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FOG INHIBITORS FOR PHOTOGRAPHIC EMULSIONS

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8 Claims. (Cl. 95—7)

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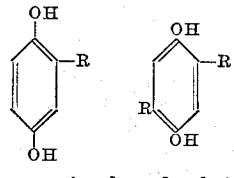
This invention relates to fog-inhibitors for photographic emulsions and to photographic emulsions containing them.

It is known that photographic emulsions, particularly ultra-sensitive emulsions or those containing color sensitizers exhibit a tendency to form a deposit of silver in the emulsion. This deposit extends more or less uniformly over the entire emulsion and is known as fog. Photographic fog is of two types: Local and general. Local fog is formed by exposure of the film or plate at undesired points as by a little leak in the camera. General fog, or, as it is sometimes known, chemical fog, is formed in a number of ways. It may be caused by the conditions under which the film or plate is stored, such as conditions of high temperature or humidity or unusually long time of storage. The nature of the emulsion may also produce chemical fog as well as the conditions of development of the emulsion, as by development for protracted periods of time or at temperatures above normal. Highly sensitive emulsions are more likely to fog than those of lower sensitivity. We are primarily concerned with general or chemical fog.

General fog and loss of sensitivity of the emulsion are especially likely to occur when the sensitive material is stored under conditions other than ideal, that is, under conditions of high temperature and humidity as in tropical regions.

The primary object of the present invention is to provide anti-fogging or fog-inhibiting agents for photographic emulsions and thereby to increase the stability of the emulsions upon storage. A further object is to provide anti-fogging agents which do not markedly lower the sensitivity of the emulsion.

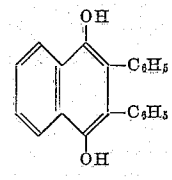
These objects are accomplished by incorporating in the emulsion an aryl-substituted hydroquinone, particularly a phenyl substituted hydroquinone. Compounds of this type are represented by the following general formulas:



in which R represents phenyl substituents, which

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may be the same or different in the case of the second general formula, and which may be unsubstituted or substituted with groups such as alkyl, alkoxy, halogen and hydroxyl. The phenyl-substituted hydroquinone may also have other substituents on the hydroquinone ring or the ring may have a fused-on ring as in 2,3-diphenyl naphthohydroquinone:



These compounds are incorporated in a fast negative emulsion particularly a silver halide emulsion which contains optical sensitizing dyes. The emulsion may be one which is intended to be used directly after emulsification or one which is subject to ripening.

The following examples illustrate compounds which we have found suitable for inhibiting fog in photographic emulsions.

1. 2,5-diphenylhydroquinone
2. 2,5-di-p-methoxyphenylhydroquinone
3. 2,5-di-p-methylphenylhydroquinone
4. 2,5-di-p-chlorophenylhydroquinone
5. 2,5-di-p-hydroxyphenylhydroquinone
6. 2,5-diphenyl-3,6-dichlorohydroquinone
7. 2,5-diphenyl-3,6-dibromohydroquinone
8. 2-p-methoxyphenylhydroquinone
9. 2,3-diphenyl naphthohydroquinone

Compounds 1 and 2 and their preparation are described by Pummerer and Prell, Berichte, vol. 55, page 3108 (1922). Compounds 1, 2, and 7, and their preparation are described by Shildneck and Adams, Journal of the American Chemical Society, vol. 53, page 2373, (1931). Other compounds referred to above may be similarly prepared.

The anti-foggant action of our compounds was determined by incubation of the emulsions containing them, at 120° F. for six days and also by incubation for four weeks under simulated tropical conditions. The results of these tests are tabulated here for comparison with the initial fog, contrast and speed of the emulsions with and without the anti-foggants.

	Initial			6-day 120° F. incubation			4 weeks tropical incubation		
	10/i Speed	Gamma	Fog	10/i Speed	Gamma	Fog	10/i Speed	Gamma	Fog
Control	2,850	0.97	.18	2,100	0.91	.28	1,580	0.92	.32
2,5-di(p-methoxyphenyl)-hydroquinone 0.1 mg./liter	2,575	1.02	.12	2,100	0.97	.14	2,450	0.92	.16
2,5-di(p-tolyl)-hydroquinone 0.1 mg./liter	3,400	1.10	.14	2,575	0.98	.20	2,150	0.96	.25
2,5-di(p-chlorophenyl) hydroquinone 1.0 mg./liter	3,300	1.00	.12	2,800	1.10	.15	2,525	1.08	.19
Control	3,450	0.97	.19	2,175	1.01	.31	3,000	1.29	.45
p-(methoxyphenyl)hydroquinone, 2.0 mg./liter	3,750	1.01	.12	2,375	1.16	.24	3,700	1.16	.30
p-(methoxyphenyl)hydroquinone, 10.0 mg./liter	3,350	1.02	.09	2,750	1.05	.15	4,700	1.25	.23
p-(methoxyphenyl)hydroquinone, 50 mg./liter	3,150	1.06	.08	2,475	1.03	.08	4,150	1.01	.15
Control	2,775	1.27	.16	2,350	1.11	.25			
2,5-diphenyl-hydroquinone, 10 mg./liter	3,450	1.27	.09	2,600	1.08	.18			
2,5-diphenyl-hydroquinone, 20 mg./liter	2,950	1.32	.09	2,800	1.03	.12			
2,5-diphenyl-hydroquinone, 50 mg./liter	2,975	1.22	.07	2,750	1.05	.08			

The amount of fog-inhibiting agent used in the emulsion will depend upon the composition of the agent and upon the type of emulsion. In general, the amount of fog-inhibiting agent used will vary from 0.1 mg. to about 50 mg. per liter of wet emulsion. It will be understood that more or less than this amount may be used. Generally, however, if a greater amount is used in the emulsion, either no increased fog-inhibiting effect is obtained or there is a decrease in the sensitivity of the emulsion. The compounds may be incorporated in the emulsion by mixing them with any suitable solvent which is inert with respect to the emulsion such as water, methyl alcohol, ethyl alcohol, acetone and others.

The fog-inhibiting agents which we have described may be used in various kinds of photographic emulsions. Although they are useful in non-sensitized emulsions, they are of greater value in orthochromatic and panchromatic emulsions. If used with sensitizing dyes, they may be added to the emulsion, before or after such dyes are added. Various silver salts may be used as the sensitive ingredient of the emulsion such as silver bromide, silver iodide, silver chloride and mixtures of these. The dispersing agent for the silver salt may be gelatin or other colloid such as collodion, albumen, cellulose organic derivatives or synthetic resins.

It will be understood that we contemplate as included within our invention all modifications and equivalents falling within the scope of the appended claims.

We claim:

1. A gelatino silver halide emulsion containing a fog-inhibiting amount of an aryl-substituted hydroquinone, the aryl substituent being an aryl group of the benzene series and substituted in at least one of the 2, 3 and 5 positions of the hydroquinone.

2. A gelatino silver halide emulsion containing a fog-inhibiting amount of a phenyl-substituted hydroquinone the phenyl substituent being substituted in at least one of the 2, 3 and 5 positions of the hydroquinone.

3. A gelatino silver halide emulsion containing a fog-inhibiting amount of a diphenyl-substituted hydroquinone.

4. A gelatino silver halide emulsion containing a fog-inhibiting amount of a mono-phenyl hydroquinone.

5. A gelatino silver halide emulsion containing a fog-inhibiting amount of a 2,5-diphenyl hydroquinone.

6. A gelatino silver halide emulsion containing a fog-inhibiting amount of 2,5-diphenyl hydroquinone.

7. A gelatino silver halide emulsion containing a fog-inhibiting amount of 2,5-di-(p-methoxyphenyl) hydroquinone.

8. A gelatino silver halide emulsion containing from about 0.1 mg. to about 50 mgs. per liter of wet emulsion of a phenyl-substituted hydroquinone the phenyl substituent being substituted in at least one of the 2, 3 and 5 positions of the hydroquinone.

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