

# Digital textile printing with hybrid nano-reactive pigment inks

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## Introduction

**Digital printing** is one of the most interesting advances in the textile sector. Digital textile printing can create an infinite number of colors as well as **excellent print fastness**. One of the most important components of **ink-jet printing technology** is the ink, which influences the printing quality and reliability. The general requirements for inks used in textile digital printing are purity, **particle size** (in the case of pigment inks), **viscosity**, surface tension, **stability**, pH value, and **conductivity**.

In this work, an ink for digital textile printing with **hybrid reactive pigments** was supplied by Ecofoot for testing in **reactive dyes printing**. The aim was to **reduce water, energy, and time** in the **washing-off process**, or **even eliminate it**, just by applying the dye **fixing agent**, already used for the dyes, at the end of the printing process, immediately after steaming.

## Materials

- Digital textile inks with hybrid reactive pigments;
- 100% cotton fabric with a coating;
- Reggiani Machine K16 Renoir equipped with 16 print heads Kyocera.

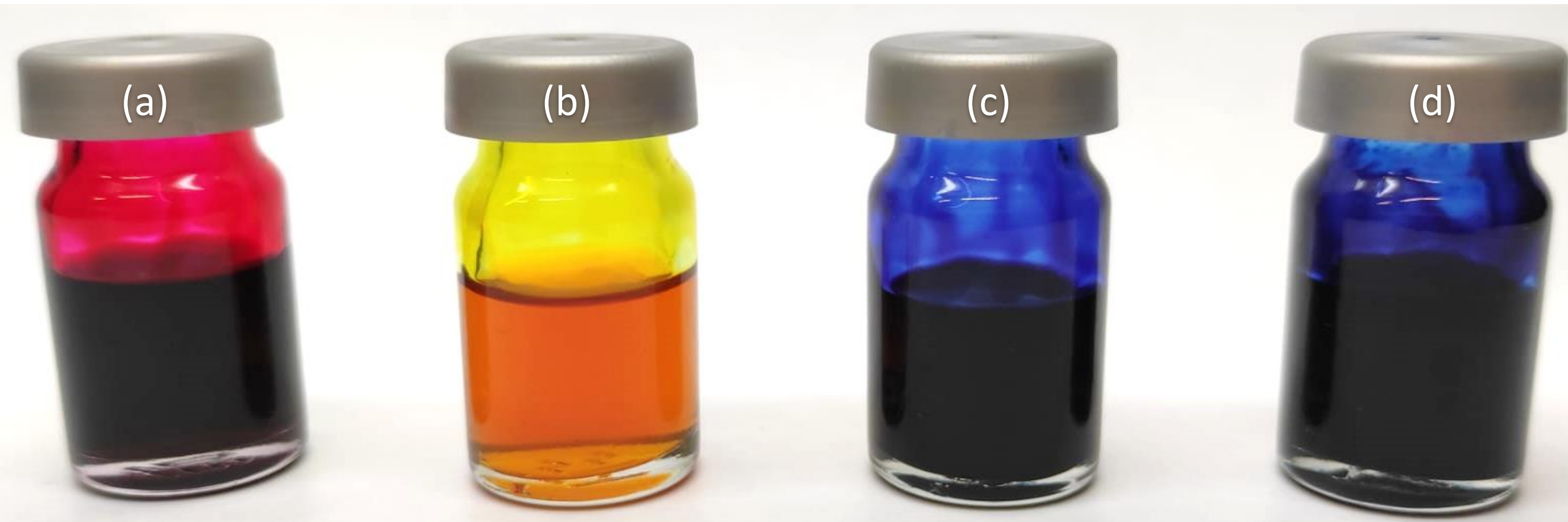


Figure 1. Colours of the hybrid reactive pigment inks: (a) magenta, (b) yellow, (c) blue, and (d) cyan.

Table 1. Hybrid ink properties for digital printing

COLOUR INK	Magenta	Yellow	Blue	Cyan
Conductivity (ppm)	3270	565	830	2340
Viscosity (cP)	14.94	14.46	13.14	14.88

## Methods

- The definition of printing was evaluated;
- Processes described in Figure 2 were applied;
- Compared colours, intensity, washing, and wet rubbing colour fastness results.

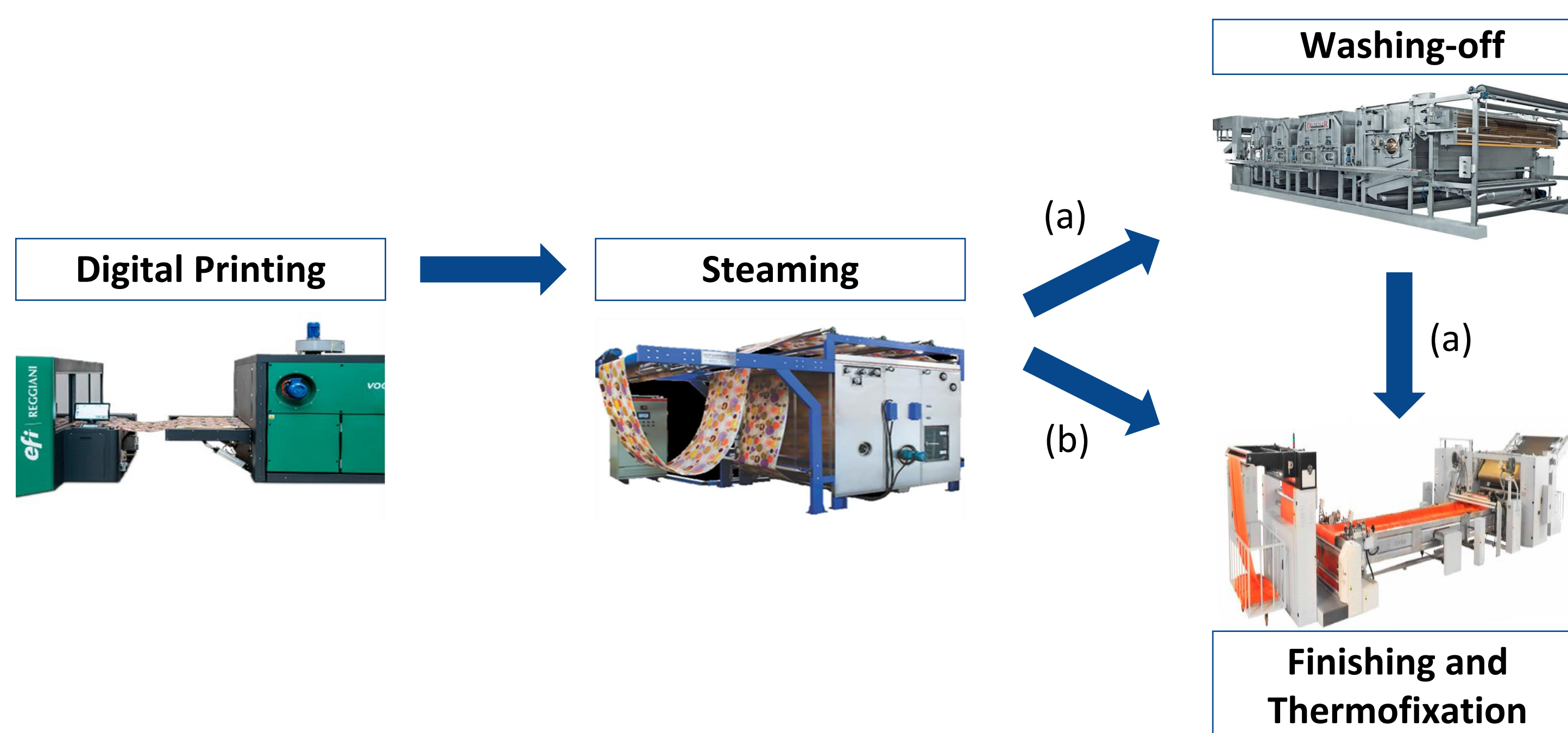


Figure 2. Description of the processes used after digital printing: (a) Process 1: Hybrid reactive dyes – with washing-off and fixing agent; (b) Process 2: Hybrid reactive pigments – without washing-off and fixing agent.

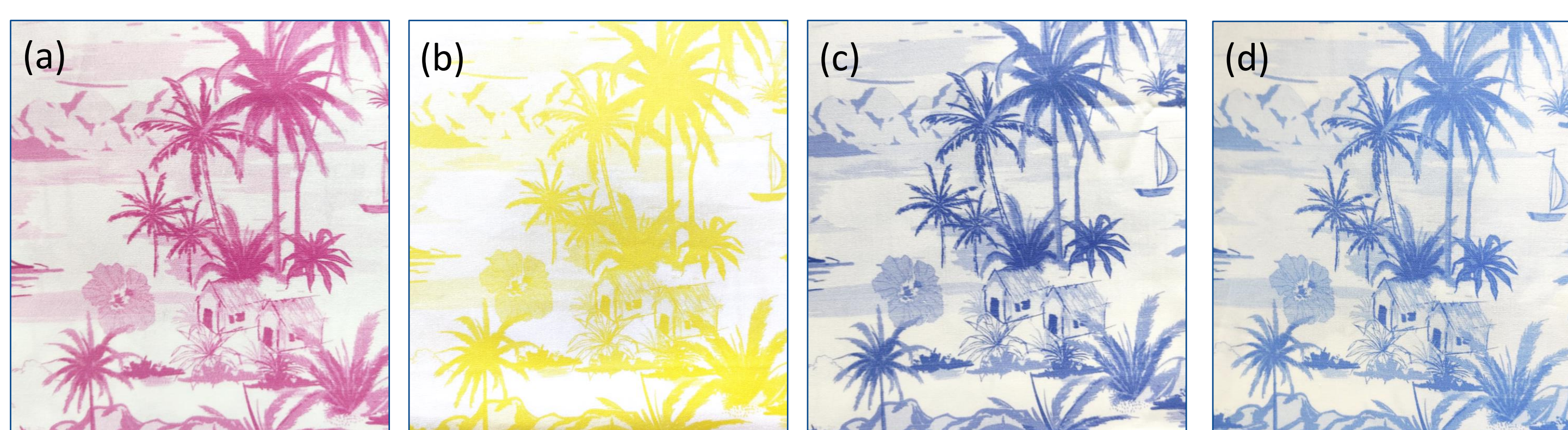


Figure 3. Colours and definition of the hybrid reactive inks: (a) magenta, (b) yellow, (c) blue, and (d) cyan.

## Results and Discussion

- Printing:** Took place without clogging the head meaning the nanopigments were small enough and did not agglomerate;
- Definition:** The soft contours of the lines produced in the drawing indicate the viscosity was correct;
- Intensity:** Process 2 samples are more intense than process 1 samples (Figure 4).

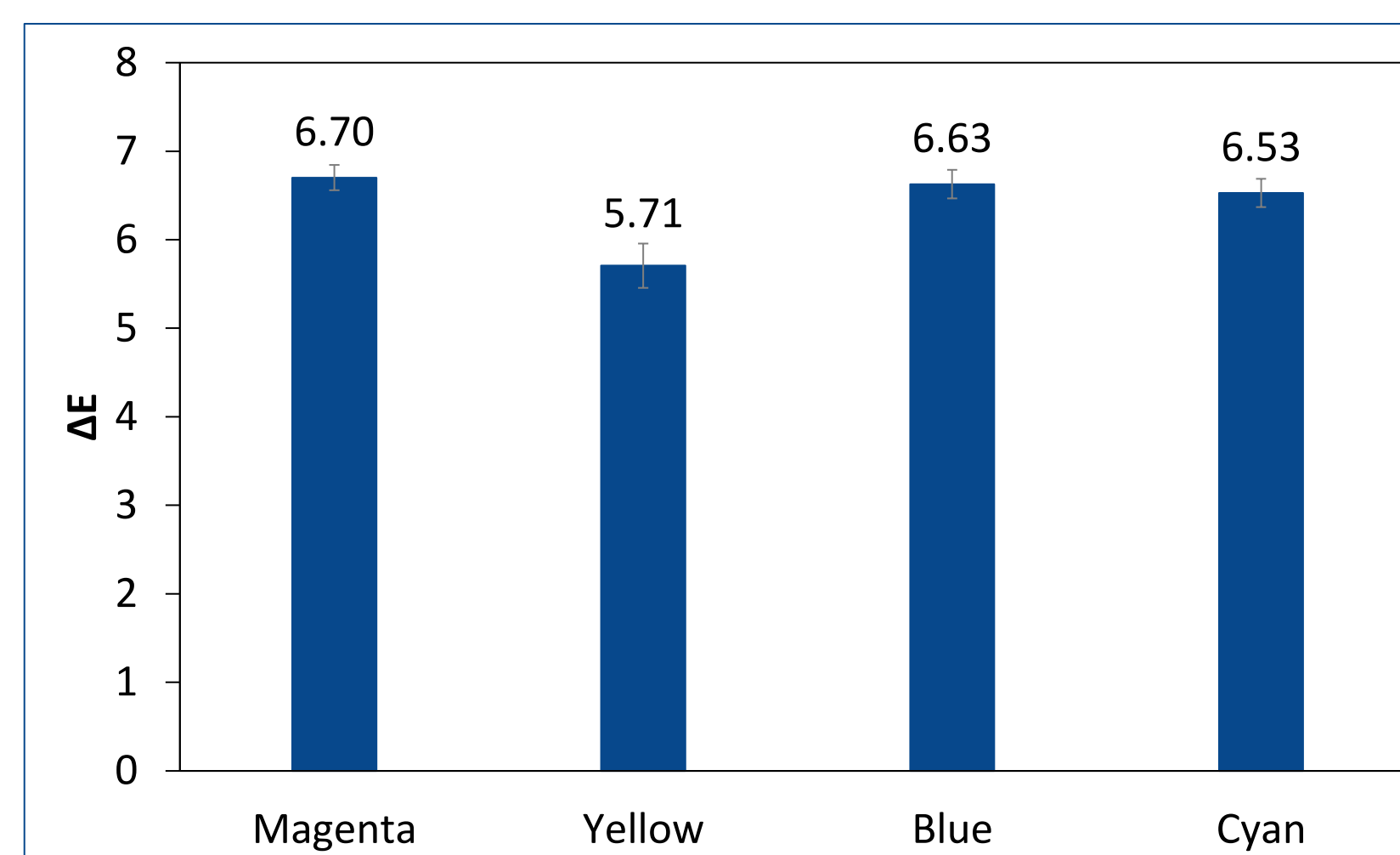


Figure 4. The difference in colour between the least intense samples (process 1) and the most intense samples (process 2).

- Colour fastness to washing:** Grey scale assessment for the staining has similar results in both processes, and there is no color transfer to the multifiber. Grey scale evaluation for color change is represented in Table 2.

Table 2. Washing fastness of hybrid reactive dyes: A, B, C, and D: control samples; A', B', C' and D': washing test, and grey scale assessment for the colour change to washing test.

HYBRID REACTIVE DYES	Washing fastness	A	A'	B	B'	C	C'	D	D'
		Grey scale assessment	4		4		4		4-5
HYBRID REACTIVE PIGMENTS	Washing fastness	A	A'	B	B'	C	C'	D	D'
		Grey scale assessment	4-5		4		4-5		4-5

- Colour fastness to wet rubbing:** Grey scale assessment for the wet staining is slightly worse in process 2 than in process 1 samples, which is expected since the samples had more intense colour, Figure 5.

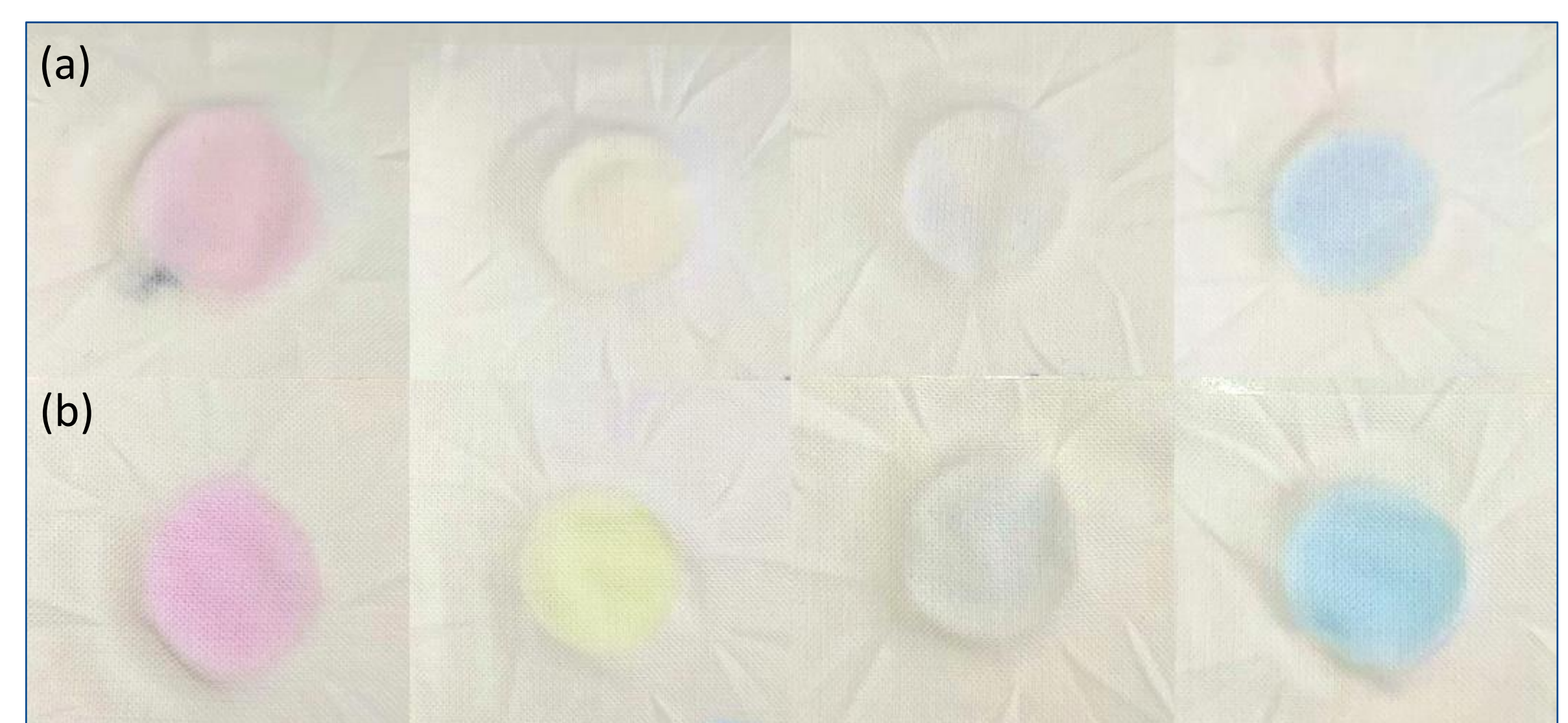


Figure 5. Staining in wet rubbing fastness test, in processes 1 (a) and 2 (b).

## Conclusions

- A digital textile ink with hybrid reactive nanopigments was **successfully tested** without clogging in the **same conditions as digital printing** with reactive dyes, i.e., on a coated cotton fabric and undergoing steaming;
- A **process without washes**, only with the application of the **fixing agent**, was **successfully applied** and with similar fastness results, compared to the conventional process with washes;
- Large savings** of water, energy, and time were **accomplished**.

## Acknowledgments

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