

# Effect of Atmospheric Air Pressure Plasma on Polyester Fabric Meant for Transfer Printing

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**Abstract**— Plasma is a very reactive material which can be used to modify the surface of a certain substrate which is known as plasma activation or plasma modification. Plasma can be defined as a partially ionized gas with a roughly equal number of positively and negatively charged particles. Low temperature plasmas are used in surface modifications and organic cleaning. The design on a paper is transferred to a fabric with the use of heated rollers by the method of vaporization. Plasma treatment also imparts etching of fiber surface. This property can be utilized in transfer printing of polyester fabric. It is expected that plasma treatment will increase the fixation of disperse dye on printed area. In the work presented an attempt has been made to modify the surface of the polyester fabric with the use of continuous atmospheric pressure plasma.

**Key words:** Plasma, Transfer Printing, Polyester, Surface Modification

## I. INTRODUCTION

Plasma is the “fourth state of matter” because plasma is neither liquid nor gas; its properties are similar to those of both liquids and gases. The plasma is an ionized gas with equal density of positive and negative charges which exist over an extremely heavy temperature and pressure. Plasma treatment of textile materials has revealed that it has a huge potential as an alternate technology for the textile processing in terms of cost saving, water saving and eco-friendliness.

There are two types of plasma – high temperature and low temperature. A good example of high temperature plasma is lightning. This type of plasma is artificially generated using a high voltage, high temperature arc, which is the basis for the corona discharge process and for the plasma torch used to vaporize and redeposit metals.

By vaporization the design on a paper is transferred to a fabric. There are mainly two processes for this- Dry Heat Transfer Printing and Wet Heat Transfer Printing. In Conventional Heat Transfer Printing, that presses a fabric against a printed paper placed on a heat resistant blanket with the use of electrically heated cylinder. In Infrared Heat Vacuum Transfer Printing, the transfer paper and fabric is passed between infrared heaters and a perforated cylinder which are protected from excessive heat by a shield. For vaporizing the dye pattern from paper to fabric the Wet Heat Transfer Printing uses heat in a wet atmosphere.

## II. LITERATURE REVIEW

### A. Plasma

Without any preprocessing, polyester fabric has very less ability to hold on water due to the smooth morphology and chemistry property of polyester fibers. Therefore, patterns directly printed with the use of pigment inks have poor color yields and easily bleed [1]. Plasma surface treatment of

polyester fabrics was carried out in composite atmosphere with atmospheric air and 10% Argon under different experimental conditions. After plasma treatment the samples were printed with pigment inks [2]. Research show that the surface-modified polyester fabrics improved color yields and excellent pattern sharpness [3]. Due to its special characteristics such as higher strength and resilience, polyester fabric is often used as inkjet printing substrate [4]. Atmospheric air + 50% Argon plasma introduce more oxygen-containing groups onto the fabric surface than air plasma [5].

### B. Transfer Printing

The popularity of polyester fabrics lead to the development of a completely new form of printing: heat transfer printing, which prints the pattern on paper with carefully sublimation dyes. The paper is then applied to the fabric by passing between the two hot calendar rollers and the pattern is transferred from one to the other. This method opens up new possibilities, which is the production of halftone effects. Against these advantages may be set the relative lack of flexibility in transfer printing: no single transfer-printing method is universally applicable to an extreme range of textile fibres.

## III. EXPERIMENTAL METHODOLOGY

### A. Material used

Fabrics were made up of 100% polyester. This was prepared on water jet machine. Warp and weft denier is 76 & 162. Fabric GSM is 87.2 GSM.

### B. Experimental Methodology

The selected woven polyester fabrics in suitable denier and plain weave for application of low temperature plasma, and done Plasma treatment on polyester fabric under atmospheric condition. After applying plasma, transfer printing has been done within 1 hrs. After applying plasma, the effect of plasma was evaluated visually. Study of physical properties such as Rubbing and Washing fastness, Light fastness, surface properties (on Scanning Electron Microscope) of the plasma –treated and untreated fabrics is in process.



Fig. 1: Plasma Machine



Fig. 2: Transfer Printing

Sample Code	Description
3PU	3 KV, Plasma Untreated
3PT	3 KV, Plasma Treated
5PU	5 KV, Plasma Untreated
5PT	5 KV, Plasma Treated

Table 1: Sample Coding

#### IV. RESULTS AND DISCUSSIONS

SEM Results are shown in figure 3. Testing Results are tabulated in Table 2. Washing Fastness (ISO III) is calculated. Table 3 shows the Result of Rubbing Fastness. And Table 4 showed the Result of Light Fastness.

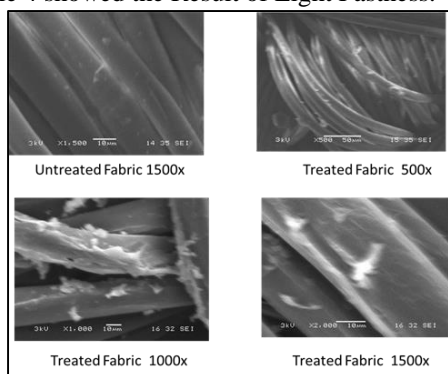


Fig. 3: SEM Results

Sample	Change in color	Staining on bleached cotton
3PU	4	4/5
3PT	4/5	5
5PU	4	4/5
5PT	4/5	5

Table 2: Washing Fastness

Sample	Change in color	Staining on bleached cotton
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	Dry	Wet	Dry	Wet
3PU	4/5	4/5	4/5	4/5
3PT	5	5	5	5
5PU	4/5	4/5	4/5	4/5
5PT	5	4/5	4/5	4/5

Table 3: Rubbing Fastness

Sample	Blue Wool Rating
3PU	5
3PT	Above 5
5PU	5
5PT	Above 5

Table 4: Light Fastness

#### V. CONCLUSIONS

From the results, we can conclude that plasma treatment increases washing fastness of transfer printed polyester fabric by 4/5 rating (ISO-III). It will also improve Rubbing fastness of transfer printed polyester fabric by 5 rating (ISO-766, 1988). It will also improve the light fastness of transfer printed polyester fabric above 5 rating (ISO 105 B02).

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