Thermal Printing for Digital Output

David G. Foster; Consumer Digital Group, Eastman Kodak Company, Rochester, NY/USA

Abstract

Resistive-head thermal dye transfer printing is a digital printing method in which thermal energy is used to create photographic quality output by the transfer of dyes from a donor ribbon to a receiver that are in intimate contact. Like many systems, thermal printing is a synergistic combination of many parts. Thermal dye donor elements consist of support, dye layers, adhesive layers, laminate overcoat layers, and slipping or heat-resistant layers. Thermal receivers are also multilayered structures consisting of a dye-receiving layer, interlayers, antistatic layers, and a high-quality paper support. Thermal hardware and software in combination with thermal media elements result in high-quality photographic images. This paper will focus on the thermal media contribution to the system.

Introduction

Resistive-head thermal dye transfer printing is an imaging system that was developed and has been used at Kodak since 1984. Thermal printing is used in consumer, home, government, professional, entertainment, and commercial printing applications. In the thermal printing process, electronic images are subjected to color separation and converted into electronic signals. These electronic signals are transmitted to a thermal printer where images are created by printing yellow, magenta, cyan, and laminate patches from the dye donor to a receiver. Based on the amount of heat that is generated from the print-head, as a function of the color needs of the particular image, dye is transferred from the donor to the receiver during the printing process (Figure 1).

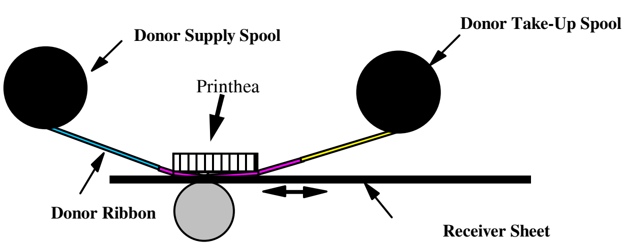

Figure 1. Simple model of thermal printing [1].

Thermal Donor

Thermal donors are multilayered material structures that are coated on a thin polyethylene terephthalate (PET) support (Figure 2). Donors generally contain alternating patches of cyan, magenta, and yellow dyes that are coated in a gravure coating process. Dye donor layers commonly contain dyes, binders, plasticizers, and other addenda to facilitate thermal printing. The dye layers are engineered to include dyes with desirable hue, compatibility with the polymeric binder, and high dye transfer efficiency. In addition to the dye layers, several other layers are incorporated.

The support of choice is generally poly(ethylene terephthalate) (PET) with a thickness of either 4.5 or 6 µm. The thickness of the support affects the heat transfer efficiency. Thicker supports require more heat to transfer dye but may be more robust during printing. Thinner supports require less heat for dye transfer, but can be more difficult to handle during both coating and printing processes. An adhesive layer is coated on each side of the PET support to assist in adhesion of the functional layers, as well as acting as a barrier and antistatic layer [2,3]. A slipping layer is coated on the side opposite the dyes and acts to facilitate the transport of the donor through the printer and is in direct contact with the thermal print-head during the printing process [4–6]. The laminate layer is coated on the dye side of the support and is the last layer to be printed in the printing sequence. The laminate acts to protect the print from environmental attack, including UV radiation, ozone, and dirt. It is because of the laminate layer that thermal prints may be completely immersed into water without loss of image quality. Thermal dye transfer prints without a protective laminate layer are susceptible to density loss that is due to faster light fade of dyes near the surface, attack by ozone, and other chemicals. Laminate options include both glossy and matte finish for images [7].

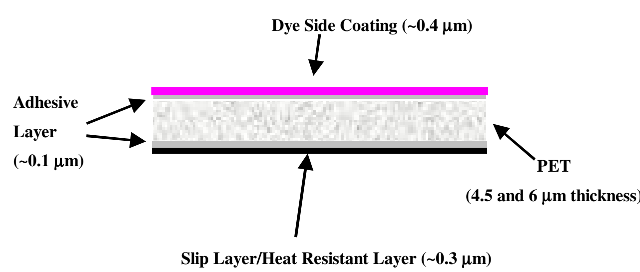

***Figure 2**. Basic structure of thermal donor.*

As thermal printing systems have increased in output speed, releasing the donor from the receiver after printing has become an important area of advancement. So-called release agents may be incorporated in both donor and receiver layers to facilitate this separation after printing [8,9].

Thermal Receivers

Thermal receivers also have multilayered material structures (Figure 3). The goal of the receiver is to produce a print that looks and feels like a traditional photographic picture with excellent color reproduction. Receivers can take many forms, from traditional image stock to labels, transparency films, and identification cards. Receivers must be able to readily accept and be compatible with dyes. They also must be insensitive to deformation by heat and pressure due to the thermal printing process and insensitive to humidity, scratch, and abrasion, be robust in transport, and have good image stability. The top layer of the receiver is the so-called dye-receiving layer (DRL), and it is specifically designed for this system. The DRL needs to efficiently accept dye from the donor and provide a stable medium for the dyes. Receiver supports have evolved from a resin-coated cellulosic paper to a multilayered structure. The support contains a multilayer microvoided film on top of a pigmented tie layer that is adhered to the cellulosic paper raw base support. On the opposite side of the cellulosic paper are a tie layer and anticurl layer to prevent curling of the final image [10].

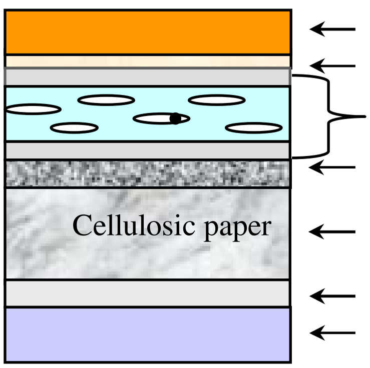

Figure 3. Basic structure of thermal receiver.

Conclusions

The synergistic combination of thermal dye donor and receiver technologies along with the thermal printer and software components results in photographic quality images. Donor and receiver media structures contain multiple layers specifically designed to facilitate printing in this system. The donor structure is designed to transfer dyes in the most efficient manner while protecting it while in contact with the thermal printhead. The receiver is designed to optimally incorporate the dyes and create output with the look and feel of a traditional photographic image.

References

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Author Biography

David G. Foster is a Senior Principal Research Scientist at Eastman Kodak Company, where he has been employed for over 25 years. He has a B.S. in Chemistry from Rochester Institute of Technology and Ph.D. in Chemical Engineering from the University of Rochester. For the last 9 years he has worked in thermal media research and development. In 1999 he received the Distinguished Inventor Award at Kodak; he holds over 35 U.S. Patents and has authored numerous scientific publications and presentations. He is currently an Adjunct Professor in Chemical Engineering at the University of Rochester where he teaches courses in Fluid Dynamics and Transport Phenomena.