

FIBEJET PIGMENT INKS FROM NIPPON KAYAKU

Yuji Suzuki and Masafumi Watanabe of Nippon Kayaku, believe that the combination of two technologies – inkjet printing and the use of advanced pigment inks – can deliver more sustainable textile printing in the future

Textile printing is a global business with end applications spanning apparel, home furnishings, technical textiles, flags and banners. Overall, the textile industry is under pressure to improve its environmental performance as it is estimated to consume 79 billion m³ of water per annum. The industry produces 10% of global greenhouse emissions – more than all international air travel and maritime. In recent years, Nippon Kayaku has actively been developing aqueous-pigment dispersions cultivated from its long history in textile dye stuff.

THE GROWTH OF INKJET PRINTING

Inkjet printing currently produces just over 10% of printed textiles by volume. Analogue printing, especially screen printing, produces the balance. Inkjet printing is poised to grow its percentage, underpinned by market drivers including:

- **Sustainability:** Inkjet can cost-effectively produce short-run print, allowing producers to manufacture small lots in line with end-consumer demand. This can reduce over-production of printed textiles. Printing materials consumption is also reduced due to the lack of screens or plates. Furthermore, inkjet only deposits where the design dictates
- **E-commerce:** This channel is growing with companies such as Spoonflower and Amazon producing inkjet-printed textiles on demand

- **Fast-fashion:** This industry depends on rapid changeover of designs, with each produced in limited amounts
- **Digitised workflows:** Inkjet, being a 'digital' technology, is well suited for automated textile-production workflows

PIGMENT VERSUS DYE-BASED INKS

Pigment inks offer some distinct advantages over dye-based inks for textile printing, such as:

- **Substrate versatility:** Pigment inks can be used on many different types of textile substrate (cotton, polyester, nylon, polyester/cotton blends, etc). In contrast, different types of dye-based ink are needed for these substrates
- **Water-free finishing:** Pigment prints can be finished using dry processing

Despite these advantages, pigment inks only account for around a tenth of the inkjet ink volume consumed in textile printing today. This is due to a combination of technical and commercial factors. Nippon Kayaku's high-performance aqueous FIBEJET pigment inks overcome many of the current technical limitations. FIBEJET inks have been specifically formulated to meet market needs in terms of processability, print performance, safety and environmental profile.

STABILITY AND REDISTRIBUTION

Inkjet printing is a sensitive process that requires inks to be chemically and physically stable for a given shelf life. The FIBEJET inks'



Masafumi Watanabe wearing t-shirt printed with Fibejet

“Nippon Kayaku’s high-performance aqueous FIBEJET pigment inks overcome many of the current technical limitations”

pigment stability at -15°C and 60°C, under prolonged testing, is shown in Figures 1 and 2. Figure 3 shows the long-term viscosity profile of the inks stored at 60°C. These data demonstrate that FIBEJET inks are stable and suitable for use in industrial-inkjet printing.

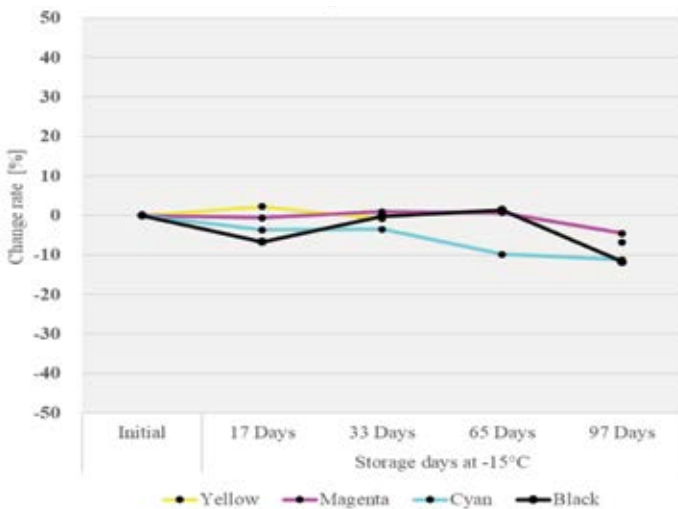


Figure 1: Average particle size (D50) variation from long-term ink storage stability tests at -15°C

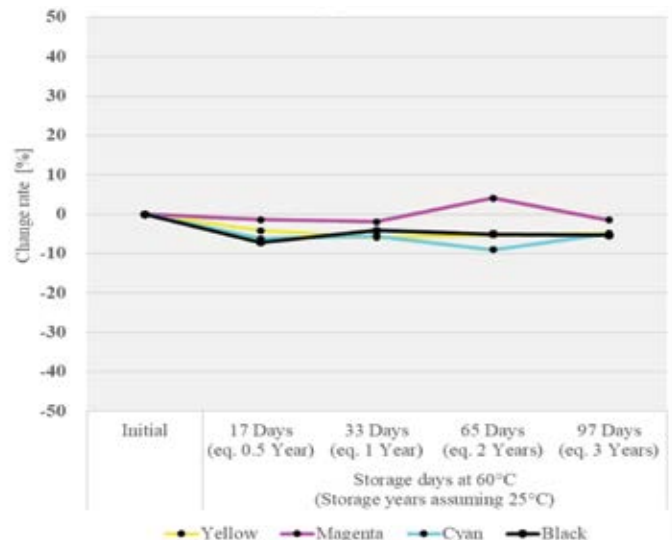


Figure 2: Average particle size (D50) variation from long-term ink storage stability tests at 60°C

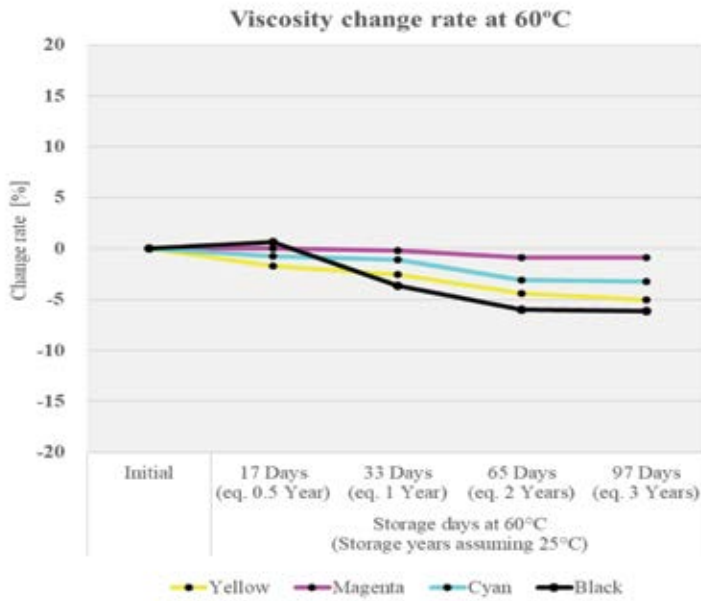


Figure 3: Variability in ink viscosity long term ink storage stability tests at 60°C

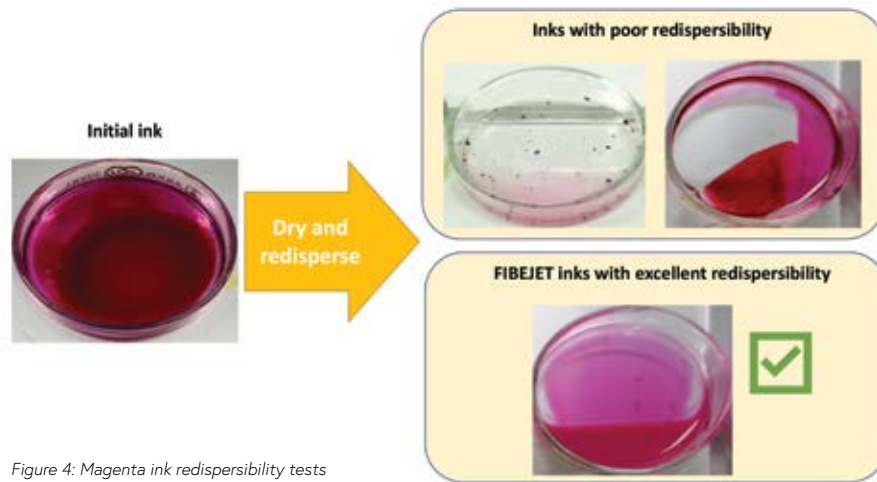


Figure 4: Magenta ink redispersibility tests

“These data demonstrate that FIBEJET inks are stable and suitable for use in industrial-inkjet printing”

PRINT PERFORMANCE

There are many print-performance requirements in textile printing. Key items such as colour and fastness are considered below.

FIBEJET pigment inks, printed onto pre-treated cotton, give the colorimetric data shown in Table 1. The colours and optical densities achieved, are aligned with industry requirements for pigment prints.

	OD	L*	a*	b*
Yellow	1.2	89.5	-2.6	85.2
Magenta	1.2	47.8	63.3	-2.5
Cyan	1.2	41.4	-7.8	-50.3
Black	1.3	29.3	0.8	0.6

Table 1: Colorimetric results of textile pigment inks

It is important that printed textiles have acceptable colour fastness to rubbing. Irrespective of whether a pigment print is produced using conventional analogue or

inkjet printing, it is common to overcoat the print. Table 2 shows the rub-fastness results of over-coated FIBEJET pigment prints on cotton (assessed using the grey-scale method). These inks meet the market’s required performance level.

	Yellow	Magenta	Cyan	Black
Dry	Class 5	Class 5	Class 5	Class 5
Wet	Class 4-5	Class 4-5	Class 4-5	Class 4-5

Test Protocol: ISO 105-X19:2020

Table 2: FIBEJET pigment ink rub fastness on cotton

Importantly, the handle of the fabric after printing with FIBEJET inks is acceptable for the clothing industry.

SUSTAINABILITY AND SAFETY

Aqueous inkjet inks can evaporate at the air/ink interface at the printhead nozzle causing viscosity increase and/or film formation, resulting in clogging and jetting failure. In extreme cases it may become impossible to recover the blocked nozzle, leading to replacement of the printhead. To avoid this it is necessary to use inks with excellent redispersibility.

Nippon Kayaku's aqueous FIBEJET pigment inks require no globally harmonised system (GHS) labelling and the inks have low/no odour. This allows printers to operate in a safe and comfortable working environment.

FIBEJET PIGMENT INK	
Health Toxicity	Unclassified
Acute Toxicity	Unclassified
Skin Corrosion & Skin Irritancy	Unclassified
Skin sensitization	Unclassified
Reproductive Toxicity	Unclassified
GHS Label	N/A

Table 3: Safety of FIBEJET pigment inks

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Inks with excellent redispersibility properties are designed in the early stages of all Nippon Kayaku's ink development. Pigment inkjet inks contain film-forming polymers that bind the colourant to the fabric. As a result, a balance of good redispersibility and pigment-binding properties is required. Nippon Kayaku has developed novel pigment dispersions and ink formulas which combine excellent redispersibility, as shown in Figure 4, with good rub fastness.



Kayaku spirit with Mr World

SUMMARY

The inkjet textile print sector is positioned for significant growth over the coming decade. By overcoming technical issues and delivering sustainability benefits, pigment inks will increase their market share. Nippon Kayaku will use its depth of experience to further develop FIBEJET pigment inks and combine high performance with excellent safety and environmental profile. ■

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