AEC-NASA TECH BRIEF

Shortened Processing Time Technique for Color Industrial Radiography

The problem:

To reduce the film processing time required for color radiography to more practical limits. The advantages of color radiography, including faster film reading, more precise thickness determination, and much improved film latitude, have been known for some time. However, the very long processing time required for such radiographs has discouraged more widespread use.

The solution:

A shortened method for processing Ektachrome film which eliminates some of the processing steps. The length of processing time required to generate a color radiograph after the film is exposed to penetrating radiation is reduced by about a factor of 3 by the shortened method. This method retains most of the advantages of the color techniques.

How it's done:

In making the color radiographs, conventional multilayer color film, such as Ektachrome, is employed. Routine exposing methods are used in exposing the film to penetrating radiation. An exception to this rule occurs when intensifying screens are employed. One calcium tungstate screen is placed on the emulsion side of the film only, and a lead screen on the back side. The emulsion side of the film is always directed toward the radiation source whether or not screens are used.

Prior to, or after exposure to penetrating radiation, the emulsion side of the film is flashed to a colored light. This colored light produces the hue changes in the processed radiograph. Best results were obtained with red or a combination yellow and amber. The flashing is carried out by the safelight filter(s) to an adjustable safelamp containing a 250-watt photoflood lamp. The safelight is connected to a variable transformer to control the intensity of the flash at about 90 volts. The transformer is in turn connected to an electronic timer to control the duration of the flash. The distance from light source to film is kept at 2 feet. The duration of flash depends upon the color of light used, from 0.1 second for the yellow-amber to 0.2 second for the red.

After exposure and flashing, the film is processed in Kodak C-22 developer for 8 minutes, placed in a stop bath for 2 minutes, and, finally, placed in a fixing bath for 5 minutes. These processing steps differ greatly from those recommended by the film manufacturers. Agitation of the film during processing is important to assure uniformity of results. Two agitation methods may be used, the nitrogen burst method or the manual method. These procedures are outlined in the processing directions included in each container of developer.

Table I summarizes the recommended processing steps. Table II summarizes the shortened processing method that has been found useful in those studies.

TABLE I

Recommended Processing of Kodak Ektachrome Film
Summary of Steps for Kodak Film Processes E-2 and E-3

Step	Solution or Procedure	Time in Minutes
1	First developer	10
2	Rinse (H_2O)	1
3	Hardener	3
4	Wash (H_2O)	3
5	Reversal exposure (drain)	1
6	Color developer	15
7	Wash (H_2O)	5
8	Clearing bath	5
9	Rinse (H_2O)	1
10	Bleach	8
11	Rinse (H_2O)	1
12	Fixing bath	6
13	Wash (H_2O)	8
14	Stabilizer	1

(continued overleaf)

TABLE II

Recommended Shortened Processing of Kodak Ektachrome Film

Summary of Steps Employing Shortened Processing

Step	Solution or Procedure	Time in Minutes
1	Develop C-22 developer	8
2	Stop bath or rinse H_2O	2
3	Fixing bath	5
4	Wash H_2O	10

An appreciable amount of time is gained with this method although the amount of hue variation is somewhat limited. The high latitude which color radiographs normally display, however, is essentially the same with either process. The radiographic negatives produced have shown excellent stability even though the hardening step and some other developmental steps have been eliminated. The reproducibility of the radiographs taken with this technique has been excellent and the process permits high darkroom production.

Notes:

1. A complete discussion of the results is available in a paper by Norman P. Lapinski entitled "A Shortened Processing Time Technique for Color Radiography," reprinted from *Materials Evaluation*, vol. XXV, no. 2, p. 33–35, February 1967.
2. Inquiries concerning this innovation may be directed to:

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Patent status:

Inquiries about obtaining rights for commercial use of this innovation may be made to:

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