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HARDENING OF GELATIN

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The present invention relates to the hardening of gelatin and is particularly directed to the hardening of gelatin and like emulsions employed as an emulsion layer in photographic films, plates or papers.

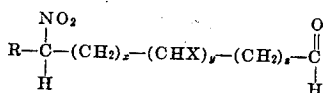
It is common practice to harden photographic gelatin emulsion layers by incorporating in the emulsion a minor amount of a material known to have the property or overcoming the tendency of gelatin to melt or swell during processing, particularly at elevated temperatures. The materials most commonly employed for this purpose are chrome alum or acetate and various aldehydes, particularly formaldehyde.

As is well known in the photographic field, gelatin is widely employed in the preparation of photographic films, plates or paper in the form of gelatin emulsions. In addition, layers of gelatin emulsion are coated on the photographic films, plates, papers and the like to serve as anti-halation layers, to act as filter layers, to separate two sensitized layers and for numerous other purposes.

In order to permit the photographic materials which are coated with layers of gelatin emulsion to be satisfactorily processed at even slightly elevated temperatures, for instance in a warm climate, it is necessary to incorporate in the gelatin some material which will overcome the tendency of the gelatin to melt or swell.

The present invention is particularly directed to an improvement in aldehyde types of hardening materials and is directed particularly to the use as gelatin hardeners of certain aldehyde derivatives which will cause no fogging or loss of speed of sensitized gelatin layers while producing a substantial increase in the melting point of the gelatin.

I have discovered that the nitro aldehydes possess the property of hardening gelatin in a manner quite similar to that possessed by the corresponding aldehyde. The nitro aldehydes may be represented by the formula



in which R is hydrogen or an alkyl group containing not more than 6 carbon atoms and which may be substituted, X is hydrogen, halogen, or hydroxyl, and x, y and z are any whole numbers less than 6 including zero.

Thus the nitro aldehydes which I prefer to employ are the lower aliphatic nitro aldehydes, containing 8 or less carbon atoms and which in addition

to the nitro group may contain other substituents such as halogen radicals or hydroxy groups, carbonyl groups and the like.

As specific examples of the nitro aldehydes which I may employ in practicing the present invention, although it is to be understood that the present invention is not limited to the use of these specific nitro aldehydes, may be listed nitro propandial, also called nitromalondialdehyde, which has the formula



I may also employ nitrolactic aldehyde which may be prepared from nitromethane and glyoxal semi-acetal, having the following probable formula:



I have found that certain of the nitroaldehydes are particularly effective for hardening gelatin emulsions which are slightly alkaline, i. e., emulsions having a pH greater than 7, generally between 7 and 8.5. Nitropropandial, for instance, exerts a greater hardening effect in alkaline emulsions than it does in emulsions having an acid reaction. It should be understood, however, that this material exerts a hardening action in an acid emulsion, and certain of the nitroaldehydes, nitrolactic aldehydes, for instance, are as satisfactory in an acid emulsion as in an alkaline emulsion.

The present invention may be most readily described by considering several specific examples thereof.

Example 1

To 16 ccs. of a 10% gelatin emulsion having a pH of 8 was added 1 cc. of an aqueous solution containing 5% nitropropandial. A glass plate was coated with the thus obtained mixture and the gelatin layer thus obtained was dried. After drying, it was found that the thus hardened gelatin layer had a melting point of 53° C., which compared with the melting point of 37° C. possessed by an unhardened layer of the same gelatin.

Example 2

16 ccs. of the same silver halide gelatin emulsion as in Example 1 and having a pH of 8 and containing 10% gelatin was mixed with 1 cc. of

an aqueous solution containing 15% nitropropandial and a glass plate was coated with a thin layer of the thus obtained mixture. The gelatin layer was dried and after drying had a melting point of 60° C.

It was also found that the nitroaldehyde caused no fogging of the silver halide emulsion and caused no desensitization of the emulsion.

It should be understood that the exact proportion of ingredients in the above examples are illustrative of the preferred amounts which I employ. However, the exact amounts may be varied within reasonable limits and with due regard to the particular hardening material employed.

I claim:

1. A composition of matter comprising a solution of gelatin containing a lower aliphatic nitro aldehyde, said solution being adapted for the production of a hardening gelatin layer.

2. A gelatin layer containing as a hardening agent a lower aliphatic nitro aldehyde.

3. A photographic material provided with a gelatin silver halide emulsion layer, said layer containing the condensation product of gelatin and a lower aliphatic nitro aldehyde.

4. A photographic material provided with a gelatin silver halide emulsion layer, said layer containing the condensation product of gelatin and nitropropandial.

5. A photographic material provided with a gelatin silver halide emulsion layer, said layer containing the condensation product of gelatin and nitrolactic aldehyde.

6. In the manufacture of photographic articles provided with a hardened gelatin emulsion layer, the step which comprises acting upon said gelatin emulsion with a dilute solution of a lower aliphatic nitro aldehyde.

7. In the manufacture of photographic articles provided with a hardened gelatin emulsion layer, the step which comprises acting upon said gelatin emulsion with a dilute solution of nitropropandial.

8. In the manufacture of photographic articles provided with a hardened gelatin emulsion layer, the step which comprises acting upon said gelatin emulsion with a dilute solution of nitrolactic aldehyde.

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