ANNALS OF THE UNIVERSITY OF ORADEA
FASCICLE OF TEXTILES, LEATHERWORK

# SCREEN PRINTING ON COTTON FABRIC USING CHITOSAN AND ALGINATE AS NATURAL THICKENING AGENT

**RONDANINI Sara, DÍAZ-GARCÍA Pablo, MONTAVA Ignacio, GISBERT-PAYÁ Jaime, BOU-BELDA Eva**

Departamento de Ingeniería Textil y Papelera, Universitat Politècnica de València
Plaza Ferrándiz y Carbonell s/n, Alcoi, Spain

Corresponding author: Bou, Eva, E-mail: evbobel@upv.es

***Abstract:*** *In the process of making a print on a fabric, several steps that require many materials and substances are involved. When the purpose is to create a pattern through the use of natural products, it is necessary to pay close attention, not only to the origin and method of extraction of the pigments that you intend to use, but also, for example, to the thickeners to be added to the paste for increasing the viscosity of the pastes and molding, to the stains to be applied for better color rendering on the fabric and to the final fixatives, designed to make the product durable. Thickeners are a fundamental step in the success of printing on fabrics. These agents are generally compounds with a high molecular weight whose task is to transfer to the fabrics the dyes and chemical compounds necessary to create the printing pattern, thanks to the plastic action that they give to the compound used. As far as the environmental consequences of the use of thickeners are concerned, starting from the analysis of the wastewater of the processes, it has emerged that the use of biodegradable additives and guar rubber on the fabrics is preferable, since they are less harmful to the ecosystem. In this work different natural compounds, chitosan and alginate, are used in order to increase the viscosity of the paste prepared for printing. Color measurement of each printed cotton simple was analized and it could be appreciated that alginate paste printed on pretreated fabric with chitosan reached good results.*

***Key words:*** *thickners, turmeric, natural pastes, natural dyes, eco-friendly*

## 1. INTRODUCTION

For several years now, the textile production system has been strongly criticised for its role in the pollution of the environment. For this reason, textile world is strongly challenged to develop new production methods that encourage environmental sustainability and the health of the worker involved in the work and of the final consumer and this without forgetting the quality of the product.

This work is focused on printing process, used to give the textile coloring and disegn. In the process of making a print on a fabric, several steps that require many materials and synthetic substances are involved. When the purpose is to create a pattern through the use of natural products, it is necessary to pay close attention, not only to the origin and method of extraction of the pigments that you intend to use, but also, for example, to the thickeners to be added to the paste for increasing the viscosity of the pastes and molding, to the stains to be applied for better color rendering on the fabric and to the final fixatives, designed to make the product durable.

Natural dyes and pigments are being studied in several scientific papers, both in the field of dyeing [1-4] and printing [5-6], achieving good results in both cases. Regarding printing process, it can find different works that focus the study on using natural products to formulate printing paste [7-8].

The aim of this work to compare different printing formulations using natural products as thickner, using chitosan and alginate, and turmeric like natural pigment. In order to compare the resulting fabrics, these were compared with a printed fabric using a conventional and synthetic thickner. In this work, images of each sample and color measurement are show.

## 2. EXPERIMENTAL

### 2.1 Materials

Plain cotton fabric with 210 g/m2 was used. In the production of the printing paste, as far as that related to the traditional synthetic method is concerned, it was decided to use Lutexal (suministrated by Archroma) as main thickner.

For the natural thickner, different components have been investigated: in particular chitosan (in combination with acetic acid to allow the solution of the first) and alginate, both provided by Sigma Aldrich.

Natural pigment used was turmeric, which makes it possible to obtain yellow color.

### 2.2 Methods

During the research it was necessary to experiment with the formulation and application of different compounds before obtaining those that ensured adequate viscosity and performance.

In some cases, in fact, the formulations and the proportions of the components have been slightly and progressively variated, until a formula that appeared viscous enough to pass to the printing step was reached. Then it was applied on the fabric following the screen printing method, but not always the final result was considered satisfying and in those cases the research on the compounds was restarted and so on, until a result that was evaluated as satisfying was reached. In table 1 are shown the optimum formulations which are compared.

***Table 1:*** *Formulas prepared in order to make printing paste*

| Samples | Turmeric (g/L) | Alginate (g/L) | Chitosan solution (g/L) | Lutexal (g/L) | Acrilyc resin (g/L) |
|---|---|---|---|---|---|
| Cotton Alg | 1 | 40 | - | - | - |
| Cotton Xit + Alg | | 40 | 10* | - | - |
| Cotton Lut. | | - | - | 30 | 10 |
| Cotton Xit | | | 22 | | |

*Cotton fabric is pretreated by padding with chitosan solution

In order to objectively compare the results of the prints obtained, the reflection spectrophotometer MINOLTA CM-3600d was used (D65/10º observer) in terms of CIELAB values (L*, a*, b*) and color difference.

## 3 RESULTS

In table 2 images of sample are shown. It is immediately visible that in all cases there has been a change of colour in the final product with respect to the untreated fabric.The most intense

colour can be observed in the case of printing with Lutexal, while printing with the paste containing chitosan is the least effective from the point of view of the intensity of the colour. At the same time, the use of this product as a pre-treatment on which to apply the paste containing alginate allows to obtain a good outcome and increase the performance of chitosan. Even the use of the alginate compound alone allows to obtain a positive result.

***Table 2**: Images of printed fabrics using different formulations*

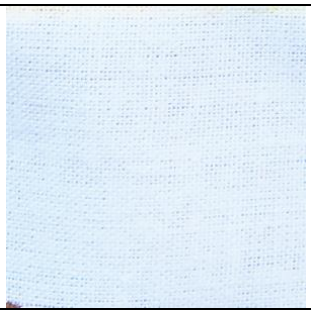
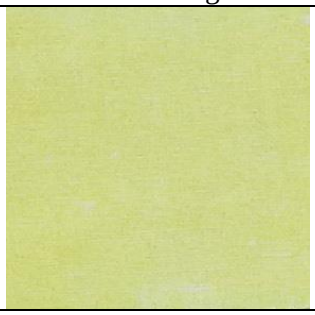
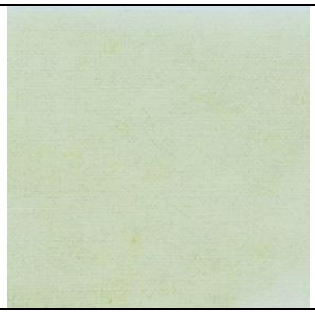
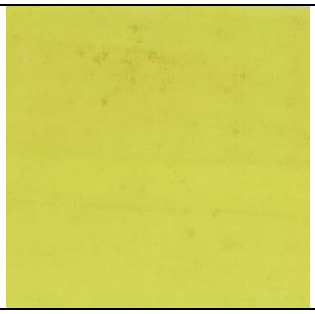
| Untreated fabric | Cotton Alg. | Cotton Xit |
|---|---|---|
|  |  |  |
| **Cotton Xit** | **Cotton Lut** | |
|  |  | |

Table 3 shows the chromatic coordinates L*, a*, b* and the difference of color (DE*ab) calculated from these values using untreated fabric as reference sample.

***Table 3:** Color values and color difference of each sample*

| **Samples** | **L*** | **a*** | **b*** | **DE*ab** |
|---|---|---|---|---|
| Untreated fabric | 83,06 | 1,49 | -5,65 | |
| Cotton Alg | 79,61 | -4,74 | 38,87 | 45,08 |
| Cotton Xit + Alg | 81,25 | -5,08 | 43,36 | 49,48 |
| Cotton Lut. | 82,95 | -9,46 | 65,41 | 71,91 |
| Cotton Xit | 80,87 | -5,40 | 29,40 | 35,79 |

This analysis was in fact based in particular on the data offered by the parameters that indicate the color difference between the undyed fabric and the same one after the application of the pigment, considering the color difference (DE*ab), the lightness L* of the color (L*=0 refers to black and L*=100 refers to white) and expecially the value of the parameter b* (-b* refers to blue and +b* refers to yellow).

It can be stated that all cases of printed fabrics are traceable within the yellow area, given the high b* values, being the value of printed fabric with sinthetic composition “Cotton Lut” the highest result. It is appreciated the same result when DE*ab results are compared.

## 5. CONCLUSIONS

Different formulations of printing pastes were prepared, using as thickner natural (chitosan and alginate) and synthetic products with the purpose to identify the best eco-sustainable methods for the realisation of prints on cotton.
To compare the color obtained in printed cotton fabric images and color measurements have been studied. It is observed that all printed fabrics with nature formulations performed, get less intensity of color than printed fabrics with synthetic thicner. However if alginate paste is printed on pretreated fabric with chitosan, the intensity of color is higher.

## REFERENCES

[1] Moiz, Arsheen, et al. "Study the effect of metal ion on wool fabric dyeing with tea as natural dye." Journal of Saudi Chemical Society 2010, 14.1, pp. 69-76.

[2] Deo, H. T., and B. K. Desai. "Dyeing of cotton and jute with tea as a natural dye." Coloration Technology, 1999, 115.7-8, pp. 224-227.

[3] Mohini, Kuchekar, Landge Tejashree, and Navghare Vijay. "Dataset on analysis of dyeing property of natural dye from Thespesia populnea bark on different fabrics." Data in brief 16 (2018): 401-410.

[4] Rossi, T., et al. "Waste from eucalyptus wood steaming as a natural dye source for textile fibers." Journal of cleaner production 2017, 143, pp. 303-310.

[5] Bahtiyari, M. Ibrahim, et al. "Use of different natural dye sources for printing of cotton fabrics." Journal of Textile & Apparel/Tekstil ve Konfeksiyon, 2017, 27.3.

[6] Glogar, Martinia, et al. "Optimisation of process parameters of Alpaca wool printing with Juglans regia natural dye." Coloration Technology , 2020, 136.2, pp. 188-201.

[7] Babel, S., and R. Gupta. "Screen printing on silk fabric using natural dye and natural thickening agent." J Textile Sci Eng, 2016, 6.230.

[8] Ali, Hend, et al. "New nature dye printing paste functional on Varies fabric kinds enhanced by plasma irradiation." Egyptian Journal of Chemistry, 2020, 63.2, pp 743-758.