

Laser Dye Removal Technology for Digital, Dry Imagesetting Film

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Abstract

Laser dye removal is a process whereby an infrared laser interacts with an infrared sensitive material to remove some, or all, of that material.[1] As applied to imaging systems, removal of material must afford a contrast change and thus result in an image. For imagesetting films used in the graphics arts, ultraviolet contrast is the desired image characteristic. KODAK DIRECT IMAGE Recording Film is a laser dye removal system with high contrast for imagesetting and the subsequent preparation of contact and duplicating films as well as printing plates. The high D-max (> 3.5 UV) and low D-min (< 0.08 UV) of the film make it suitable for intermixing with normal AgX films. Each element of the film structure contributes to the overall performance of the final film, and has been developed through several years of effort. The image-setting systems in which this film is used are unique both for the nature of the printhead as well as the need to account for the stream of material as it is removed from the film. These and other aspects of the system will be discussed.

Introduction

The use of digital information has become more and more pervasive in the graphic arts in recent years. A typical, digital work flow might begin with a computer work-station, for composition and imposition of text, and graphics from a wide variety of sources. From the final composition, raster image processing of the data creates four discreet image files reflecting the yellow, magenta, cyan, and black records of a color image. Typically, four ultraviolet masks are prepared from this data by exposing silver halide film with a digital imagesetter using an LED or laser followed by wet processing to yield separations. These separations are then used in the exposure of printing plates (in the case of fully composed and imposed data files), or carried to subsequent composition and exposure of contact and duplicating films prior to the creation of printing plates. The major goal of KODAK DIRECT IMAGE Recording Film was to provide an ultraviolet mask (imagesetting) film that fit into the work flow described, but that was suitable for use immediately on exposure in the imagesetter without the need for wet processing. KODAK DIRECT IMAGE Recording Film is also a truly single sheet-material that can be handled in room lighting. This technology occupies a place with other new, digital, “direct to” technologies such as “computer to plate”, “direct to press”, and “on demand printing”. A brief description of KODAK DIRECT IMAGE Recording Film and the system which exposes it follows.

Results and Discussion

Film that does not require wet processing offers obvious advantages both from an environmental and a convenience perspective. Elimination of wet processing removes the need for drains and supply lines in the work environment. It also eliminates the need for cleaning, replenishing, and calibrating the processing system. A less obvious but very important advantage is the elimination of processing as a potential source of errors and image degradation in the overall system. In a laser imaged, processless film like KODAK DIRECT IMAGE Recording Film, the ability to define the image is governed by the ability mechanically and optically to position the laser. Issues of processor variability or dimensional stability variation induced by processing do not apply. In fact, there are no sources of image degradation after imaging since KODAK DIRECT IMAGE Recording Film requires no post imaging lamination or delamination.

The requirements for an imagesetting film are fairly well defined and follow naturally from the film’s use in the graphic arts work flow. For functionality as an ultraviolet mask, high D-max density and low D-min density in the UV region of the spectrum are requirements. KODAK DIRECT IMAGE Recording Film features a UV D-max greater than 3.5 and a UV D-min less than 0.08. As such, KODAK DIRECT IMAGE Recording Film can be intermixed with typical AgX films in a single com-posite with no adjustment of exposures. Because halftone printing is essentially a binary process, the halftone dots created on an imagesetting film are ideally binary (or infinite in contrast). Because of the dye removal process used to image KODAK DIRECT IMAGE Recording Film, excellent “hard” dots are created. Varying exposure of KODAK DIRECT IMAGE Recording Film images to AgX duplicating film shows a dot gain response as good or better than typical hard dot (SHN) imagesetter films. In addition, no processing means that the dots can be created with high reproducibility as well. Imagesetting film must also have sufficient photo-chemical and thermal stability to meet the storage (post imaging) requirements of the graphics segment in question, and to exhibit physical characteristics suitable for normal handling in a typical work flow environment. A high degree of density uniformity (in the D-max regions) is also required

since these films are frequently used in an overlay or compositional mode. This is particularly true for KODAK DIRECT IMAGE Recording Film, which is translucent green visually, and which has its uniformity characteristics defined during manufacture (coating) rather than by processing.

KODAK DIRECT IMAGE Recording Film is a three-layer imaging structure on PET film base with conductive and matte surface layers coated on the non-image side. The latter layers afford static protection as well as a high matte feel that is particularly desirable in the Japanese graphic arts market. Imaging of the three-layer structure occurs essentially by the action of an 830 nm infrared diode laser effectively "drilling' through the structure to remove material and leave a low D-min area behind.[1] (Note that this mechanism is in contrast to what is referred to as ablation imaging, in which material is removed in a binary sense that can be considered to be almost explosive in nature.)[2] The resulting image can be thought of as a relief image in which the "clear" areas are recessed (due to layer removal), relative to the D-max areas where no removal has taken place. Currently, systems for imaging KODAK DIRECT IMAGE Recording Film integrate a laser diode printhead (designed and manufactured at Kodak) with other manufacturer's technology for imagesetting devices. A collection system for material removed from the film completes the overall system.

Each layer of the imaging structure brings essential performance attributes to the overall film. Thus, the layer closest to the support (the barrier layer) is critical to attaining clean, low density D-min. Films without this barrier layer typically have UV D-min densities in the vicinity of 0.15. Incorporation of the barrier layer formulation affords UV D-min densities less than 0.08 and routinely near 0.06.

The imaging layer comprises the heart of the system. The dye package in this layer includes an infrared absorbing dye for interaction with the laser, ultraviolet/yellow dyes for proper masking in most UV exposure systems, and cyan dye(s) to provide an overall green color that allows the user to easily visualize the image. The final color and visual density of KODAK DIRECT IMAGE Recording Film represents a com-promise between cosmetic desirability (for example, the film could easily be black, red, very dark green, or other combinations) and the fact that every component on the imaging side of the film requires laser energy for removal. For most efficient performance, a light yellow but fully UV masking film would work but be difficult to visualize. A black film comparable visually to AgX film would be more traditional but would extract a penalty in efficiency of removal. A polymeric binder is required for film formation. Studies of organic polymers as binders show that not all respond to the laser generated energy with equal efficiency. Speed differentials of 15% - 20% can be observed from the most efficient studied to the "average" response.

A thin overcoat layer of binder and particles reduces the coefficient of friction on the film surface making it easier to handle and less susceptible to physical damage like scratching or abrasion.

KODAK DIRECT IMAGE Recording Film has been available commercially in Japan since June 1996. Matsushita Graphics Communication Systems provides an imagesetter for the newspaper industry (the GX-3600) that incorporates Kodak printhead technology to image KODAK DIRECT IMAGE Recording Film. Dainippon Screen offers a KODAK DIRECT IMAGE Recording Film imagesetter (the TE-R1070 or Mojave 1070) that targets the commercial graphic arts market in Japan. The latter device is scheduled for introduction in North America and Europe in 1997.

References

1. "Laser Dye Ablation vs. Laser Dye Removal" , M. S. Burberry, L. W. Tutt, and R. P. Henzel, *Proceedings of the IS&T Congress on Advances in Non-Impact Printing Technologies*, pg. 312-315 (1996).
2. E. W. Ellis, et al, US Patent 5,501,938 and references therein.