TEXTILE FABRICS DYEING TO CONFER HALOCHROMIC PROPERTIES

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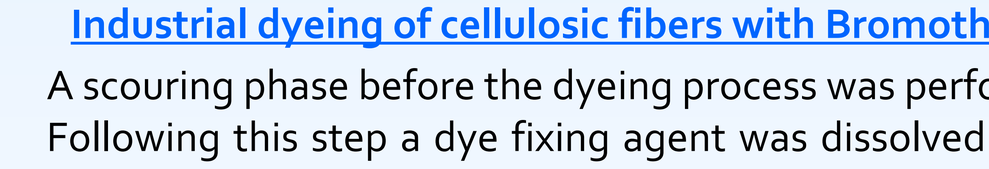
INTRODUCTION

Recent literature reported an increasing number of papers related to pH-sensitive materials or devices. Wearable technologies can offer the opportunity of continuous monitoring of the health status. The real time check of physiological parameters (including pH of sweat) is growing among athletes and the medical community, for instance. Moreover, a pH-sensitive wound dressing can indicate the progress of healing by a simple colour observation. In addition, the pH of the skin plays a role in the development of skin disorders such as infections and dermatitis. Textile materials are the substrates of choice for developing wearable devices because of mechanical properties, flexibility, breathability, lightweight and washability. Furthermore, textile materials can cover large surfaces, but if the whole surfaces is sensitive, a single spot of pH variation can be detected.

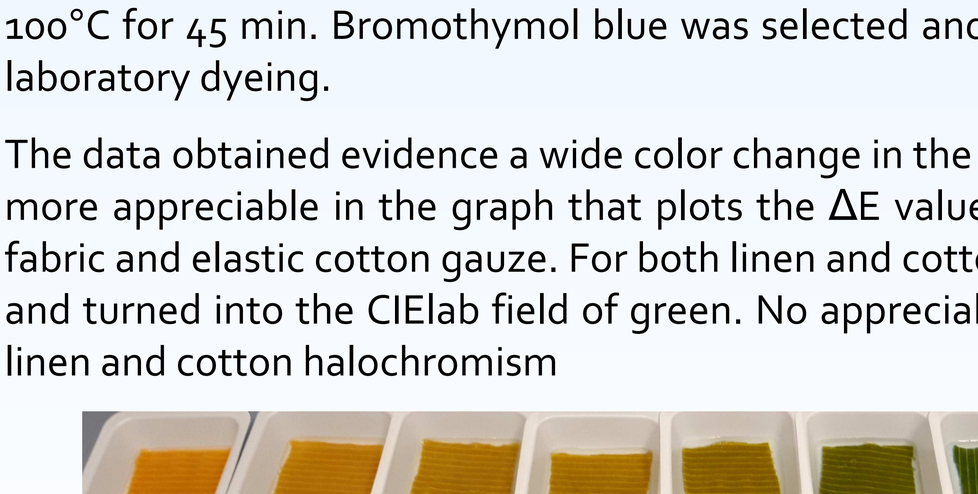
Multifibers textile fabrics dyeing

Rectangles of multifibers textile fabrics having a size of 5 by 15 cm were cut and dyed according to the following conditions; liquor ratio 1:20 (10 g of textile material in 200 ml bath); temperature 100°C with a heating rate 1°C/min; process temperature and time 100°C 40 min. Dyes concentration 1 g/L. The dyeing process was carried out in a AHIBA Nuance Top Speed II equipment. Speed was 35 rpm and reverse time 3 min.



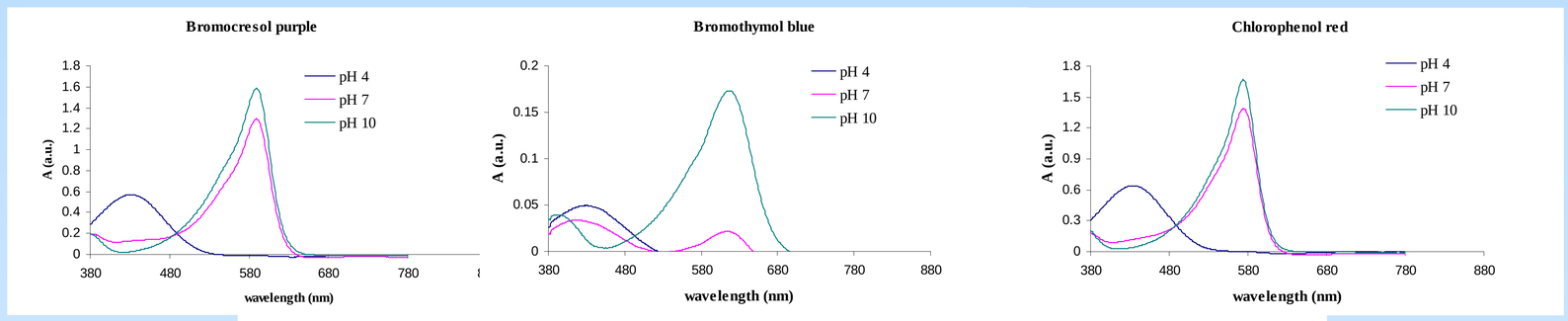
Wool
Polyacrilonitrile
Polyester
Polyamide 6.6
Cotton
Cellulose acetate

A-Bromocresol purple; B-Curcumin; C-m- cresol purple; D-Chlorophenol red; E- Bromothymol blue



Halochromic dyes

Five halochromic dyes were employed in the dyeing process.

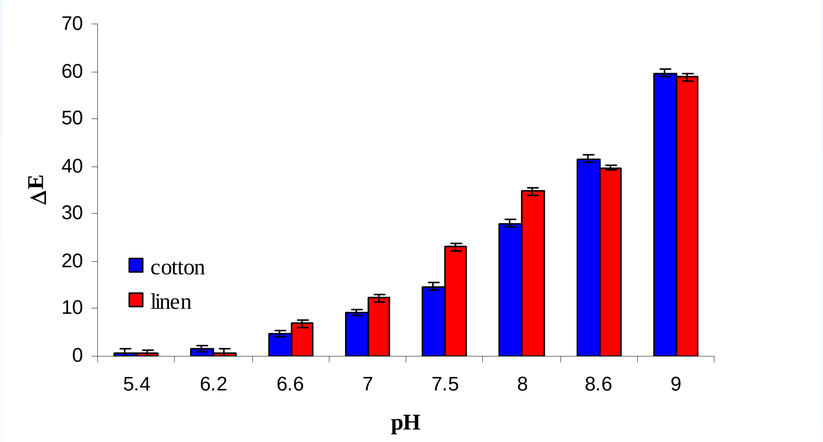


The analysis performed evidence different wavelengths of absorption changing the pH f the solutions. According to de Meyer et. Al. the color change of the dye solutions is due to a protonation/deprotonation mechanism that causes a different electron configuration that results in a different interaction with the visible light. The dyes analysed, apart from Curcumin, belong to the class class of sulfonephthalein dyes, where the color change is due to the ring-opening reaction as a consequence of deprotonation. Curcumin, bis-α,β-unsaturated β-diketone or diferuloylmethane, is a compound which exhibits *keto-enol* tautomerism. In acidic and neutral medium manifests the *keto* form and is yellow, while in alkaline conditions evidences the *enol* form and a chromatic change to red.

Industrial dyeing of cellulosic fibers with Bromothymol blue

A scouring phase before the dyeing process was performed in sodium hydroxide and hydrogen peroxide, at 98°C for 40 min. Following this step a dye fixing agent was dissolved in a water solution at 60 °C for 20 min. The dyeing process was carried out at 100°C for 45 min. Bromothymol blue was selected and used in 1% concentration. Process conditions were the same as those of the laboratory dyeing.

The data obtained evidence a wide color change in the pH interval from 5.5 until 10.0, more appreciable in the graph that plots the ΔE values versus pH of the dyed linen fabric and elastic cotton gauze. For both linen and cotton the samples become darker and turned into the CIElab field of green. No appreciable difference was observed in linen and cotton halochromism



ΔE versus pH (from 5.5 to 9.0) of dyed elastic cotton gauze and linen fabric

Conclusions

Dyeing processes with halochromic dyes were performed on different textile materials. In the first part of the work a multifiber textile fabric was selected to test the affinity of the dyes for the different types of fibers. The dyes employed have shown affinity for wool and polyamide 6.6 fibers. A low affinity; not null however for cotton and acetate was also highlighted. The halochromic test performed on the dyed samples evidenced the maintenance of the halochromic properties of the dyes after adsorption on textile substrates. The industrial trial carried out on cellulosic fibers confirmed the results obtained in laboratory so as a scale up of the process might be feasible.

Acknowledgements

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