Control of the performance of a stain repellent treatment by image analysis

Monia Kabbari, Faten Fayala, Adel Ghith, Noureddine Liouene

***Abstract*— The production of self-cleaning textiles is of great interest to the textile industry. This field concerns various textile products which are full around us. Among them, baby clothes that required many functions to be suitable for using. Such textiles, to be resistant to the use ageing, should be essentially stain repellent. The use of fluororocarbons to product such textile has been attracting much interest both for commercial reasons and the need of an environmental sound alternative. The purpose of this research is to study the efficiency of a chemical treatment applied on plush knit used for baby clothes by a fluorocarbon resin using image analysis.**

***Index Terms*—Fluorocarbon resin, image analysis, plush knit, stain repellent.**

I. INTRODUCTION

Performance textiles are a new paradigm for the textile industry and represent one of the fastest growing sectors of the industry. Performance textiles are textiles that provide additional functions such as repellency, resistance, or protection from a specified element including fabrics that resist wrinkles, soils, or odors, and/or protect from an environmental condition. They were first introduced in the active wear and outdoor markets, for a wide range of athletics such as aerobics, running, cycling, hiking, swimming, and skiing. Today performance textiles are not limited to sports and outdoor enthusiasts; they are crossing over the boundary into everyday fashion and home furnishings.

'Stain-repellent' finishes enable spills to bead up and roll off or allow them to be gently blotted off. The stain repel function is often associated with liquid or water-based stains, such as coffee or juice but can also prevent dry soils and dirt from sticking to the surface of the fabric. On the other hand, 'stain/soil release' finishes work with ground-in and oily stains, those stains that tend to penetrate the fabric more intensely. The release function allows the soil to wash out easily during clothes washing or carpet cleaning. Stain repel/stain release chemistries that make this performance possible include fluorocarbons, silicones, and urethanes applied as nano-sized particles that will provide the performance without altering the texture and appearance of the fabric. Home furnishings as well as the fashion market have benefited from these new technologies, for example Eddie Bauer's Nano-Care® chinos and Levi's Dockers® Go Khaki™ with Stain Defender® that offer wrinkle and stain-resistance, and Teflon® Advanced Carpet Protector that protects carpet and upholstery from dirt and stains and facilitates easy maintenance [1].

To evaluate the efficiency of textile treatments, the image analysis was used by several researchers, in a study of a Bloodstain Patterns on Textile Surfaces [2], a synthetic blood recipe patterned after ASTM F1819-07 was used. The mixture was altered to mimic the viscosity and surface tension of real blood for reliability of results. Single 10-100 µL drops of blood were dropped on plain woven and knitted fabrics. High-speed video imaging confirmed the absence of accompanying drops from the source. Testing analyzed the drop height, drop size, warp angle, fabric angle, good photographic methods and documentation of these factors as well as the stains were employed. The image analysis method is used to study the effect of various relaxation processes on fabric regularity and stitch shape [3]. . Using the principles of image analysis, an automatic fabric evaluation system was developed, which enables rapid structure-analysis of knitted [4].

With an image analysis compounded from Nikon microscope, CCD camera and NIS Elements software, the influence of various tones of colors on measuring porosity of knitted fabrics printed by sublimation was studied [5].

The aim of our work is to investigate the effiency of a stain repellent treatment applied on plush knitted fabric by means of the image analysis of the behavior of some stains on samples surface during the time.

II. EXPERIMENTAL:

A. *Materials:*

One sample made of PES/cotton plush knit fabric is used for this study. It is composed with two types of yarns (plush yarn and ground yarn), this knit is used for baby clothes made on a single bed circular machine (Gauge E 20, diameter 30 inch). To modify the surface properties of this sample, a chemical treatment was applied using a cationic fluorocarbon resin.

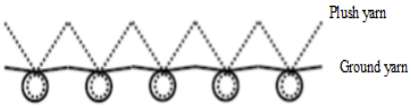

Figure 1: tying of plush knit [6]

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Fluorocarbon repellent finishes are formed by modifying an acrylic or urethane monomer with a perfluoro alkyl group. These perfluro alkyl chains are extremely hydrophobic and provide excellent repellency.

B. Image analysis:

Microscopic analyses are essential in nanotechnology. Electron microscopes are one of the most common analysis instruments that use the interaction of emission ray of electrons with the sample atoms to provide magnified image. There are several types of electron microscopes according to the type of electrons that has been using for producing image.

Image analysis can be applied to investigate the surface condition, purity and the structure of uncoated fabric. The development of surface analysis technique is first closely coupled to specific analytical methods used for example to determine the morphological and structural changes. The use of a microscopic camera (Figure 2) linked to a computer allows the acquisition of images obtained using the software 'visioscal' 'to present the appearance of a stain on the textile surface during different time intervals. A white light source is reflected on the scanned object, which provides a magnification image suitable for examining the samples.

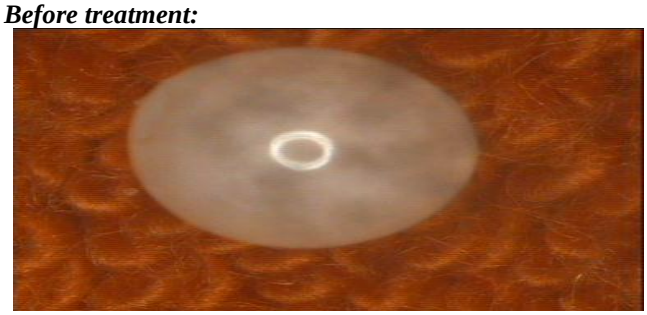
Figure 2: Video Microscope

III. RESULTS:

After treatment, to study the hydrophobic character of sample, we measured the contact angle, the wet strength and the air permeability. Results obtained showed that the hydrophilic sample was transformed to hydrophobic one with maintain of the hygienic comfort. To ensure this character we carried out to the application of two types of stains on the two most consumed food by babies (milk, soup). In our case the analysis of different images aims to control the absorption of the filed stain or not, and the presence of a trace or not after his disappearance. Figure 3 illustrate an example of the images that presented the behavior of a drop of milk deposited on the knit surface. Figure 4 shows the effect of a stain of 'Soup '. This analysis is performed before and after treatment.

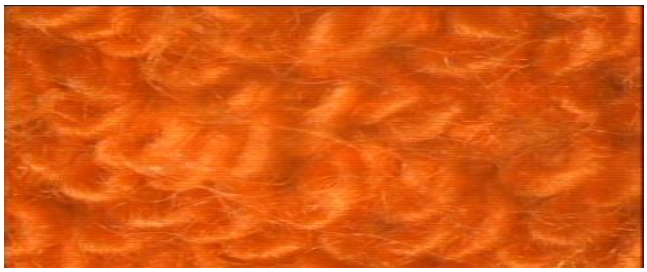
Absorption viewpoint: (Stain type 1 ''milk'')

Before treatment:



(t=0)

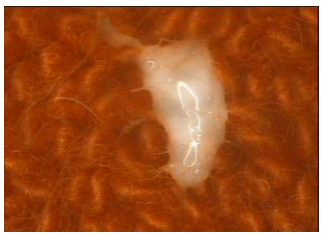
(t=10 minutes)



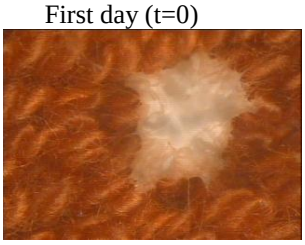
(t=1 hour)

After treatment:

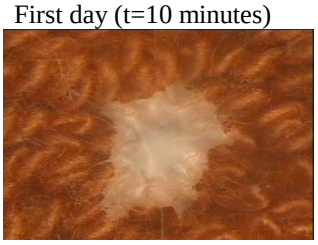
First day (t=0)



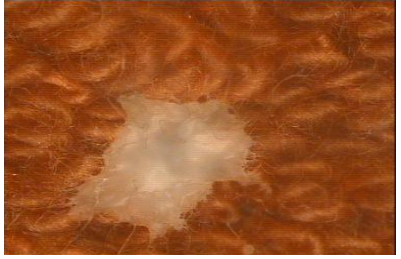
First day (t=10 minutes)



First day (1 heure)



Second day

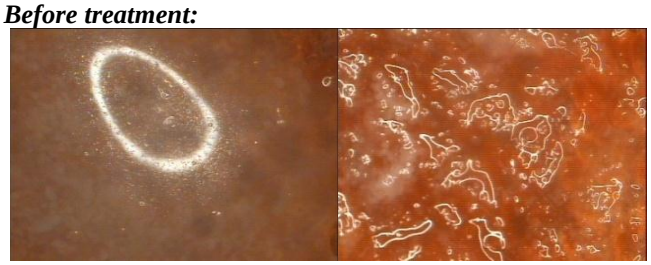


The seventh day

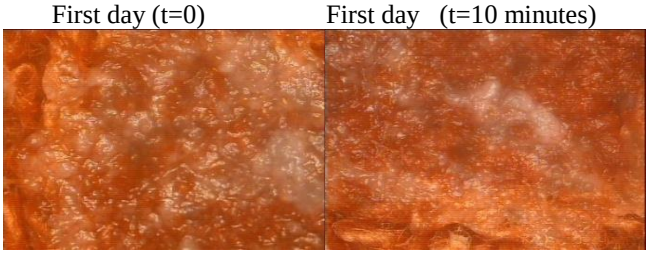
Figure 3: Microscopic visualization of the behavior of a drop of milk on the surface sample

Disappearance perspective: (Stain type 2 ''soup'')

Before treatment:



First day (t=0) First day (t=10 minutes)

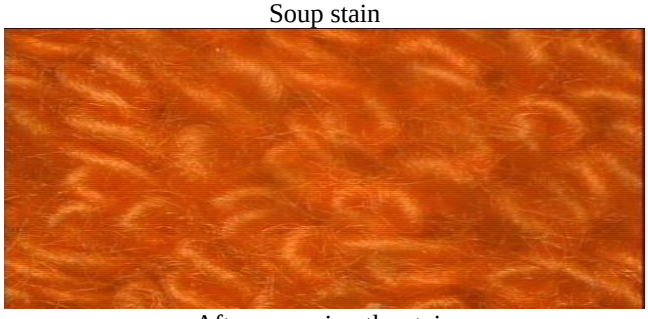


First day (1 hour) Second day

The seventh day

After treatment:

Soup stain



After removing the stain

Figure 4: visualization of the effect of the soup

IV. CONCLUSION:

The results of the analysis of the images showed that the stain of milk was completely absorbed before treatment for a very short duration and there is a persistence of the soup trace despite the removal of the stain in this case. By against, for the treated sample is found that the drop of milk is flowing to the surface at first otherwise it remains superficial and solidifies during the time without being absorbed. In the case of the soup stain it leaves no trace after removal in this case. Indeed, this behavior does satisfy history stain treatments in the textile industry who treat fibers in depth and prevent the penetration of dirt that remain superficial.

So, we can deduct that Application of fluorocarbon finishes can yield durable plush knit fabrics with excellent stain resistance and stain repellent properties. To strengthen our control tests, we can go later to sensory analysis to study the effect of treatment on the odor of applied stains.

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