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A comparative study of using different types of print paste in screen printing

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Abstract
Printing is known as localized dyeing of fabric or garments by applying different styles and methods. In this study, the colorfastness and color durability of synthetic (acrylic) printed fabric was improved by the application of synthetic printing fixer (Anionic acrylic polymer). Moreover, different percentage of fixer with different viscosity or wicking effects of chemical viscosity on colorfastness was investigated. In this study, the fixing agent (2-5%) has a good wash fastness effect and rubbing fastness effect on rubber and Emboss-rubber printed fabric. Furthermore, there is no effect of the fixing agent in light fastness on printed fabric.

Keywords: anionic acrylic polymer, colorfastness, emboss- rubber, fixer, rubber

1. Introduction
The desire of adding color and design to textile materials is almost as old as mankind. Early civilizations used color and design to distinguish themselves and to set themselves apart from others. Textile printing is the most important and versatile of the techniques used to add design, color, and specialty to textile fabrics. It can be thought of as the coloring technique that combines art, engineering, and dyeing technology to produce textile product images that had previously only existed in the imagination of the textile designer. Textile printing can realistically be considered localized dyeing [1-5]. In ancient times, man sought these designs and images mainly for clothing or apparel, but in today's marketplace, textile printing is important for upholstery, domestics (sheets, towels, and draperies), floor coverings, and numerous other uses [2, 6].
The exact origin of textile printing is difficult to determine. However, a number of early civilizations developed various techniques for imparting color and design to textile garments. Batik is a modern art form for developing unique dyed patterns on textile fabrics very similar to textile printing. Batik is characterized by unique patterns and color combinations as well as the appearance of fracture lines due to the cracking of the wax during the dyeing process. Batik is derived from the Japanese term, "Ambatik," which means "dabbing," "writing," or "drawing" [8, 10]. In Egypt, records from 23-79 AD describe a hot wax technique similar to batik. The early Egyptians also used ink-carved designs on the ends of wooden cylinders to print on fabrics as early as 400 AD. In Europe, the earliest evidence of textile printing is provided by a wooden block discovered in France dated to the end of the 14th century [7, [11].
The development of screen-printing began in Japan in the middle of the 17th century. Early development involved the use of design stencils held together by fine silk threads or even human hair. The designs were laid onto textile fabrics and color was applied only to the areas outside of the designs. Since the silk threads were so fine, they were not apparent in the final fabric design [12, 15]. The Japanese technique was taken to France where modern flat screen printing was developed, initially using silk fabric stretched over a wooden frame.
Before the modern methods of textile printing are discussed in detail, some specific information on textile material must be covered. The properties of fibers, yarns, and fabric constructions impact the textile printing processes as well as the characteristics of the final printed fabrics [13, 16, 19].
Screen-Printing as a print-making technique most probably developed and survived because of its efficiency and as a result of its strong visual impact as well. In the mostly digital present, it brings a spectator to the different level of visual experience [7, 24-25]. it brings back the "material feeling" of reproduction. As Walter Benjamin in his widely celebrated essay "The Work of Art in the Age of Mechanical Reproduction" explains: "Getting closer to things in both spatial and human terms is every bit as passionate a concern of today's masses as their tendency to surmount the uniqueness of each circumstance by seeing it in reproduction" [9, 18, 23].
Screen-printing in the 60s, when it was being used as a highly industrial printing technique, might have been seen as a mass production-copying medium. Nowadays, in the face of extremely efficient and fast digital printing, it gained a new name, standing in between painting and intaglio printing techniques [17, 20-21].
Based on that, is possible to claim that the screen-printing technique is mostly based on both the print-maker and spectators physical and emotional experience while producing and perceiving it. This paper will aim to prove this hypothesis.
This document researches the roots, possible techniques and recent rebirth of the screen-printing medium, trying to figure out why this particular print-making technique gained such a big success in recent years. This project will be able to understand the possible aspects about the Rubber paste printing and also the Emboss-rubber paste printing with the use of fixer and without fixer.

2. Materials and Methods

2.1. Materials

2.1.1. Fabric

Single jersey 100 % cotton knitted fabric. The yarn count was 40^s combed yarn; the fabric weight per unit area was $140 g/m^2$.

2.1.2. Print paste and chemicals

- Rubber
- Rubber Clear
- Binder
- Fixer
- Emboss (puff)

2.1.3. Chemical Composition of Print Paste

Table 1: Chemical composition of print paste

Chemical	Composition	Type	% by weight
Rubber Rubber Clear Binder Emboss (puff)	Polymer	Acrylic	50-70
	Others	Water and Additives	30-50
Fixer	Polymer	Poly functional cross linker with nitrogen containing active groups	100

2.1.4. Equipment

- Mesh
- Squeegee

2.2. Methods

2.2.1. Testing standards

The colour fastness fabrics are dictated by the end use of the dyed material and by any further processing to which the material will be subjected. For this project work, the following testing standards were used to analysis the fastness properties of printed samples.

- Color fastness to wash [ISO 105 C06]
- Color fastness to rubbing (Dry and wet) [ISO-105-X12 and AATCC-08]
- Color fastness to light [ISO 105 B02]

2.2.2. Steps in Printing Process

a) Preparation of printing paste

Type of specific formulation used depends on the fibre, the colorant system used and to some extent the type of printing machine.

b) Printing of fabric

Dye or pigment paste is applied to the substrate using different techniques.

c) Fixation (Drying)

Immediate after printing, the fabric is dried and then the prints are fixed mainly with steam or hot air (for pigments).

d) After-treatment (Washing)

This final operation consists in washing and drying the fabric (it is not necessary when printing with pigments or with other particular techniques such as transfer printing).

2.2.2. Rubber Printing

A very common and versatile material that is used to print to garment due to its ability to adhere well to fabric. It can apply to most fabric materials in light or dark colors. The texture feels thick and tensile. A special rubber formulation has to be made in order to apply this print to elastic material

Recipe (S1): Rubber Print Paste with Fixer

Table 2: Rubber Print Paste with fixer

Rubber	60 %
Rubber Clear	20 %
Binder	15-18% (A ratio which is suitable to ink and stir until homogenous)
Fixer	2-5 % (A ratio which is suitable to ink and stir until homogenous)

Recipe (S2): Rubber Print Paste without Fixer

Table 3: Rubber Print Paste without fixer

Rubber	60 %
Rubber Clear	20 %
Binder	20 % (A ratio which is suitable to ink and stir until homogenous)

2.2.3. Flow Chart of Rubber Printing Process on Cotton Fabric

Table preparation
↓
Fabric plaited on the table
↓
Rubber printing paste apply with the help of screen
↓
Hanging the sample for 30 minutes
↓
Drying the sample with the drier
↓
Delivery

2.2.4. Emboss (puff) Printing

Emboss printing is not as available as pigment printing, foil printing, flock printing or any others dyes printing. It is specially done for logo making or others decorative purpose. In this printing process, printing is done by embossing the printing paste on the textile materials. It is almost similar to the rubber printing process but the difference is here emboss or foaming paste is applied to appear the desired look

Recipe (S3): Emboss-Rubber Print Paste with fixer

Table 4: Emboss-Rubber Print Paste with fixer

Rubber	**30 %**
Rubber Clear	20 %
Binder	15-18 % (A ratio which is suitable to ink and stir until homogenous)
Emboss (Puff)	30 % (A ratio which is suitable to ink)
Fixer	2-5 % (A ratio which is suitable to ink and stir until homogenous)

Recipe (S4): Emboss-Rubber Print Paste without fixer

Table 5: Emboss-Rubber Print Paste without fixer

Rubber	30 %
Rubber Clear	20 %
Emboss (Puff)	30 % (A ratio which is suitable to ink)
Binder	20 % (A ratio which is suitable to ink and stir until homogenous)

2.2.5. Flow chart of Emboss-Rubber printing process

Preparation with puff chemical
↓
Table preparation
↓
Fabric plaited on the table
↓
Apply printing paste by screen (3times)
↓
Keep the fabric for 15 minutes
↓
Dry the fabric with drier (Every time when puff print paste applied)
↓
Delivery

3. Result and Discussion

3.1. Assessment of Color Fastness to Wash

Color fastness to wash in this experiment was assessed to the samples in the lab with the printed fabric by obeying ISO 105 C06 method. Usually color fastness was assessed separately with respect to fading and staining.

3.2. Assessment of Color Fastness to Rubbing

Color fastness to rubbing in this experiment was assessed to all the three samples in the lab with rubbing fabric by obeying ISO 105. Usually color fastness was assessed separately with respect to fading and staining in the basis of wet & dry phase.

3.2. Assessment of Color Fastness to Light

This test measures the resistance to fading of dyed textile when exposed to day light. The test sample was exposed to light for a certain time, which was about 24 hours, and compare the change with original unexposed sample the changes are assessed by Blue Scales.

Table 6: Assessment of color fastness

Color Fastness		**Rubber with Fixer (S1)**	**Rubber without Fixer (S2)**	**Emboss-Rubber with Fixer (S3)**	**Emboss-Rubber without Fixer (S4)**
Washing		4-5	3-4	4-5	4
Rubbing	Dry	3-4	3-4	3	3
	Wet	3-4	3-4	3	3
Light		5	5	5	5

[Grey Scale consists of five pairs of grey colored material numbered from 1 to 5. Class 5 best, Class 1 worst, Half Rating, such as 3-4 also used, 5-Excellent, 4-Good, 3-Fair, 2-Poor, and 1-Very poor]

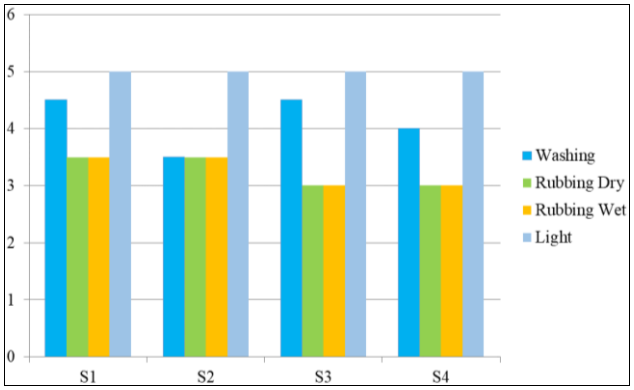

Fig 1: Assessment of Color Fastness Test

From figure-1, it is noticed that the effect of fixer impact great effluence on printed fabric. Moreover different percentage of fixer with different viscosity or wicking effects chemicals viscosity on color fastness on investigated. Hence fixing agent (2-5%) gave good wash fastness effect and rubbing fastness effect on rubber and Emboss-rubber printed fabric. Furthermore, there is no effect of the fixing agent in light fastness on printed fabric.

4. Conclusion

In this project different types of print paste have used in screen printing. We have used different types of chemicals in four recipes of print paste such as rubber, binder, fixer emboss. In this study of screen-printing color fastness and color durability of synthetic (acrylic) printed fabric was improved by the application of synthetic printing fixer (anionic acrylic fixer).There is little effects of color fastness and color durability of using printing chemicals. However, using fixing agent's effects more on color fastness and color durability. Finally, in this project work fixer play a vital role.

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