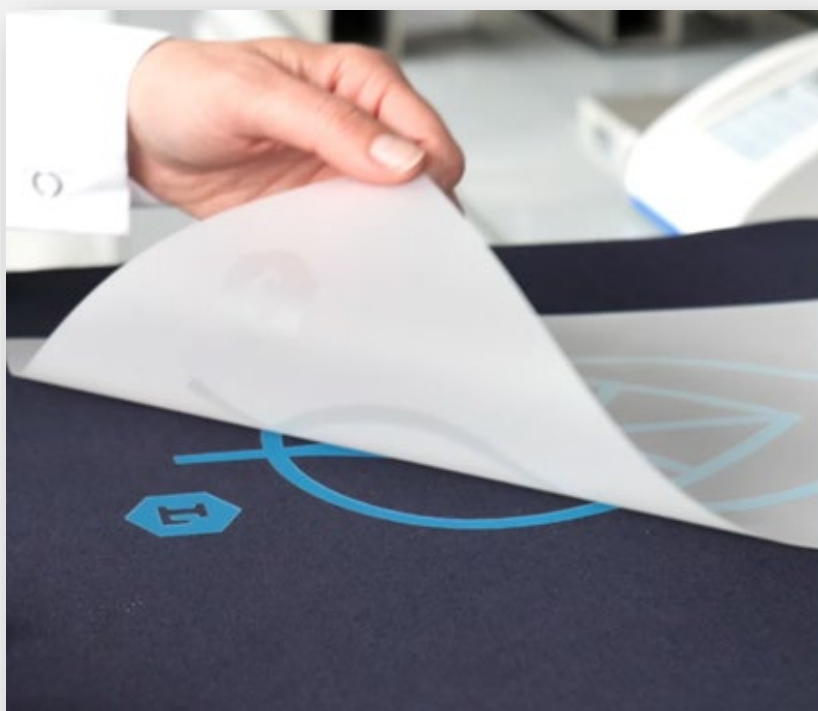


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Lab News



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Textile Inkjet Printing: An Inevitable Revolution

Textile Inkjet printing is an increasingly consolidated reality and the clear trend in the textile printing market. This year, shaped by the geopolitical situation in the Middle East, Inkjet printing has become an imperative necessity, offering the simplest and fastest solution to reduce energy consumption and operational costs.

For this reason, the first 2026 edition of our technical bulletin is dedicated to our latest developments in pre-treatments and ink ingredients.



Reactive Inkjet Printing: The Alchemy of Precision

(M. Gallucci)

Reactive inkjet printing on cotton represents the gold standard for high-quality digital textile production, combining exceptional color brilliance, outstanding wash fastness, and high softness. Understanding its underlying mechanism and process parameters is essential for achieving optimal print quality and process efficiency.

1. Mechanism: The Chemistry of Reactive Dyes

Unlike pigments, which adhere mechanically to the fabric surface via a binder, **reactive dyes form a covalent bond** with the hydroxyl groups (-OH) of the cellulose molecule in cotton.



Under alkaline conditions and thermal activation, this chemical reaction permanently integrates the colorant into the polymer matrix of the fiber.

The result is a print with an extremely soft hand-feel and exceptional resistance to wet washing and rubbing.

2. Process Workflow

Achieving a fully fixed reactive print on cotton requires a strict 4-step sequence:

1. **Pre-Treatment (Paddings/Coatings):** Impregnating the fabric with necessary auxiliary chemicals before printing.
2. **Inkjet Printing:** Applying low-viscosity reactive dye inks via Drop-on-Demand (DoD) piezo printheads.
3. **Steaming (Fixation):** Exposing the printed fabric to saturated steam (100 °C to 102 °C for 8–12 minutes) to swell the cotton fiber and trigger the covalent bonding reaction.
4. **Washing & Drying:** Rinsing off unfixed dye, hydrolysed dye molecules, and residual pre-treatment chemicals to ensure maximum fastness and brilliant color contrast.

Stage 1: Cold Rinse	Stage 2: Hot Wash	Stage 3: Final Rinse
Removes the coarsest surface residues.	Near-boiling operation with surfactants. Removes unreacted (hydrolysed) dye and pre-treatment chemicals.	The water runs clear. The remaining colour is entirely fused.
		
 Cold water removes loose dirt, oils, salts and other surface impurities.	 Surfactants and heat lift and remove unreacted dye molecules and pre-treatment chemicals.	 Clear water ensures that only the fully fixed colour remains on the fabric.

3. The Critical Role of Pre-Treatment

Because inkjet inks have a water-like viscosity, printing directly onto untreated cotton causes severe **ink bleeding, poor color yield, and dull definition**. Pre-treatment acts as a functional chemical matrix that controls droplet spreading, thickens the ink upon contact, and provides the alkaline medium required for fixation.

A standard pre-treatment formulation consists of four main ingredients:

- **Alkali (e.g., Sodium Carbonate/Bicarbonate):** Raises the pH to enable dye-fiber reaction.
- **Thickener (e.g., Sodium Alginate or Synthetics):** Controls ink migration and droplet sharpness.
- **Urea (Hygroscopic Agent):** Retains moisture during steaming to facilitate dye diffusion into the fiber.
- **Mild Oxidizing Agent:** Prevents chemical reduction of the dye during steam fixation.

4. The Role of the Thickener in Reactive Inkjet Pre-Treatment

In reactive inkjet printing on cotton, the **thickener** acts as the primary **rheology modifier and migration control agent**. Because digital inks have an extremely low, water-like viscosity, applying them directly to untreated woven or knitted cotton leads to immediate capillary wicking—causing severe bleeding, blurred edges, and poor color depth.

The thickener resolves this through **three critical functions**:

- **Ink Migration Control (Sharpness):** It instantly increases viscosity upon droplet contact, "freezing" the ink in place to prevent lateral bleeding and ensure sharp detail.



- **Color Yield Optimization:** It traps dye molecules on the fabric surface rather than letting them sink deep into the core, delivering maximum color depth with less ink.
- **Reversible Reaction Matrix:** During steaming, it swells to allow dye-fiber covalent bonding; during washing, it dissolves completely, restoring the cotton's natural soft hand-feel.

Thickener Type	Print Definition	Wash-Off Ease	Cost	Application Notes
Sodium Alginate	Good / High	Very Good	Medium-High	Industrial Standard, Raw-material variability
Modified Guar Gum	Good / High	Very Good	Medium-Low	Popular cost-effective alternative or blend component
Cellulose Derivatives (CMC/HEC)	Fair / Good	Moderate (stiffening risk)	Medium	Can compete with cotton by reacting with the dye
Synthetic Polyacrylates	Very High	Formula-dependent	Variable	Requires extremely thorough washing to avoid fabric stiffness

Fluicool PK/R: Pure Natural, Synthetic-Grade Performance

(M. Gallucci)

As the textile printing market demands higher sustainability without compromising on technical quality, **FLUICOL PK/R** emerges as a game-changing solution for reactive pre-treatment formulations. Derived from a **sustainable natural polymer**, FLUICOL PK/R bridges the gap between bio-based chemistry and high-end synthetic performance.

1. *Features & Technical Advantages*

- **Bio-Based Origin:** Formulated from renewable natural polymers to support eco-conscious and environmentally responsible textile production.
- **Advanced Migration Control:** Provides exceptional dye-migration inhibition, ensuring sharp image contours, high line definition, and maximum visual color yield.
- **Outperforms Market Standards:** Rigorously tested to surpass traditional HEC (Hydroxyethyl Cellulose) and synthetic acrylic-based chemical alternatives.
- **High Efficiency at Low Dosage:** Delivers outstanding color performance and rheological stability at remarkably low application levels (**only 7.0 - 8.0 g/L**).
- **Optimized Cost-to-Performance Ratio:** Combines ultra-low consumption with premium quality, maximizing production efficiency and overall cost savings.

	Liquor 1 (g/L)	Liquor 2 (g/L)	Liquor 3 (g/L)
Water	803	795	710
Defomex SE/47 (defoamers)	5	5	5
FLUICOL PK/R	7	-	-
HEC	-	15	-
Fluicoll LQ (synthetic at 25 %)	-	-	100
Redox L2P	15	15	15
Urea	135	135	135
Sodium Bicarbonate	35	35	35

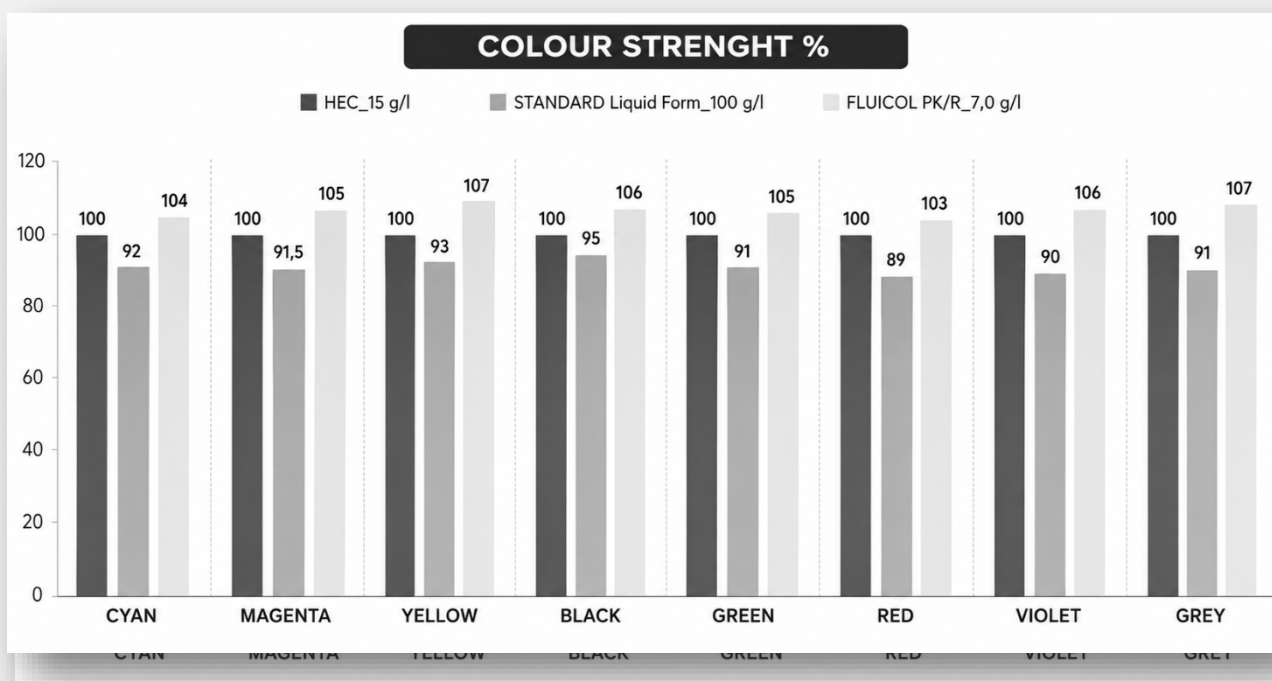
The pre-treatment trials (foulard impregnation and drying at 110°C) followed by inkjet printing were carried out on cotton poplin item whose wet-pickup value was 63 %.

2. Application process

- **Inkjet Printing:** Epson 4880 printer / Lamjet KR inks
- **Print Resolution:** 1440x720 dpi
- **Drying:** 85°C
- **Steaming:** 102°C for 10 minutes
- **Process Washing:** Including soaping with Lamegal DSP (anti-redepositing agent)

	Cyan	Magenta	Yellow	Black	Green	Red	Violet	Grey
Liquor 2 with 15 g/L HEC	100	100	100	100	100	100	100	100
Liquor 3 with 100 g/L Fluicoll LQ	92	91,5	93	95	91	89	90	91
Liquor 1 with 7 g/L Fluicoll PK/R	104	105	107	106	105	103	106	107

Color Yield Results from Spectrophotometer Measurements



Compared to standard HEC, using 50% less FLUICOLL PK/R yields higher color strength with minimal impact on the hand-feel and better washability. Furthermore, as a 100% natural product, it enhances process sustainability by reducing overall chemical consumption.

Transforming Apparel Decoration: The Power of DTF Technology

(E. Delia)

Direct-to-Film (DTF) technology represents a major advancement in textile personalization. By enabling high-quality, durable prints across a wide range of substrates, it offers unmatched flexibility, efficiency, and strong growth potential for the digital printing market.

Having emerged around 2020 as a disruptive force in garment decoration, the DTF sector is now transitioning from a phase of explosive volume expansion toward intense commercial commoditization.

According to WTiN estimates, global DTF ink consumption will grow from 17,708 metric tons in 2021 to 67,315 metric tons by 2030. While China remains the market leader, massive growth is projected across the Asia-Pacific, European, and North American regions. This expansion directly drives an increase in binder consumption, which accounts for 10–15% of the formulation in CMYK inks and 25–30% in White inks.

Direct-to-Film (DTF) Technology: The Critical Role of Ink Binders

Direct-to-Film (DTF) technology has established itself as a transformative force in the digital textile printing landscape. Unlike Direct-to-Garment (DTG) printing, DTF utilizes a multi-step transfer process: pigment inks are printed onto a specialized PET film, then coated with a hot-melt adhesive powder, cured, and thermally transferred onto the target fabric.

This process eliminates the need for fabric pre-treatment, offering exceptional versatility across cotton, polyester, blends, leather, synthetic materials and hard-to-print substrates.

While the hot-melt powder provides the primary adhesion to the fabric, **the binder within the digital ink formulation is the true cornerstone of print durability and image quality.**

As a core functional polymer (typically **Polyurethane Dispersions (PUD)**, valued for superior stretch, softness, and high elasticity), the binder fulfils several technical functions:

- **Film Formation:** Creates a continuous, solid layer holding the micronized pigment particles together on the PET film once the liquid carrier evaporates.
- **Pigment Suspension:** Keeps color and white titanium dioxide particles suspended inside the fluid ink to prevent printer nozzle clogs.
- **Adhesion:** Melts and fuses with the hot-melt adhesive powder during the heat-pressing stage to grab tightly onto various substrates.
- **Elasticity and Flexibility:** Provides stretchability so the printed design moves and flexes with the fabric without cracking.
- **Wash Durability:** Protects the color pigments from water, friction, and detergent breakdown, allowing garments to endure heavy washing cycles.

The binder content varies significantly depending on the ink color profile:

Ink Type	Binder Content	Primary Technical Requirement
CMYK Inks	10-15 %	Low viscosity, rapid film formation, and high color transparency
White Ink	25-30 %	High loading capacity for heavy TiO ₂ particles, opacity, and anti-cracking elasticity

Esajet D 30: The Next Generation Binder for DTF inks

(E. Delia)

In the rapidly growing Direct-to-Film (DTF) market, ink quality is the ultimate factor for success. ESAJET® D30 is a high-performance polyurethane binder specifically engineered for formulating both premium White and CMYK DTF inks.

Designed to overcome the industry's most critical technical bottlenecks, ESAJET® D30 provides ink manufacturers and formulators with an ideal balance of colloidal stability, opacity, low viscosity, and high washing fastness.

1. *Key Performance Benefits*

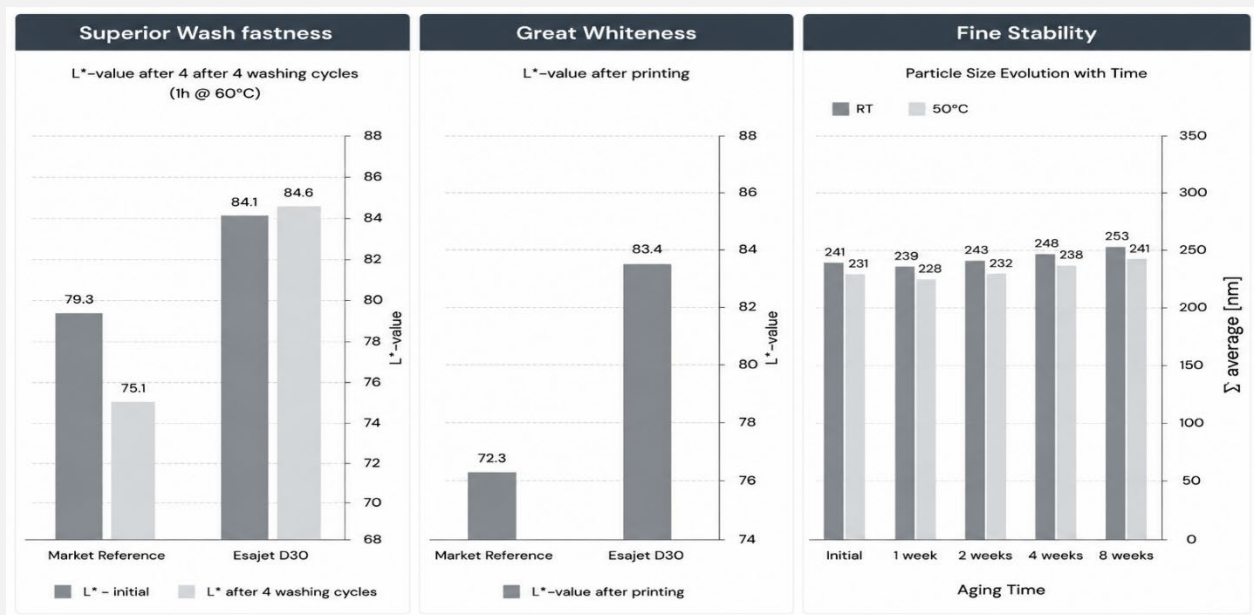
- ***Universal Compatibility:*** Highly compatible with a broad range of pigment dispersions, ESAJET® D30 offers a versatile, single-source binder solution for both CMYK and White ink formulations.
While competitors typically require two different products—one for CMYK and another for White inks—ESAJET® D30 performs exceptionally across both systems, simplifying formulation and inventory management.
- ***High-Opacity White with Low Viscosity:*** Enables exceptionally vibrant, high-coverage white prints on dark garments while maintaining low ink viscosity. This ensures consistent ink flow and prevents printhead nozzle clogging.
- ***Superior Wash Resistance:*** Delivers outstanding washing fastness and fabric elasticity. Printed garments maintain a soft hand-feel and resist cracking or fading, even after repeated laundry cycles.
- ***Enhanced Production Efficiency:*** Minimizes printer maintenance and downtime for end-users, significantly boosting overall customer satisfaction and operational reliability.

2. Performance Overview

*A comparative evaluation was conducted using a standard White ink formulation containing a **Kronos** pigment dispersion and **ESAJET® D30**, benchmarked against a leading market competitor binder.*

DTF White Ink Recipe	Weight (%)
Kronos 9900 Digital White	16%
ESAJET® D30 (35% Active Content)	26 %
Glycerine	10 %
Teg	8 %
Surfynol 465	1 %
Tegowet 260	0,30%
Bit	0,1%
Water	Up to 100%
Viscosity @ 25°C	3,68 cPs

The following charts provide a comprehensive overview of the performance and rheological behaviour of ESAJET® D30 under the tested conditions. Notably, in the tested formulation, the data demonstrate a clear improvement in whiteness (L^*) and washing fastness compared to the reference benchmark.



Furthermore, the results highlight excellent formulation stability paired with low viscosity—a critical parameter for ensuring jetting reliability in White DTF inks.

ESAJET® D30 stands out as a highly reliable and efficient binder solution for the next generation STF ink formulations, by combining long-term formulation stability with exceptional print durability.

ESAJET® D30 effectively meets the evolving demands of the industrial digital printing market.