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INFLUENCE OF RESIN TO BIND SILICA PARTICLES ON THE COTTON FABRIC

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Abstract: *Functionalization of textiles has been the aim of many studies in the field of intelligent materials. The aplication of nanoparticules on the fabric is one of approaches used for get textile functionalization. Normally, there is no attraction between inorganic particles and polymeric materials such as textiles. The difference between surface energy of two aforementioned organic and inorganic materials causes a kind of repellency in their interfaces. This problem is intensified by using nanoparticles because of their high specific surfaces In this research, treated samples with silica particles are compared to evaluate the effectiveness of the binder used. Cotton fabrics´ surfaces were observed by scanning electron microscopy (SEM) and energy dispersive using X-Ray (EDX). EDX technique showed that it was a suitable method to detect Si particles presence on fabric surface, this technique offers quantitive results which help to compare different formulations. We confirm that the treated fabric with resin contained higher quantity of Ti particles than the one treated without resin. We analyzed %weight (Si/O) for unwashed and washed treated samples with and without binder. We concluded that whased samples which had been treated using acrylic resin contain higher quantity of the silica particles onto fabric than those whased samples which had been treated without resin.*

Key words: *Silica particles, SEM, coulter, durability, washing machine.*

1. INTRODUCTION

Functionalization of textiles has been the aim of many studies in the field of intelligent materials. The aplication of nanoparticules on the fabric is one of approaches used for get textile functionalization. These can impart new properties to the fabric, such as antimicrobial [1], UV protection [2], self cleaning [3], flame retardancy [4], hydrophobic [5], etc. These properties depend on the type of particle used.

Normally, there is no attraction between inorganic particles and polymeric materials such as textiles [6]. The difference between surface energy of two aforementioned organic and inorganic materials causes a kind of repellency in their interfaces. This problem is intensified by using nanoparticles because of their high specific surfaces [7]. Consequently, surface modification of textiles with nanoparticles is not permanent, especially against washing.

The aim of this work was to determine the influence of resin on the presence of silice particles on the fabric surface after the application of washing cycles. Therefore, we treated the fabrics with domestic washing cycles, and analyzed the way in which particles are lost from the fabric surface by means of image analysis.

For surface observation, a scanning electron microscope was used. Each sample was fixed on a standard sample holder and sputter coated with palladium and gold. Samples were then examined with suitable acceleration voltaje and magnification. To get a quantitive result the washed and unwashed samples were analyzed by energy disperse X-Ray Spectroscopy (EDX-SEM).

2. EXPERIMENTAL

We used a 100% cotton fabric with the weight of 115 gr/m^2. All cotton fabric samples were impregnated with four diferent solutions. To study the behavior of the resin, silica particles and acrilyc binder STK-100, suministrated by Color-Center, were used. The size of the particles are around 3 μm.

We prepared four different solutions, these are shown in the table 1.

Table 1: *Formulation used in each treatment.*

Samples	Si Particles (g/L)	Resin (g/L)
10 Si	10	0
10 Si 5 R	10	5
5 Si	5	0
5 Si 5 R	5	5

The samples were immersed in the aqueous solution and then were passed through squeeze rolls to give a specified pick-up, we obtained 75% in both treated samples.

Treated samples were washed by following UNE EN ISO 6330 method no. 2A, 5 cycles of washes were carried out.

To verify the existece of silica particles on the fiber surface, treated samples were observed with a scanning electron microscope FEI model Phenom (Fei, Oregon, USA). Prior to sample observation, samples were covered with a gold–palladium alloy in a Sputter Coater EMITECHmod. SC7620 (QuorumTechnologiesLtd., EastSussex, UK). Samples were then examined with suitable accelerating voltage and magnification.

To obtain quantitive results Energy dispersive X-Ray (EDX) was used. Analyses were condusted using a Scanning Electron Microscope JEOL JSM-6300. All the electron microscopy images were obtained with an accelerating voltaje of 10 KeV. The EDX spectrums were also performed to verify the elemental composition of the deposited material on the fiber surface. Analysis of this data allowed comparisons of Si particles at different locations on the fabric.

3. RESULTS ANS DICUSSION

To check the presence of the particles on the surface fiber, some images from SEM were taken from the fabrics that have been studied in this work. In Figure 1, we can observe the laundered treated samples with different concentration of silica particles.

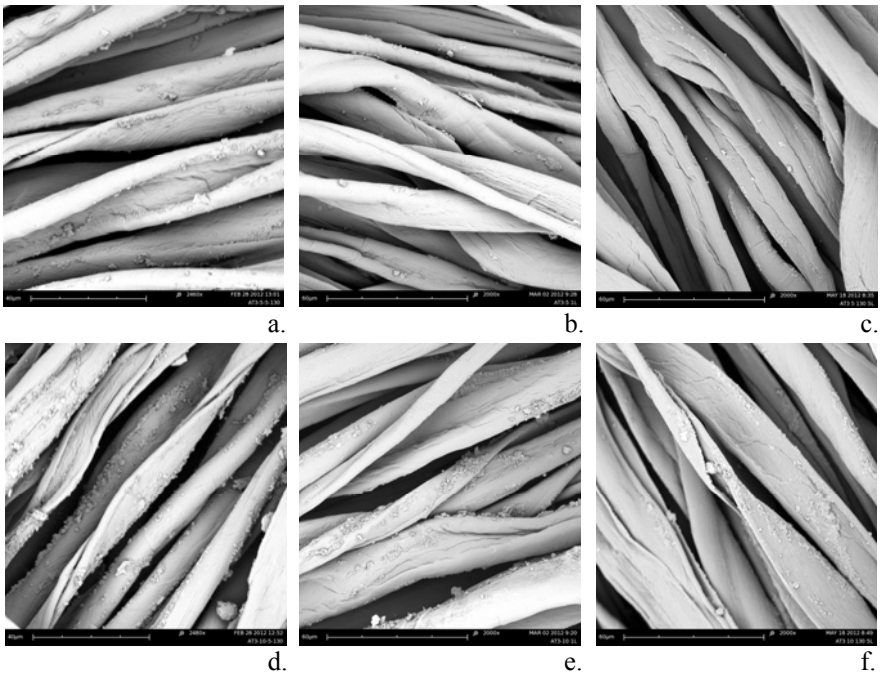

Fig. 1: *SEM images of the treated samples using different concentration of silica particles and 5 g/L of resin at 2000 magnifications.a, b, c)5 g/L silica particles and d, e, f)10 g/L silica particles. a, d) unlaundered samples, b, e) treated fabric after 1 washing cycle, c, f) treated fabric after 5 washing cycle.*

After the washing cycles, we can observe the presence of particles on the fabric, but when we used greater quantity of silica particles, the quantity of microcapsules on the fabric surface is higher in all cases. But images get by microscope SEM do not allow us to obtain a quantificate result. For this reason energy dispersive X-Ray (EDX) was used to compare different treatments. In order to know the quantity of Si bonded located on the fabric, every sample was analized on the same area (120x90 um), then we calculated the ratio Si atoms/O atoms, these results are represented in the figure 2.

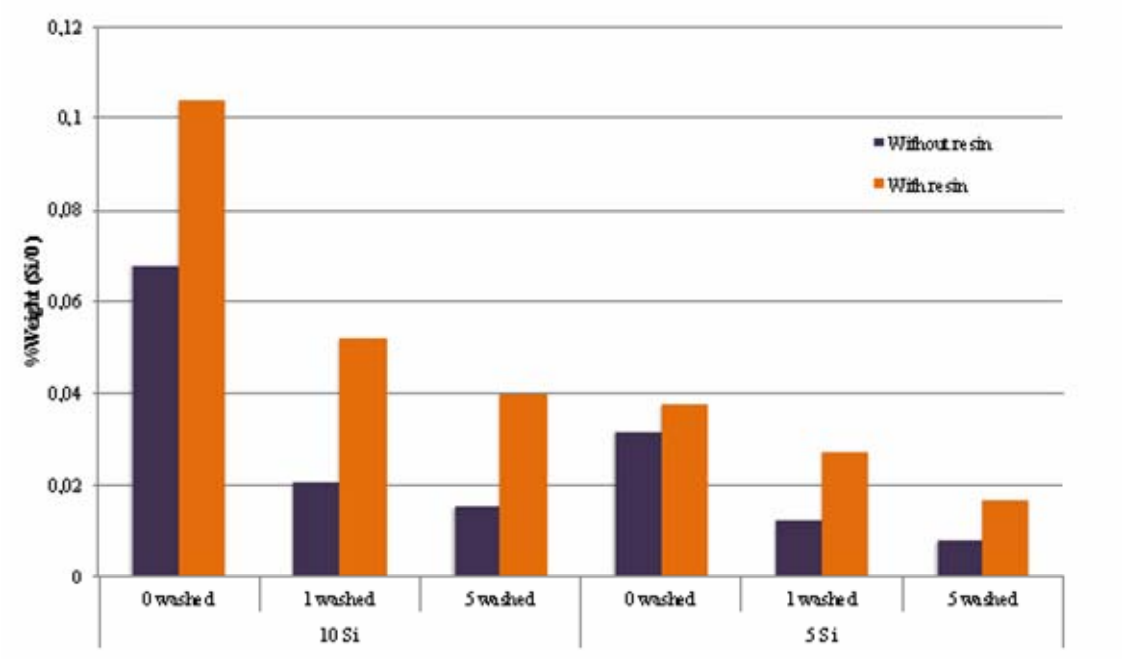

Fig. 2: *Representation the ratio %weight (Si/O) obtained of the treated samples with different silica particles concentration after different wash cycles.*

We can observe with these results that this ratio, which expres the quantity of particles on the surface of the analized samples, decreases when washing cycles are applied. If we compare the results between treated samples with different concentration of silica particles with and without resin, we can see that there are more quantity of the silica particles on the treated samples with resin after the aplication. As expected, this quantity decreases less than treated samples without resin after 1 and 5 wash cycles.

4. CONCLUSIONS

Samples analysis by EDX evaluated the effect of silica particles durability. We analyzed %weight (Si/O) for unwashed and washed treated samples with and without binder. We concluded that whased samples which had been treated using acrylic resin contain higher quantity of the silica particles onto fabric than those whased samples which had been treated without resin. This points out the acrylic resin as a good adhesive to join this kind of particles onto the fabric.

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