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Color Photographic Development Accelerators Part II– Effect of Development-Accelerator-Releasing Colorless Couplers on the Photographic Characteristics of Color Negative Material

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ABSTRACT

The effect of five development-accelerator-releasing colorless couplers on the photographic characteristics of color negative material has been studied. It was found that the development-accelerator-releasing colorless couplers examined may be used together with the cyan and magenta image couplers in a color negative material to increase the photographic speed.

1 INTRODUCTION

The inclusion of a development-accelerator-releasing (DAR) color coupler in a color negative imaging layer has been suggested as a means of improving photographic speed and photo efficiency with color development.[1–4] A detailed photomicrographic study has revealed that the action of a DAR color coupler involves a localized fogging of unexposed grains in close proximity to a strongly developing grain, and hence increases the number of developed silver halide grains per unit area.[5]

According to the principle of a DAR color coupler, the authors have previously synthesized a class of new DAR colorless couplers.[6] The advantage of the DAR colorless coupler[6] over the DAR color coupler[1–4] is that the former may be used in conjunction with any one of the cyan, magenta and yellow image couplers in a color negative material. Reported are some practical application properties of the DAR colorless couplers.

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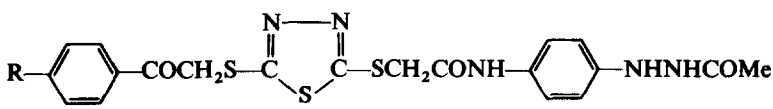
2 EXPERIMENTAL

To examine the effect of DAR colorless couplers on the photographic characteristics, a single-layer color negative coating structure was employed. For most of the experimentation, one coating contained an experimental 400-speed bromo-iodide T-grain emulsion sensitized to green light, together with a magenta (C1) dye-forming image coupler; another coating contained the same emulsion sensitized to red light, together with a cyan dye-forming image coupler (C2). Silver halide laydown in both coatings was fixed at $1{\cdot}5 \times 10^{-2}$ mol m^{-2}. Image couplers C1 and C2 were coated at $2{\cdot}5 \times 10^{-3}$ and $2{\cdot}1 \times 10^{-3}$ mol m^{-2}, respectively. The DAR colorless couplers examined in this study were hydrazide releasers; their structure and a schematic diagram of the coatings formed are shown in Fig. 1. The laydowns of the DAR colorless couplers were varied from 0 to $7{\cdot}5 \times 10^{-6}$ mol m^{-2} in the green-sensitive layer and from 0 to $4{\cdot}2 \times 10^{-6}$ mol m^{-2} in the red-sensitive layer.

Green-sensitive coating	*Red-sensitive coating*
Gelatin coat 1·0 g m^{-2}	Gelatin coat 1·0 g m^{-1}
Emulsion coat	Emulsion coat
Ag $1{\cdot}5 \times 10^{-2}$ mol m^{-2}	Ag $1{\cdot}5 \times 10^{-2}$ mol m^{-2}
Gel 2·0 g m^{-2}	Gel 2·0 g m^{-2}
Image coupler C1 $2{\cdot}5 \times 10^{-3}$ mol m^{-2}	Image coupler C2 $2{\cdot}1 \times 10^{-3}$ mol m^{-2}
DAR colorless coupler	Dar colorless coupler
0–$7{\cdot}5 \times 10^{-6}$ mol m^{-2}	0–$4{\cdot}2 \times 10^{-6}$ mol m^{-2}
Acetate base	Acetate base
Anti-halation coat	Anti-halation coat

The chemical structure of the DAR colorless couplers employed had the following structures:



DAR colorless coupler	*R*
1	H
2	Br
3	Cl
4	Me
5	MeO

Fig. 1. Schematic representation of the experimental coatings employed and DAR colorless coupler chemical structure.

TABLE 1
Effect of DAR Colorless Couplers on the Photographic Characteristics of Green-Sensitive Coatings

DAR colorless coupler	*Laydown* $\times 10^6$ ($mol\,m^{-2}$)	*Relative sensitivity*	*Contrast*	*Fog*
—	0	100	1·84	0·62
1	7·5	148	1·90	0·79
2	7·5	132	2·02	1·06
3	7·5	120	2·12	0·76
4	7·5	118	1·91	0·94
5	7·5	147	1·89	1·02

To obtain dye sensitometric response curves, the coatings were exposed stepwise to white light, followed by C-41 processing. The densities of the processed green-sensitive and red-sensitive coatings were measured using red and green light, respectively.

3 RESULTS AND DISCUSSIONS

The dye sensitometric data for green-sensitive and red-sensitive coatings are given in Tables 1 and 2.

It is apparent from the tables that the increase of photographic speed was excellent for the coatings incorporating the DAR colorless couplers compared with the coatings without the DAR colorless couplers, and virtually no increase of fogging was observed (Table 2) unless the emulsion was heavily fogged (Table 1).

TABLE 2
Effect of DAR Colorless Couplers on the Photographic Characteristics of Red-Sensitive Coatings

DAR colorless coupler	*Laydown* $\times 10^6$ ($mol\,m^{-2}$)	*Relative sensitivity*	*Contrast*	*Fog*
—	0	100	0·98	0·36
1	4·2	150	0·96	0·38
2	4·2	155	0·93	0·35
3	4·2	151	1·10	0·40
4	4·2	162	0·95	0·41
5	4·2	129	1·00	0·30

4 CONCLUSIONS

A photographic speed increase has been observed when the DAR colorless couplers employed in this study are incorporated within an experimental bromo-iodide T-grain emulsion containing either cyan or magenta dye-forming image couplers.

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