section six of the Photo-Lab-Index by Henry M. Lester, published by Morgan and Lester, 101 Park Avenue, New York 17, New York. Kodak X-ray developer is also a hydroquinone—"Elon" combination while "Microdol" is an "Elon" formulation. The film types illustrated are high speed negative gelatin-silver halide emulsions having the properties set forth in "Kodak Films," 7th ed. (1956).

The data included in the above examples were obtained by exposing strips of the test film through a standard step wedge followed by development in a standard processing unit. The density of the resulting wedges was measured and H and D curves plotted. The speed was taken as the antilog (3—log E) at D=0.2 above (fog+base). Cations suitable for use with the nitrosodisulfonate anion include sodium, potassium, lithium and ammonium. The prebath treatment refers to latensification by immersion of the exposed film in an agitated bath of nitrosodisulfonate ion solution in water at the indicated pH and concentration. These tests were conducted at 68° F. The latensified test films were washed for one minute in water before development.

These data show that nitrosodisulfonate radical ions

in solution are capable of intensifying the latent image and increasing the speed by an amount varying up to 150% depending upon the type of film used, the developer, and the length of treatment. The latensifying treatment of this invention raises the fog level of the film only about 10–15% which is considerably less than the increase caused by previous methods. This treatment is also superior because the result is more closely reproducible. Drying is not required after treatment thereby eliminating streaking caused by uneven drying and requiring less handling of the film. According to the present process the exposed film strip is treated with a nitrosodisulfonate ion solution, then washed in water for one minute and can then be developed while still wet. The water wash after latensification is not essential but is recommended because the nitrosodisulfonate radical will oxidize developer molecules. While the amount of latensifier remaining on the treated film is small, this oxidation would decrease the re-usable life of developer solutions. Where fresh developer is used, the result on the film without washing is substantially the same as processing which utilizes the water wash.

Solutions containing nitrosodisulfonate radical ions are not stable at low pH. Therefore best results are obtained above pH 8 with the optimum pH being between about 10 and 11. At higher pH's an undesirable increase in fog level accompanies the latensification. The desired pH is conveniently obtained with a carbonate-bicarbonate buffer system. Suitable concentration for the nitrosodisulfonate ions can vary from 0.001 molar to about 0.0125 molar. While higher concentrations may be employed, no appreciable gain results. The latensification obtained according to this invention is most effective with higher speed film types as shown in the examples above. The contrast is not visibly affected by the treatment.

It is an important aspect of this invention that treatment with a nitrosodisulfonate ion solution latensifies X-ray film. With this treatment it is possible to reduce the exposure time of patients and X-ray technicians to radiation while still obtaining the same picture. This is very desirable since excess exposure is dangerous and is a source of increasing concern.

Potassium and sodium nitrosodisulfonate can be prepared as set forth in Murib and Ritter, J. Am. Chem. Soc. 74, 3394 (1952), and Harvey and Hollingshead, Chemistry and Industry 244 (1953). Other salts can be prepared by varying the salting out procedure described in these references according to well known techniques. Potassium nitrosodisulfonate is commercially available from the Aldrich Chemical Co. of Milwaukee, Wisconsin.

We claim:

1. In the process of developing an exposed photographic silver halide emulsion, the step which comprises latensifying the film after exposure and before development with a solution containing a member selected from the group consisting of alkali metal and ammonium nitrosodisulfonates.

2. The step according to claim 1, wherein the solution is a water solution having a pH between about 10 and 11.

3. The process of forming a photographic image which includes exposing a photosensitive silver halide emulsion, latensifying the exposed emulsion with a solution comprising nitrosodisulfonate ions and a cation selected from the group consisting of alkali metals and ammonium and developing the latensified film without intermediate drying.

4. In the process of developing an exposed silver halide X-ray film, the step of treating the film after exposure and before development with a solution containing a member selected from the group consisting of alkali metal and ammonium nitrosodisulfonates.

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