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Silver Halide Photographic Paper:

It still makes sense in the digital age

Executive Summary

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Executive Summary

Rapid advances in digital capture technology and the widespread availability of capture devices at every price point makes it important to understand the continued relevance of silver halide paper in digital photographic workflows. Kodak is taking a leadership role in the research and technology innovations that keep silver halide at the forefront of photographic printing for film and digital images.

The intent of this White Paper is to demonstrate why Color Negative (CNP) or silver halide photographic printing paper makes sense — and helps to position your lab as offering the highest quality output for the digital age.

KODAK PROFESSIONAL ENDURA Premier Paper provides the best imaging media for digital prints available to photographers today.

Listening to the Customer

Our philosophy of continuous improvement and listening to the customer is a part of who we are. Eastman Kodak Company, George Eastman built this company on that founding principle. Ongoing trade trials with selected customers ensure that experimental paper, enhancements or changes to our current silver halide offerings meet our customers' needs. We listen to customers about what they like, what works, what we can improve and we pay careful attention to your ideas and recommendations.

The Importance of Making Prints

Why make prints when we have computers, tablets and smartphones? There are two compelling reasons we make prints of the best images in our digital collections. First, because sharing a tangible print with friends and family creates a durable bond through instant and shared communication.

Second, a hard-copy print is the best way to ensure that important images and prints are accessible well into the future. Digital files can be shared and copied easily, but if a flaw develops in the file, or to the drive on which it is stored, or perhaps the formats become obsolete, the image is gone forever. Heartbreaking.

Printing is Alive and Well!

When digital capture swept through the photo industry and film usage declined, prints made from film declined as well. As prints from film were declining, prints from digital were growing and continue to grow today — and that growth is accelerating. Due in part to improvements in digital camera technology for tablets and smart phones, consumers are beginning to capture an increasing number of printable images. InfoTrends, in their January 2013 Consumer and Professional Imaging Analysis titled "Road Map 2013: Photo Printing Trends", sees significant growth areas in printing. They cite trends driving this growth including significant growth in smartphone camera usage, growth in printing in emerging markets, especially the Asia-Pacific and

Latin American regions, and growth in on-line print orders. InfoTrends believes this growth "will shape the digital photo printing market for years to come." InfoTrends also continues to "...firmly believe that a photo print is still the best way to ensure that important photos will be easily accessible and viewable well into the future." This sentiment continues in "Road Map 2014", where InfoTrends expects to see the percentage of images printed from smartphones and tablets continue to grow. They believe that the best way to save the most important photos and ensure that they will be easily accessible in the future is by printing them, and says, "Photo prints will continue to be an important and very relevant segment of the digital imaging ecosystem." The InfoTrends "Road Map 2015" report again emphasizes the potential growth trends and the importance of printing by saying, "...[prints] are the best way to insure that important photos will be easily accessible and viewable years into the future and have an intrinsic, emotional value that electronic viewing does not.

Paper — A Specialty Product for Photographs

KODAK PROFESSIONAL ENDURA Premier Paper uses a specialty paper core, surrounded by a plastic, polyethylene resin coating on both sides of the paper. The resin makes the paper core essentially waterproof, blocking any absorption of processing chemicals from the top or bottom of the sheet. The process uses significantly less water or even no water at all, compared to early non-resin coated papers. The less water used the better for the environment.

The backside resin contains an anti-static layer to reduce static buildup and discharge from the plastic. This layer also provides "tooth" for writeability both for back printing to record information during printing, and for information written by the end user.

The resin layer above the paper core includes titanium dioxide and optical brighteners, to optimize the package for whiteness and provide a light, bright D-min. It also provides enhanced image sharpness. This white resin layer acts as a reflector to bounce the light back through the imaging dyes, effectively providing greater impact from the dyes resulting in better color saturation and color reproduction.

Emulsions and Dispersions

The "emulsion package" of KODAK PROFESSIONAL ENDURA Premier Paper consists of seven layers stacked on top of each other. This is not new but has stood the test of time for silver halide printing. The three main red, green and blue layers contain light-sensitive emulsions along with corresponding dispersions containing the dye-forming couplers. The entire seven-layer package is thinner than a human hair. The emulsion package is embedded in gelatin, providing overall durability and protection for the imaging layers from chemical degradation (due to atmospheric pollution) and physical abuse. The gelatin also holds dye molecules in place to prevent wandering or "bleeding," which can occur with other digital printing technologies in high humidity environments, for example certain inkjet systems.

Image Quality & Permanence

A key feature in silver halide papers is its “smooth continuous tone”. This makes silver halide technology the gold standard for professional portraiture and for the commercial print market.

Flesh Tone Reproduction

Two key attributes in image quality in the Portrait market are flesh tone reproduction and the flesh tone-to-neutral relationship. Flesh-to-neutral defines the relationship between flesh tone and the neutrality of highlights, midtones and shadows. The correct tone scale positioning of the red, green, and blue layers to support the proper flesh-to-neutral relationship is critical.

Highlight and Shadow Detail

Details in both highlights and shadows are also critical for professional photographers. The output medium must have the necessary dynamic range to reproduce these details. The special curve shape of KODAK PROFESSIONAL ENDURA Premier Paper provides a softer, lower contrast lower scale to preserve highlight details combined with a higher contrast upper scale and maximum density (D-max) to provide the digital printer with the ability to reproduce subtle details in the shadow areas.

Color Reproduction

New KODAK PROFESSIONAL ENDURA Premier Paper delivers a 5% increase in color gamut. Accurate color reproduction combined with a large color gamut (provided by the higher upper scale), allows a full range of both subtle color reproduction for the Portrait market and accurate production of the saturated colors typical in the Commercial print market.

Illuminant Insensitivity

Colorants used in digital printing technologies impact viewer sensitivity to various light sources, for example, daylight, tungsten, or fluorescent. A print may have excellent color reproduction and flesh tone characteristics under daylight illumination, but look different when viewed under indoor tungsten or fluorescent illumination. The dyes used in KODAK PROFESSIONAL ENDURA Premier Paper meet the needs of high color saturation and excellent color and flesh reproduction while at the same time having minimal sensitivity to viewing illumination variations.

Image Permanence — Image Quality Today AND Tomorrow

KODAK PROFESSIONAL ENDURA Paper technology doubles the dark stability performance of its next best competitor. “Dark” stability is the stability, or resistance to change, due to all environmental factors

except light, and includes heat, ozone, and humidity. Dark stability is critical because, over the long term, more than 90% of all professional and consumer prints are stored in the dark. ENDURA Premier Paper will last over 100 years before a noticeable change occurs. Design parameters also include sizing of the paper core to prevent yellowing with time and resin formulations with stabilizers to prevent crazing and cracking. Kodak uses special resin stabilizers in the ENDURA Papers to provide stability to equal or exceed that of the image dyes.

For Labs: Easy to Use

Manufacturing and Production

KODAK PROFESSIONAL ENDURA Premier Paper manufacturing technologies enable the coating of extremely thin layers of light sensitive and color forming chemicals. These thin layers of chemicals are coated at very high speeds and have no intermixing whatsoever. This maintains their separate, distinct position in the emulsion/dispersion package critical to the performance of the paper. The process is tightly controlled, providing extremely long runs of product with uniform sensitometry.

Kodak finely tuned manufacturing processes are also flexible enough to allow for variety so that we can provide for regional preferences and requirements in markets around the world without sacrificing productivity or the highest levels of quality and consistency they've come to expect.

“Wet” Chemistry

ENDURA Premier Paper was designed as part of a complete system, (that includes improved RA-4 process chemicals) to convert latent images to long lasting prints and a chemical recovery infrastructure to help reduce the environmental impact of wet chemistry processing.

The developer for Process RA-4 has a very low replenishment rate, as low as 11 ml/ft². In high volume applications this already low effluent is significantly reduced by the use of developer regeneration. Regeneration options allow a near 100% recycling of the developer effluent back into the process.

The bleach-fix has an extremely low replenishment rate of 5 ml/ft² as well. The wash rate for ENDURA Premier Paper can be as low as 200 ml/ft², and the water wash for these high volume processors is staged with counter-current flow, which effectively concentrates the chemical effluents (bleach-fix components and silver) into the first wash tank. In a counter-current flow scheme, only the overflow from this first wash is discharged.

In low- volume applications, such as minilabs in retail environments, the environmental impact is also low due to the low throughput volume. Much of the efficiency comes from the design of the minilab processor. The developer and bleach-fix replenishment rates are as low as above, making the effluent volume low enough that it can be collected and treated remotely. In minilab operations, a washless option can replace a fresh water wash, further reducing effluent volume.

Exposure

Digital printers have very short exposure times. ENDURA Premier Paper uses emulsion technologies that respond to very short, high-intensity exposure — improving reciprocity performance. Silver halide emulsions in 2014 are sensitive at both a 100-nanosecond exposure of a high-intensity laser printer and a 100-second optical exposure of an analog enlarger.

Spectral Sensitivity

Shifting spectral sensitization to be on peak with the very narrow bandwidth laser light is an important change from strictly analog paper.

Optimizing the speed of each emulsion layer to be more in tune with the power output capabilities of the red, green and blue lasers was another. Absorber dyes in the paper achieve the proper speed balance.

Isn't Silver Expensive?

Silver is a precious metal. The price of metallic silver fluctuates in the commodities markets. This has minimal impact on its use as a light-sensitive component in photographic paper — primarily because for every dollar of the value of silver in the paper purchased by the lab, between 90 and 95 cents is recovered. Silver halide crystals are converted to metallic silver as part of the RA-4 process, which is removed during the bleach/fix steps. Labs typically send the recovered silver to a refiner for processing. The refiner sends a check to the lab for the value of the silver, less a refining charge, and the refiner puts the silver back into the market where it can be used again.

The Bottom line

While the fundamentals of this technology are over 125 years old, our current offerings leverage over a century of continuous improvement. These investments have brought us to the current state — and with these continued efforts, the best technology in digital printing just keeps getting better!

Continuous tone or silver halide images are still the standard against which all other imaging technologies are measured. Productivity in the printing, processing and finishing of CNP also make it one of the most economical ways to put images onto a substrate. The proven performance of silver halide in print life, image quality and protection from obsolescence of digital files, continue to keep it in the forefront of the photo imaging market, while leveraging the significant capital investments made by our customers in printing equipment. So it's no surprise that by 2018, silver halide is still projected to be the most popular way to put images on media; exceeding the volume of prints produced by all other technologies combined — electrophotographic, inkjet, and dye sub/thermal.

Considering the four primary performance vectors for Color Negative Paper — image quality, cost, longevity and speed or productivity — KODAK PROFESSIONAL ENDURA Papers excel. It doesn't have to be a choice between image quality or cost, longevity or speed/productivity. KODAK PROFESSIONAL ENDURA Papers are without compromise — the one to beat. We provide the widest range of applications and usability that covers an expansive set of lab and end-user needs, from 4x6 prints, to large format display images up to 72 inches wide, and now to double-sided photo books, the photo album of the 21st century.

If photographic paper were introduced today, it would be heralded as the highest quality, infinite resolution, lowest cost, and fastest, most productive way to print an image. It would be “an overnight success” in digital imaging that's been over a hundred years in the making. We owe it to our customers, and to their customers, to fully embrace the wonder that is the photographic print. There's only one original and this one looks better than the day it was born and launched.

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