



# **DOING INKJET RIGHT**

The Importance  
of Inks and Primers





## Introduction:

# Kodak and Inkjet

Kodak has decades of experience with inkjet printing systems, going back to some of the earliest inkjet printheads used in production print applications<sup>1</sup>. Kodak leverages its expertise in creating the inkjet inks and primers in a wide range of black & white and color imprinting heads and full-width printing systems, including offerings in its KODAK Stream and ULTRASTREAM Inkjet Technology product lines. Kodak's deep understanding of the colorants, humectants, and other components that are used in KODACHROME and KODAK EKTACOLOR Inks and KODAK OPTIMAX Primers gives Kodak's Continuous Inkjet Printing Systems a significant competitive advantage.

We will start with a look at some factors associated with inkjet inks and primers manufacturing and proceed to how these can be addressed through innovative design and manufacturing standards for inkjet inks and optimizer fluids.

<sup>1</sup> Kodak's first inkjet introduction to the commercial market came in 1967. It was a 5.12"-wide continuous binary array inkjet printhead. A 10.65"-wide printhead followed in 1972.

## FACTORS FOR INKJET INKS AND PRIMERS MANUFACTURING

Any inkjet system vendor intent on making a compelling case for their product must take into account basic factors in inkjet ink and fluid manufacturing:

- **Cost:** Printing is a competitive marketplace. Dominant print technologies like offset lithography, flexography, and gravure have solidified their places in the market through high productivity and low running cost. This is the high bar that digital print technologies must surpass to dethrone the incumbents.
- **Supply chain simplicity:** Easy accessibility to the materials that comprise inkjet inks and related fluids is a key to simplifying the manufacturing process and assuring that end users will have the necessary consumables when they need them.
- **Ease of use:** Innovative printing systems take the complexity out of the hands of users, removing the possibility of human errors that lead to wasted materials.
- **Substrate independence:** Printing occurs on all types of materials, not just paper. Crafting inks and fluids that make it possible to print on paper, board, packaging materials, films, plastics, wood, metal, and glass is a significant technological challenge.
- **Sustainability:** The ability to print effectively on many substrates is a noble goal but if it requires the use of dangerous chemicals or risks operator health, then it cannot be considered. Ecological concerns and operator safety must reign supreme.

Balancing these factors is a difficult task, and one that requires a versatile toolbelt of skills to succeed.

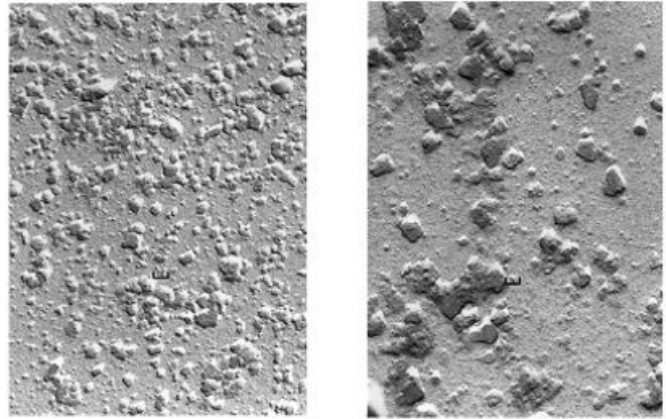


Figure 1: Kodak's micro-milled pigments (left); conventionally milled pigments (right)

## NANO-PARTICULATE INK MANUFACTURING

Kodak has designed its water-based (i.e. aqueous) KODACHROME and EKTACOLOR Inks for its inkjet systems with high levels of quality and sophistication. One key aspect of Kodak's inkjet strategy is that the inks should be as uncomplicated as possible to keep ink costs economical. This starts with carefully selected cyan, magenta, yellow and black pigments which are finely milled to produce very narrow particle size distributions with pigment particles that are typically less than 50 nanometers (a nanometer is one billionth of a meter). Competitive milling methods cannot approach these levels.

These finer pigments result in very thin dried ink layers, less scattering of light, richer and purer colors, and a superior color gamut without sacrificing image permanence. On top of that, due to the high color strength of these nanoparticulate dispersions, lower concentrations of these high-quality pigments are required to produce outstanding results, which drives down running cost.

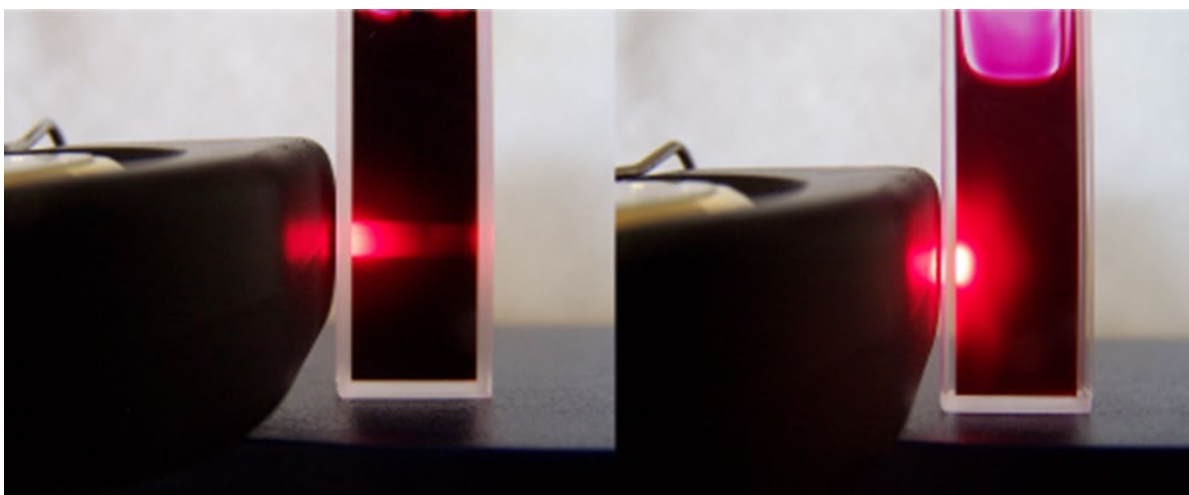


Figure 2: Light shined through finely milled KODAK Pigment Inks (left) is not scattered in the same way that it does with competitive inks that comprise much larger pigment particles

An important factor in inkjet ink formulations is the use of humectants, which are chemical components that help prevent ink from drying prematurely in printhead nozzles. Humectants are a bit of a blessing and a curse. While they prevent nozzle clogs, they also make it harder for the ink to dry when it finally reaches the substrate. As a result, it makes sense to use as little humectant as possible. Here Kodak's continuous inkjet technology both Stream and ULTRASTREAM, has a unique advantage because, as its name suggests, the ink flows continuously through the printhead nozzles. This requires lower levels of humectants in the ink because the ink is not sitting motionless in the printheads. Competitive systems using drop-on-demand inkjet technology must include higher levels of humectant in their ink since these printheads fire only as needed, which means inks spend more time in the nozzles, increasing the risk of clogging. While humectants help keep printheads wet and unclogged, there is a downside when it comes to drying, especially on non-absorbent substrates. Using less humectant in an ink formulation helps for two reasons: (1) drying is simplified; and (2) the ink

is less expensive. Kodak's continuous inkjet systems with KODACHROME and EKTACOLOR Inks benefit competitively on both of these counts.

Not all inkjet inks use pigments. Aqueous inkjet inks can also be made with dyes instead of pigments. Pigment inks generally produce a larger color gamut than dye inks. Pigment inks are also more durable. Yet with these advantages comes a somewhat increased cost. Users who opt for dye inkjet inks tend to be the most cost-conscious and least quality-driven users. The most appealing applications for dye inks are those with a relatively short shelf life, low coverage, and limited graphics or color. Printers that focus on transactional documents like bills and statements are the most frequent users of dye inks. Some high-volume, yet low coverage direct mail or publishing applications also fit that mold. Imprinting systems for addressing or coding often use dye-based inks, but pigment-based inks may also be available which is the case with EKTACOLOR Inks. Full-width inkjet system users also frequently have a choice of pigment or a dye-based inks.<sup>2</sup>

<sup>2</sup> Kodak offers dye-based inks for its KODAK VERSAMARK Printing System products and KODAK PROSPER Imprinting System products.

**“ One key aspect of Kodak’s inkjet strategy is that the inks should be as uncomplicated as possible to keep ink costs low.**

## **KODAK OPTIMAX PRIMERS**

Inkjet inks are important, but they are only one piece of the puzzle. Kodak’s inkjet systems also benefit from water-based ink-receptive OPTIMAX Primers that are optimized for the water-based pigment inks. These printable primers enable substrate-independent print quality at high speed. Kodak has developed a range of OPTIMAX Primers for print applications on newsprint, uncoated papers, matte and glossy coated papers, and other substrates, such as films. Newly developed OPTIMAX Primers broaden the range of possibilities and include ones for uncoated and coated corrugated and folding carton packaging applications as well as a film primer for impermeable substrates like plastic films, metallized surfaces, glass, and pre-printed flexographic or gravure packages. Kodak OPTIMAX Primers provide more than a standard primer. In addition to creating an adhesive layer so that the substrate accepts the ink, OPTIMAX Primers also immobilize the pigment, allowing high-speed wet-on-wet printing with no interstation drying. High quality at high speed is a hallmark of the KODAK Stream and ULTRASTREAM Continuous Inkjet Technology systems. The ability to print on non-paper substrates and films is significant because it creates digital printing opportunities for applications like flexible packaging and labels. These water-based coatings are extremely thin – typically less than 500 nanometers – which makes them very cost-effective.

## **PRIME, PRINT, PROTECT**

Inkjet printing system vendors have adopted a range of strategies to allow printing across many substrates. It is, of course, possible to create inks that will stick to any surface, but the creation of such an extremely adaptable ink has its drawbacks, most specifically when it comes to cost. Much of the underlying technology of inkjet printing systems is built into the ink itself. In doing so, much of the cost of inkjet printing also resides in the ink. An all-purpose ink has the significant drawback of becoming increasingly expensive as coverage levels go up. This may not

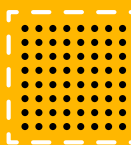
matter so much for low-coverage text documents, but consider that many commercial and industrial print applications require photos, flat color fields, and graphics that push up ink usage levels through high coverage. This has huge implications for cost.

Instead of trying to do everything with the ink, another strategy is to supplement the capabilities of the ink with pre- and/or post-treatments to the surface of the substrates, be they commercial offset papers, folding cartons, corrugated boards, or plastic films. This is the strategy that Kodak has followed in pursuit of the highest quality levels at cost-competitive running costs. Kodak’s strategy of using water-based KODACHROME and EKTACOLOR Inks and OPTIMAX Primers is built on a patented strategy of “prime, print, and protect” to produce outstanding print quality at high speed, independent of the substrate.



### **Prime:**

A thin ink-receptive OPTIMAX Primer is applied to the substrate to prepare its surface for effective printing.



### **Print:**

Continuous inkjet (CIJ) printing and drying takes place at high speed with wide gamut KODACHROME and EKTACOLOR Inks and low levels of humectants for low-cost printing with excellent results.



### **Protect:**

A post-coat with either an adhesive lamination or varnish can be added as needed to optimize gloss and to shield the print surface from damage.

At a system level, this combination of continuous inkjet printheads, water-based KODACHROME and EKTACOLOR Inks with low levels of humectants, nanoparticle pigments, and substrate-optimized surface treatments enable low cost, high quality, and high-speed printing on a wide variety of substrates.

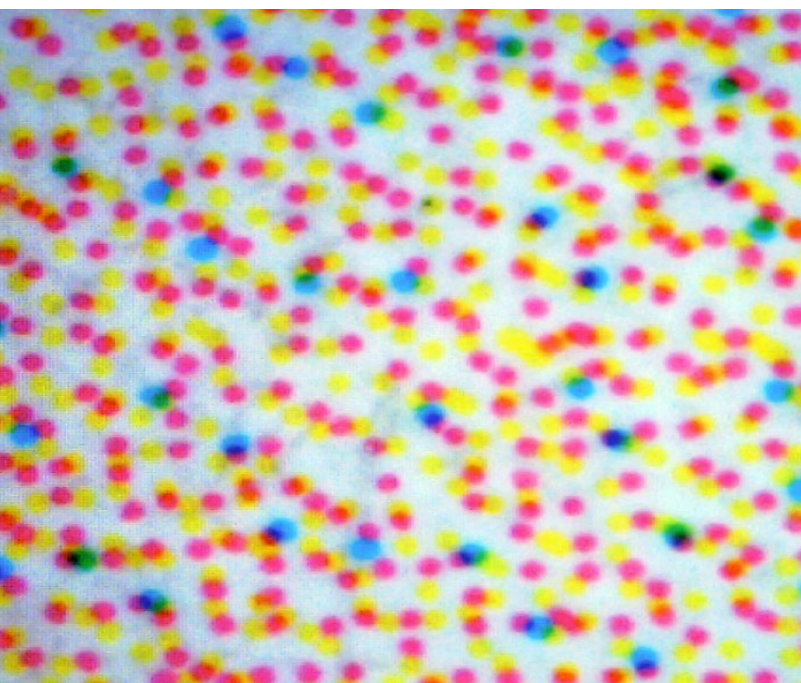


Figure 3: Microscopic view of droplets placed by KODAK Stream Inkjet Technology Printheads (left) compared to a competitive inkjet method (right)

## THE KODAK ADVANTAGE

Managing the fundamental interactions between ink and substrate through a tightly controlled process is the key to success for all inkjet printing. In this scenario, the printheads, inks, and fluids all work together to achieve high-quality results on a wide range of substrates. To orchestrate this symphony of partners, it helps when you can control all aspects from printhead to ink to fluids. Kodak's advantage is that the design and manufacture of heads, KODACHROME and EKTACOLOR Inks, and customized OPTIMAX Primers are all overseen by one source, greatly facilitating the management of ink/substrate interactions. This fact is central to the ability of KODAK Continuous Inkjet Systems to create high quality output on a wide range of papers, films, plastics, and other substrates. These systems combine the flexibility of digital print with the productivity and quality levels of analog processes like offset lithography, gravure, and flexography.

Kodak's inkjet expertise also shines in competition with other inkjet systems. Continuous inkjet (CIJ) systems not only benefit from finely milled pigments and low levels of humectants, but they also produce sharp and precisely placed dots. In combination with Kodak's color management and screening tools these are key factors in producing outstanding results.

Nanoparticle pigments, accurate dot placement, and optimized substrates contribute to high levels of quality that compare favorably to commercial offset. To quantify that, Kodak compared the CMYK color gamut of its ULTRASTREAM Printing System to two industry offset lithography standards: SWOP (Specification for Web Offset Publications) and GRACoL (General Requirements for Applications in Commercial Offset Lithography). For this test, a KODAK PROSPER ULTRA 520 Press printed on VERSO TRUEJET Glossy paper with water-based, pigment KODACHROME Inks and post coating, plus a standard PROSPER ULTRA 520 drying system at 500 feet-per-minute speed.

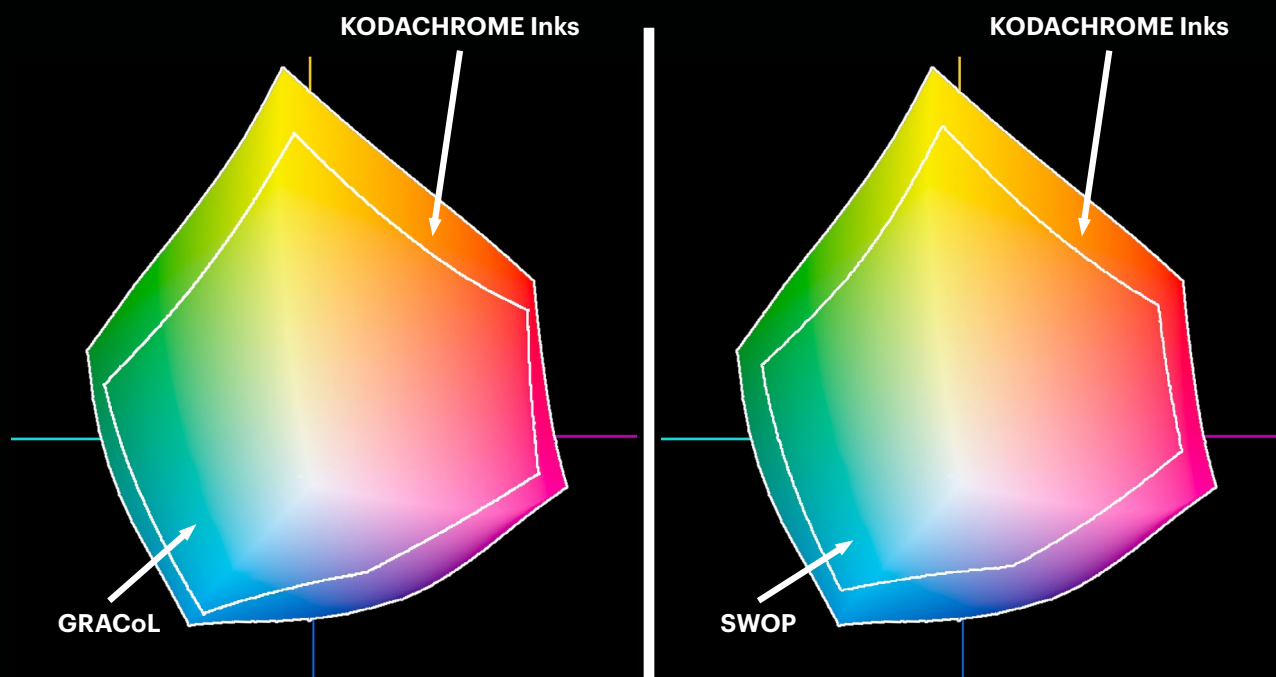


Figure 4: The CMYK color gamut of KODAK ULTRASTREAM Technology compared to GRACoL (left) and SWOP (right) inkjet method (right)

The results show that the KODACHROME Inks of the PROSPER ULTRA 520 Press produce a color gamut that is significantly larger than both of those offset lithography industry standards. In the case of SWOP, which focuses on web offset, the PROSPER ULTRA 520 Press produces a color gamut that is 95% larger. For GRACoL, which focuses on sheet-fed offset and Fogra, which is an international print standard, the PROSPER ULTRA 520 Press's color gamut is 1.4 times larger.

Kodak's years of experience in colorant chemistry, pigment milling, ink/paper interaction, and inkjet printhead production are at the core of the Stream and ULTRASTREAM Technology inkjet systems. KODACHROME and EKTACOLOR Inks are unsung heroes in this success, and deserve greater credit for these systems' high quality, low running cost, and superior productivity.

**“Kodak's deep understanding of the colorants, humectants, and other components that are used in EKTACOLOR Inks and OPTIMAX Primers gives my company a competitive advantage. With Kodak's water-based inks we get high quality, low running cost, and superior productivity.”**

Ed Zumbiel, President, Zumbiel Digital, USA

# Kodak's strategy of using water-based inks and optimizers is built on a patented strategy of "prime, print, and protect"

## CHALLENGES, SOLUTIONS, AND BENEFITS

Technology Challenges	Kodak Solutions	Customer Benefits
Matching the effectiveness of oil-based offset lithographic inks	Water-based KODACHROME and EKTACOLOR Inks	<ul style="list-style-type: none"><li>• Environmentally friendly</li><li>• Keeps ink costs economical</li><li>• Superior quality</li></ul>
Effective and economic use of ink pigments	Micromedia milling	<ul style="list-style-type: none"><li>• Wide color gamut</li><li>• Cost-effective use of pigment</li><li>• Contributes to longer printhead life</li></ul>
Printhead clogging	Limit the use of humectants	<ul style="list-style-type: none"><li>• Simplifies drying</li><li>• Lowers production cost</li></ul>
Printing on a wide range of substrates	OPTIMAX Primers	<ul style="list-style-type: none"><li>• Flexibility to print on paper, film, plastic, and other substrates</li><li>• Substrate-independent print quality</li></ul>
Image stability	Post-coating	<ul style="list-style-type: none"><li>• Protects the image and paper surface</li><li>• Can also be used to impact the finish (gloss or matte)</li></ul>

## GLOSSARY OF TERMS

**Continuous Inkjet (CIJ):** Printhead technology used by Kodak and other manufacturers of industrial inkjet printing systems

**Fogra:** German-based Research Institute for the graphic arts that maintains several ISO color standards for the print industry

**GRACoL** (General Requirements for Applications in Commercial Offset Lithography): An offset lithography industry printing quality standard for sheet-fed offset

**Humectants:** A chemical component in inkjet inks that helps prevent ink drying and clogging of printhead nozzles

**KODACHROME Inks:** Kodak micromedia-milled, water-based, pigment inks for use in ULTRASTREAM Technology

**KODAK EKTACOLOR Inks:** Kodak's patented microedia-milled, water-based pigment and dye-based inks created for Kodak Stream Technology solutions

**KODAK OPTIMAX Primer:** Kodak-developed precoat / priming solutions that are designed to facilitate the ink/paper interaction by instantly immobilizing the pigment and adhering it to the paper at extremely high speeds

**KODAK ULTRASTREAM Technology:** Electrostatic-deflection CIJ printhead technology used in the PROSPER ULTRA 520 Press

**Micromedia Milling:** Kodak proprietary technique of grinding pigment particles to less than 50 nanometers and very narrow particle size distributions

**Stream:** Air-deflection CIJ printhead technology used in the KODAK PROSPER 1000, 6000 series, and 7000 Turbo Presses

**SWOP** (Specification for Web Offset Publications): An offset lithography industry printing quality standard for web offset

[KODAK.COM/GO/INK](https://www.kodak.com/go/ink)

