EVALUATION OF THE USE OF DRY NITROGEN
TO INCREASE PHOTOGRAPHIC FILM SPEED

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DEVELOPMENT DIVISION

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MASTER

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ABSTRACT

The utility of prolonged storage of photographic film under a dry nitrogen atmosphere to increase speed was investigated. Differences between non-treated and nitrogen treated Kodak Tri-X and Royal-X are discussed.

DISCUSSION

Several methods in recent years have been used to increase the sensitivity of photographic film(1). The objective of these treatments has been to remove from the emulsion water vapor and oxygen which act as desensitizing agents. These methods have all depended upon the principle of excess partial pressures to drive off the unwanted gases. These methods have normally employed some combination of heating of the film while under a high vacuum. However, these methods have produced various undesirable side effects such as an increase in the fog level or a shrinkage and hardening of the emulsion.

Recently workers at the Royal Astronomical Observatory, Edinburgh U.K., utilized a technique wherein photographic film was subjected to prolonged storage under a high purity, dry nitrogen atmosphere. The principle of excess partial pressures was again evoked to remove unwanted gases but experiments were conducted at room temperature and pressure to avoid the previously cited unwanted side effects. Improvements in the sensitivity of Kodak IIIaJ and IIaO film were noted, while Ilford R40 showed no improvement in the nitrogen soaking process at Edinburgh.

The process developed at Edinburgh was primarily intended for use with astronomical photography wherein very long exposure times are used on very faint objects. The Edinburgh process was evaluated at Pantex so that it might possibly be used in high explosive streak camera work where typically very short exposure times are used on very bright objects. In both cases (long exposure/faint object or short exposure/bright object), the effects of the failure of the reciprocity rule in photography begins to become important; therefore any increase in film sensitivity has the possibility of increasing its recording ability significantly. This was the finding at Edinburgh and was the hoped for finding in the present series of experiments.

Experiments were conducted by Mason & Hanger on Kodak Tri-X and Royal-X, the most commonly used streak camera films that were readily available at the time. A small gas-tight, light-tight box was built, loaded with several sheets of each film type, sealed and flushed with a dry, high purity nitrogen for several minutes each day for a period of slightly over a month. The effect of the dry nitrogen purge was evaluated by loading one half of the PX-101 streak camera film cassette with a piece of treated film and one half of the film cassette with untreated film. The two pieces of film were butted against each other so that an exposure could be effected perpendicular to the interface between the two film types.

(1) P. M. Corben, V. C. Reddish and M. E. Sims, "Speeding Up Astronomical Photography," *Nature*, Vol. 249, page 22 (May 3, 1974).

Any increase in film speed was attempted to be ascertained by means of the light output from an exploding bridgewire focused on the slit plate. The exposed films were developed according to the manufacturer's recommended process. A Joyce-Loebl Model MK III CS automatic recording scanning microdensitometer was used to determine the optical density^a across the width of the exposed portion of each film sample as closely as possible to the abutment between the differing films. Figs. 1 through 4 present the results from respective pairs of treated and untreated Tri-X. Figs. 5 through 8 present similar results from Royal-X. Figs. 9 and 10 show comparative results from untreated Royal-X and Tri-X.

Results from this series of experiments show that there is a slight decrease in background fog (see Figs. 1 and 3) for Tri-X when subjected to the nitrogen treatment. Figs. 2 and 4, which present the effect of background fog subtracted out, show a slight improvement in contrast between fog and trace might be effected by the treatment. Figs. 5 and 7 show the nitrogen treatment significantly increases the background fog on Royal-X but when the effect of the fog is subtracted out (Figs. 6 and 8) there is practically no improvement in performance. Figs. 9 and 10 show some comparative aspects of untreated Royal-X and Tri-X. The background fog of Royal-X is approximately 0.1 density units greater than that for Tri-X. When the effects of this fog are removed, Royal-X will produce a density ratio of about 2.5 times greater than Tri-X. The ASA rating for Royal-X and Tri-X is 1250 and 320 respectively.

The actual application to which the films tested may be put to use should dictate the film to use. Where background fog is unimportant and light available is low, Royal-X is probably superior to Tri-X. If there is sufficient light for an exposure a treated or untreated Tri-X may be superior if for no other reason than the finer grain of Tri-X over that of Royal-X.

CONCLUSIONS

The dry, high purity nitrogen soaking slightly improves the performance of Tri-X with respect to both background fog and increased photographic speed. The nitrogen soaking degrades the performance of Royal-X and is not recommended. There is the possibility that a longer soaking time would further improve the response of Tri-X; however, this aspect will not be further investigated.

^aOptical density is defined as the common logarithm of the reciprocal of the light transmittance through a medium.

Fig. 1. Tri-X Treated and Untreated (Not normalized for effect of base fog)

Fig. 2. Tri-X Treated and Untreated (Normalized for effect of base fog)

Fig. 3. Tri-X Treated and Untreated (Not normalized for effect of base fog)

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Fig. 4. Tri-X Treated and Untreated (Normalized of effect of base fog)

Fig. 5. Royal-X Treated and Untreated (Not normalized for effect of base fog)

Fig. 6. Royal-X Treated and Untreated (Normalized for the effect of base fog)

Fig. 7. Royal-X Treated and Untreated (Not normalized for effect of base fog)

Fig. 8. Royal-X Treated and Untreated (Normalized for the effect of base fog)

Fig. 9. Untreated Royal-X and Tri-X (Not normalized for effect of base fog)

Fig. 10. Untreated Royal-X and Tri-X (Normalized for effect of base fog)