Reprint **ISSN 1997-2571 (Web Version)**

Journal of Innovation & Development Strategy (JIDS)

(J. Innov. Dev. Strategy)

Volume: 5 **Issue: 3** **December 2011**

J. Innov. Dev. Strategy 5(3):57-60(December 2011)

COMPARISON STUDY ON CLEANABILITY OF PET FABRIC WITH O_2- AND NH_3- PLASMA MODIFICATION BEFORE AND AFTER APPLYING SOIL RELEASE POLYMER (SRP)

R. SAHA

GGF
Nature is Power

An International Scientific Research Publisher
Green Global Foundation©
Publication and Bibliography Division
100 Leeward Glenway
Apartment # 1601
M3c2z1, Toronto, Canada
E-mails: publication@ggfagro.com, editor@ggfagro.com
http://ggfagro.com/ejournals/current issues

ISSN-1997-2571 (Online)
J. Innov. Dev. Strategy 5(3):57-60(December 2011)

COMPARISON STUDY ON CLEANABILITY OF PET FABRIC WITH O_2- AND NH_3- PLASMA MODIFICATION BEFORE AND AFTER APPLYING SOIL RELEASE POLYMER (SRP)

R. SAHA

Institute of Textile Machinery and High Performance Material Technology, Hohe Str. 6, 01069 Dresden, Germany

Corresponding author & address: Rajib Saha, E-mail: rajibrbb@gmail.com
Accepted for publication on 22 November 2011

ABSTRACT

Saha R (2011) Comparison study on cleanability of pet fabric with O_2- and NH_3- plasma modification before and after applying Soil Release Polymer (SRP). *J. Innov. Dev. Strategy* 5(3), 57-60.

A complete different phenomenon is found after two different plasma i.e. O_2- and NH_3- treatment in case of soiling as well as cleaning behaviour. Longer irradiation durations and Soil Release Polymer (SRP) play a significant role to improve cleanability. Difference between soiling behaviour and cleanability of PET fabrics before and after impregnation were revealed and discussed. The results obtained correlate with cleanability of polyester fabric of different exposure times to low pressure RF O_2- and NH_3-plasma, before and after deposition of Soil Release Polymer (SRP).

Key words: *polyester fabric, plasma, soil release polymer (SRP), cleanability*

INTRODUCTION

Polyester fabric is one of the most popular fabrics in the world. It has many desirable properties, including relatively high tenacity, low creep, good resistance to strain and deformation, high glass transition temperature (T_g), and good resistance to acids and oxidizing agents. These physical, mechanical, and chemical attributes make polyester excellent candidates not only for apparel and textile products but also for industrial and composite applications.

Plasma modification chemically change the surface behaviour and Soil release polymer (SRP) is responsible for cleanability.

Here, in this study observed different plasma (NH_3, O_2) with different time and SRP are also induced to characterise the comparison cleanability to establish correlation with each other.

MATERIALS

A polyester test fabric was used as substrate for this study. The fabric was supplied by Wfk-Testgewebe GmbH, Krefeld, Germany. The material was used as it received without any pretreatment. Different parameter of the test fabric is given in Table 1.

Table 1. Specifications of polyester fabric

Parameter	Value
Fineness (warp)	295 dtex
Fineness (weft)	295 dtex
Yarn density (warp)	270 +/- 5 yarn / dm
Yarn density (weft)	270 +/- 5 yarn / dm
Width	80 cm
Fabric weight	170 g/m^2
Weave	1 / 1 plain

METHODS

Plasma modification of PET fabric

The plasma treatment was done in a computer controlled customized MicroSys apparatus by Roth & Rau, Germany. The cylindrical vacuum chamber, made of stainless steel, has a diameter of 350 mm and a height of 350 mm. The base pressure obtained with a turbomolecular pump is $<10^{-7}$ mbar. A 'Micropole' mass spectrometer by Ferran, the United States, is used to monitor the residual gas. On the top of the chamber a 2.46 GHz electron cyclotron resonance (ECR) plasma source RR 160 by Roth & Rau with a diameter of 160 mm and a maximum power of 800 W is mounted. The process gas is introduced into the active volume of the plasma source via a gas flow control system. When the plasma source is on, the pressure is measured by a capacitive vacuum gauge. The sample were introduced by a load-lock-system and placed on a grounded aluminium holder near the centre of the chamber. The distance between the sample and the excitation volume of the plasma source is about 200 mm. For the plasma treatment the following parameters were applied respectively: i) process gas NH_3 (99.999%, Messer Griesheim, Germany), flow 15 standard cubic centimeters per minute, pressure 3.6 10^{-3} mbar, effective microwave power 600 W and ii) process gas O_2 (99.95%, Messer Griesheim, Germany), flow 15 standard cubic centimeters per minute, pressure 3.6 10^{-3} mbar, effective microwave power 100 W.

Soiling and cleanability

The aim was to find, whether there is difference in soiling degree and cleanability between polyester fabrics. Cleanability of stained textiles was evaluated by the SAD (soiling additional density) analysis (Badrul 2007).

Testing pieces of each fabric with 1cm x 1cm size were immersed into a SRP (soil release polymer) solution for 15 minutes. The SRP chosen for the investigation was Marloquest SL produced by Sasol Germany (Marl). A 1 g/l aqueous solution of the SRP was prepared with deionised reagent-grade water followed by drying overnight at 24°C in the open air.

In this thesis, a combination of two kinds of stain materials– paraffin oil and acethylene black– was used in the weight ratio of 97.98:2.02, respectively, according to (Jacobasch 1978; Kratzsch 1964). A 2 µl drop containing oil/black oil was applied to differently treated testing surfaces of each types of fabric– impregnated with SRP and untreated reference. For each fabric, 10 testing pieces were prepared by staining with the soil mixture followed by drying at 24°C in the open air overnight.

An aqueous mixture of anionic surfactant Marlon A350 (1 g/l) and non-ionic Marlowet 4538 (1 g/l), both from Sasol Germany (Marl), was used as a washing detergent. The samples were washed in the detergent at room temperature 15 minutes and rinsed 5 min with deionised water. Then they were dried overnight at room temperature.

Colour measurements on stained and washed fabrics were carried out with a usual scanner. Soiling additional density (SAD) was obtained from images with different grey intensities using the equation (Rees 1954)

$$SAD = \log \frac{R_{reference}}{R_{stained\ or\ washed}}$$

Where, *R* is a reflection ability factor calculated from digitised images using Origin 7.5, data analysis and graphic software. Every picture scanned is represented by a two-dimensional image as a finite set of digital values (picture elements). Picture elements are the smallest individual element in an image, holding quantised values that represent the brightness of a given colour at any specific point. Colour images were automatically converted into greyscale images by Origin 7.5. *R* was calculated as a sum of all quantised values on grey scale for each image. $R_{stained}$ is the reflection ability factor for a surface after staining before washing. R_{washed} is the reflection ability factor for a surface after staining and washing.

Surface cleanability (or 'percentage cleanability') is defined according (Flath and Muller, 1967) as

$$\Gamma = \frac{SAD_{stained} - SAD_{washed}}{SAD_{stained}} \cdot 100\%$$

In order to compare the cleanability of different substrates, relative cleanability $\Delta\Gamma$ was considered:

$$\Delta\Gamma = \Gamma_{after\ washing\ \ (treated\ with\ SRP)} - \Gamma_{after\ washing\ (untreated)}$$

RESULTS AND DISCUSSION

Here PET fabrics were modified with NH_3- and O_2-plasma using different treatment durations. Fabric samples of 1cm x 1cm size were submitted to soil release analysis. Two µL oil drops of paraffin oil and acethylene black mixtures were used as soil material. An aqueous mixture of anionic surfactant Marlon A350 (1g/L) and non-ionic Marlowet 4538 (1g/L), both from Sasol Germany (Marl), were used as washing detergent. With the help of the equations presented in experimental part, cleanability percentage $(\Delta\Gamma\%)$ and difference of cleanability $(\Delta\Gamma)$ were obtained.

Cleanability in case of NH_3 plasma

After gradually increasing the plasma treatment time, it is significantly seen that the cleanability percentage $(\Gamma\%)$ is gradually increased in case of SRP and without SRP and the difference of cleanabilit percentage $(\Delta\Gamma\%)$ is also increased gradually, shown in Table 2 and Table 3 correspondingly Fig. 1 and Fig. 2.

Table 2. Cleanability of origin fabric

Cleanability $(\Gamma\%)$		Cleanability difference $(\Delta\Gamma\%)$
SRP	Without SRP	
22.51	14.55	7.96

Table 3. Cleanability of NH_3 plasma modified fabric

Treated time	Cleanability $(\Gamma\%)$		Cleanability difference $(\Delta\Gamma\%)$
	SRP	Without SRP	
2 min	3.92	3.32	0.60
5 min	6.10	4.94	1.16
10 min	12.86	10.26	2.60

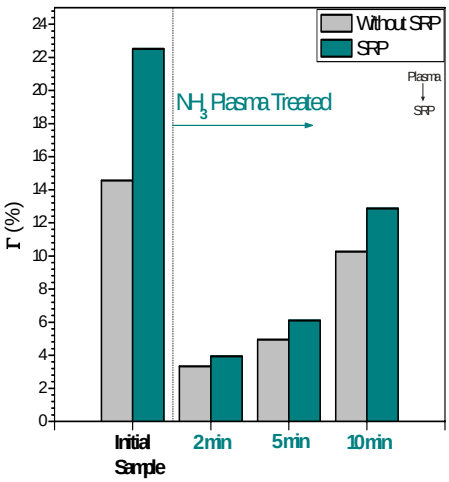

Fig. 1. Cleanability of NH_3 plasma modified fabric

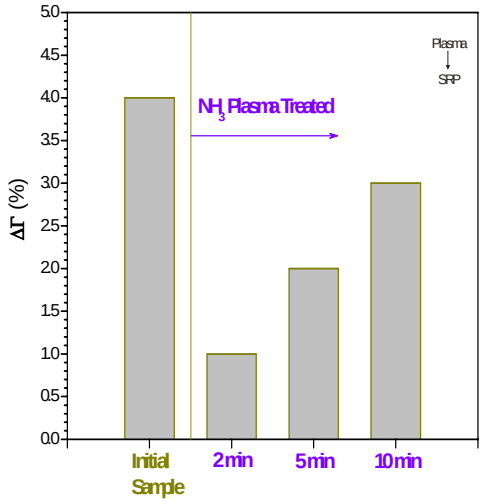

Fig. 2. leanability difference of NH_3 plasma modified fabric

Cleanability in case of O_2 plasma

In case of O_2 plasma treatment, the cleanability percentage ($\Gamma\%$) is increased in a linear way, both in case of SRP and without SRP and the difference of cleanabilit percentage ($\Delta\Gamma\%$) is also increased gradually, shown in Table 2 and Table 4 correspondingly Fig. 3 and Fig. 4.

Table 4. Cleanability of O_2 plasma modified fabric

Treated time	Cleanability ($\Gamma\%$)		Cleanability difference ($\Delta\Gamma\%$)
	SRP	Without SRP	
10 sec	3.02	2.67	0.35
20 sec	7.61	5.75	1.86
40 sec	11.69	9.29	2.40

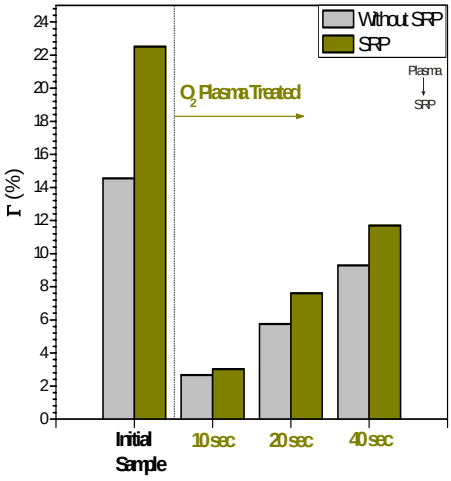

Fig. 3. Cleanability of O_2 plasma modified fabric

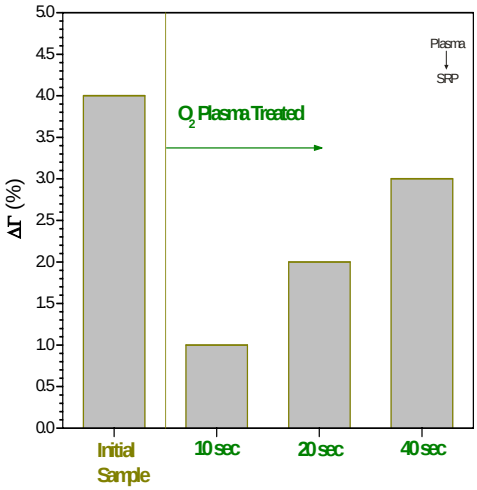

Fig. 4. Cleanability difference of O_2 plasma modified fabric

Comparison study

According to Figs. 1 and 3, NH_3- and O_2-plasma treatments respectively cause an important decrease of fabric cleanability. However, by longer irradiation durations, cleanability increases linearly in both cases.

Figures 2 and 4 show that the effect of SRP-impregnation on cleanability ($\Delta\Gamma$) is proportional to the measured cleanability on non-impregnated textile surfaces.

CONCLUSION

The main objective of the present study was to verify if plasma treatment of PET fabrics can improve the effect of the posterior impregnation with SRP in order to increase cleanability. Results show that plasma irradiation time really improves the effect of SRP-impregnation on soil release. However, cleanability values obtained show that the effect is not better than the observed by untreated fabrics before and after impregnation with SRP.

REFERENCES

Badrul Hasan MM (2007) “Untersuchungen der Oberflächeneigenschaften von gewebten Textilmaterialien aus Polyesterfasern verschiedener Geometrie ”, Master thesis.

Flath HJ, Muller G (1967) “Zur Bewertung und Verminderung der Anschmutzung von Synthesefasererzeugnissen”, Textilveredlung 2, p. 34.

Jacobasch HJ, Grosse I (1978) “Probleme der Erzeugung und Bewertung von Schmutzabweisenden Effekten”, pp. 28-36.

Kratzsch E (1964) “Ausrüstung von Diolen-Gardinen unter dem besonderen Aspekt von Vergrauung und Vergilbung”, p. 1127.

Rees WH (1954) “The soiling of textile materials- An account of the general problems with some observations”, Journal Textile Institute 45, p. 612.