POLYESTER TEXTILE SURFACE ACTIVATION FOR ANTIMICROBIAL AGENT SUBMISSION BY USING PLASMA NANOTECHNOLOGY

Raluca Maria AILENI[1], Laurenţiu DINCA[2], Lilioara SURDU[3]

Abstract. *In this work is presented the advantages of using plasma nanotechnology for textile surface activation in order to permit Sanitized submission and resistance during the numerous washing cycles. The polyester untreated sample was analyzed by compared with polyester treated sample for observing and analyzing the modification that occurs.*

Keywords: nanotechnology, polyester, sanitized, antimicrobial, textile, surface activation

1. Introduction

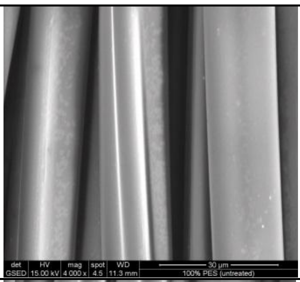
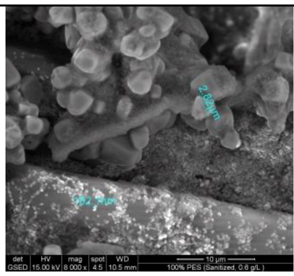
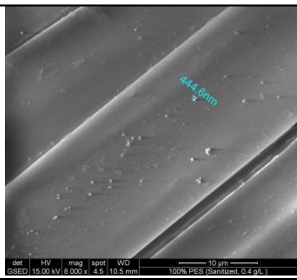
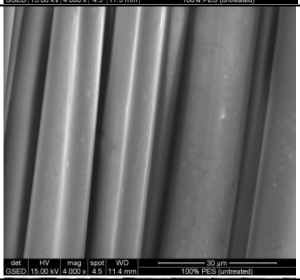
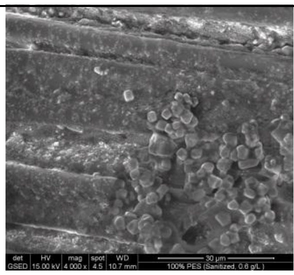
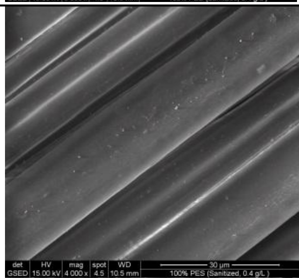
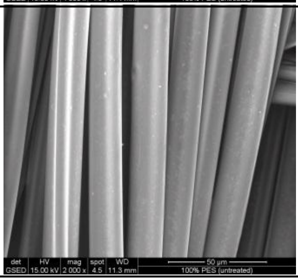
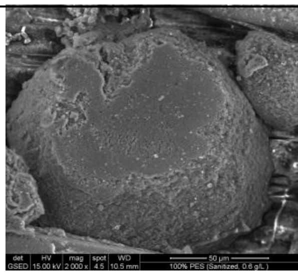
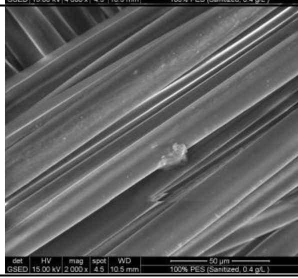
Because polyester is a thermoplastic polymer which has low surface energy, poor polarizability and need energy for bonding with additional chemical substance (sanitized), a way for increasing surface energy is to activate the surface by using oxygen plasma technology. Oxygen plasma surface treatment solves this problem by increasing polyester surface energies [1, 2]. For polyester textile surface activation was used oxygen plasma treatment in order produce polymer's surface modification for increasing the hydrophilic character [3, 4].

2. Experimental part and discussions

The experimental part consists in applying oxygen plasma treatment to polyester fabric in order to obtain surface activation. The treatment with sanitized solutions with 0.4 g/L and 0.6 g/L concentrations was applied to the samples treated for minutes in oxygen plasma [5]. For establish the sanitized treatment performance were analyzed by using scanning electron microscope (SEM) in table 1 and by using energy-dispersive X-ray spectroscopy microanalysis (EDAX). In case of untreated polyester, from SEM image (table 1), it was observed polyester fibres without Ag or Ti particles. In EDAX spectre is observed the absence of characteristics peaks for Ti and Ag (figure 1). The other chemical elements (C and O) that present in the spectre are due organics compound from textile fibres (figure 1).

[1]PhD. Eng. National Research & Development Institute for Textiles and Leather / University "Politehnica" of Bucharest, Romania (raluca.maria.aileni@gmail.com).
[2]Scientific Researcher, National Research&Development Institute for Textiles and Leather, Bucharest, Romania (laurentiu.dinca@certex.ro).
[3]PhD. Student Eng. National Research & Development Institute for Textiles and Leather, Bucharest, Romania (lilioara.surdu@certex.ro).

Table 1. Polyester samples analyze – SEM

Sample no.	Before plasma treatment	After plasma treatment and sanitized (0.6 g/L) treatment	After plasma treatment and sanitized (0.4 g/L) treatment
1			
2			
3			

In case of untreated polyester, from SEM image (table 1), it was observed polyester fibres without Ag or Ti particles. In EDAX spectre is observed the absence of characteristics peaks for Ti and Ag (figure 1). The other chemical elements (C and O) that present in the spectre are due organics compound from textile fibres (figure 1). From SEM images analysed (table 1), after polyester was treated in oxygen plasma and with sanitized (0.6 g/L), is observed a high density of Ag and Ti particles, having 180 ÷ 2800 nm dimensions. The treatment from textile surface presents non-uniform dispersion of Ag and Ti micro particles.

From EDAX spectrum is observed also very pronounced presence of peaks specific for Ag and Ti particles (figure 2). In percentage terms, Ag has a share of 25.16 % for spectral line L and Ti has a share of 19.15 % for spectral line K. The others chemical elements presences in spectrum are due settled dust or traces of detergent used (Na, Si, Al, S). The presence of C and O is due organics compound from textile fibers. It was observed the increased value for O line which is due the oxygen from TiO_2 (figure 2).

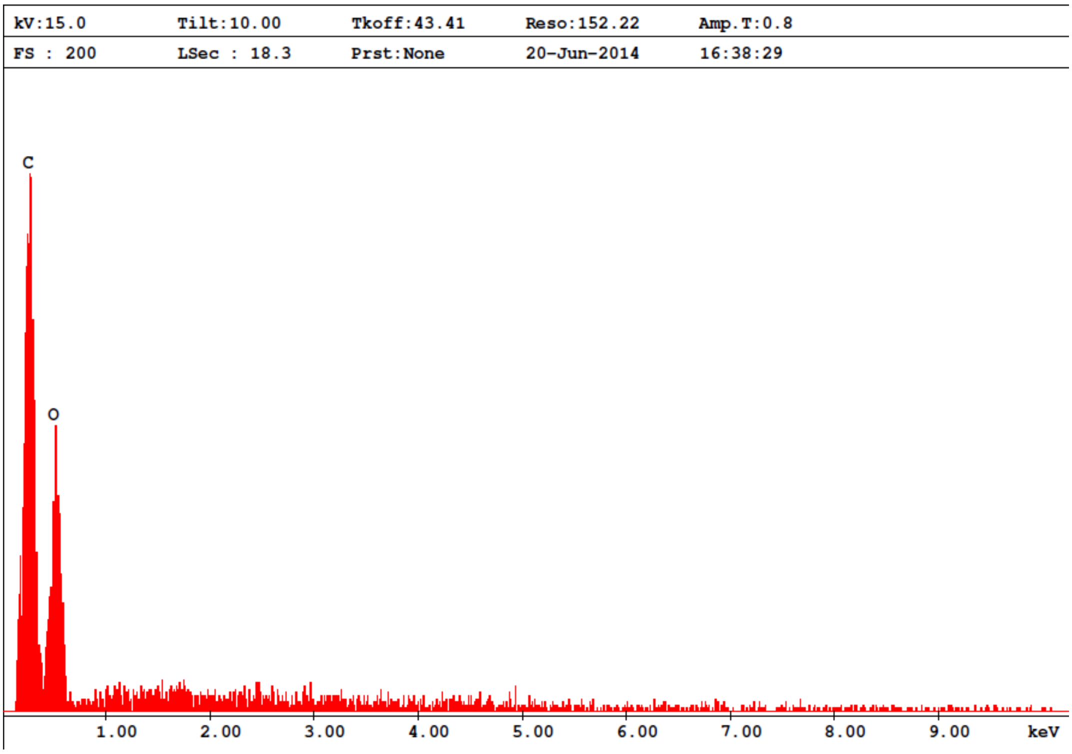


Fig. 1. EDAX – untreated polyester.

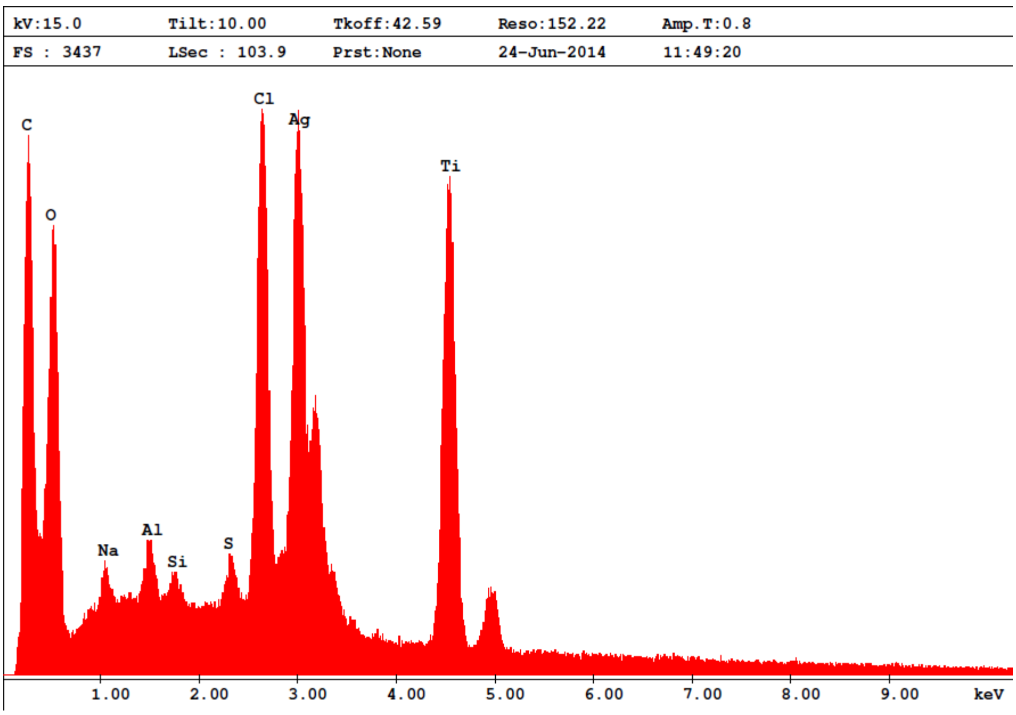


Fig. 2. EDAX – Polyester activated in oxygen plasma and treated with Sanitized solution 0.6 g/L.

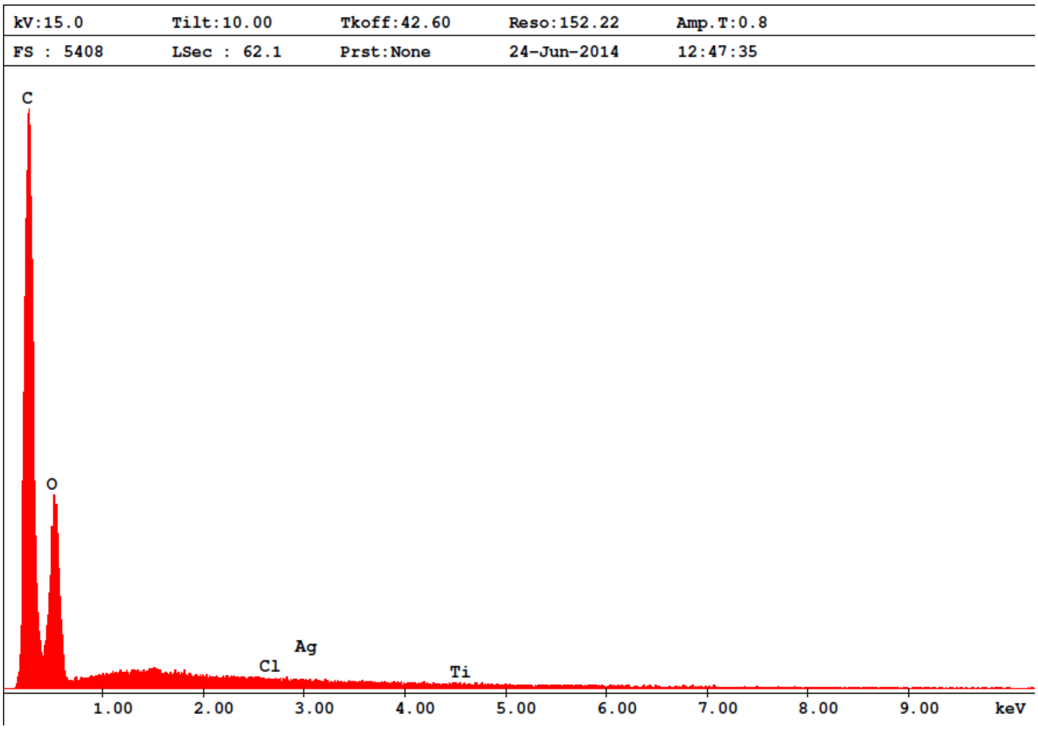


Fig. 3. EDAX – Polyester activated in oxygen plasma and treated with Sanitized solution 0.4 g/L.

After polyester was treated in oxygen plasma and was treated with Sanitized (0.4 g/L) was observed a low presence of Ag and Ti particles (table 1), with dimensions approximatively 440 nm.

The surface treatment presents non-uniform dispersion of Ag and Ti particles. In EDAX spectrum was observed low presence of peaks specific to Ag and Ti (figure 3). In percentage terms, Ag has a share of 0.42 % for spectral line L and Ti has a share of 0.36% for spectral line K. Presence of C and O is due organics compounds.

The TiO_2 contribution to O line is very low (figure 3). The observation regarding polyester treated with Sanitized solution 0.4 g/L indicate that the treatment is very low and the suspension concentration is under the minimum threshold.

Regarding oxygen plasma treatment for polyester, the experimental part was conducted by using variable time (10, 20, 30 and 90 minutes). After each treatment the samples were tested for tear strength, tensile strength and abrasion resistance [6, 7].

Tear strength is directly proportional with abrasion resistance and tensile strength (figure 4, 5, 6).

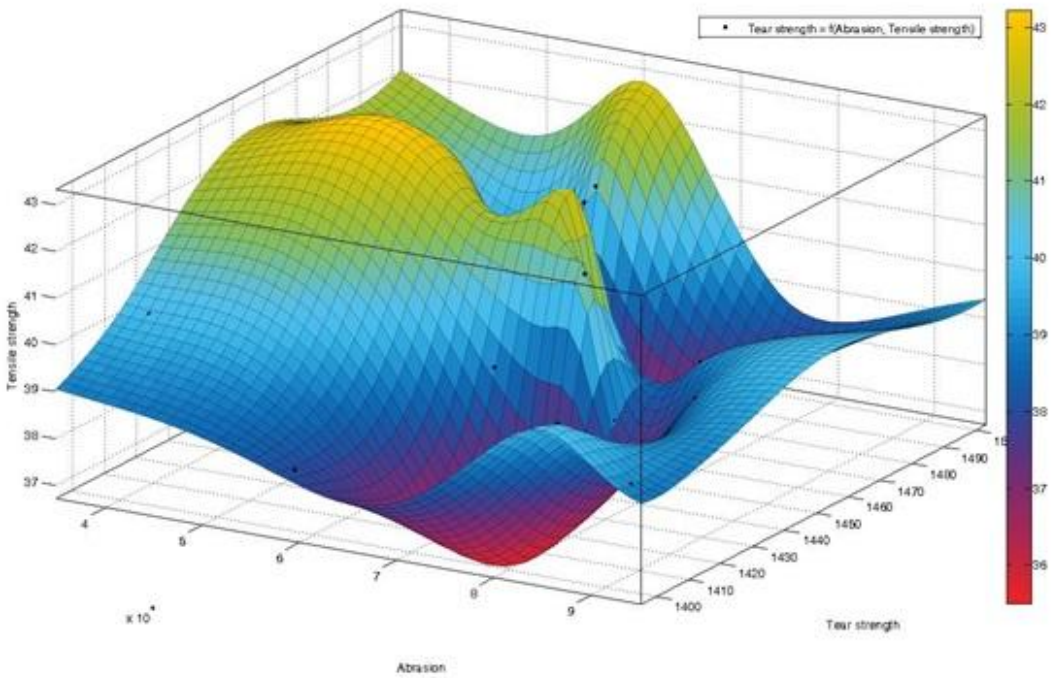


Fig. 4. Tear strength in function of abrasion and tensile strength.

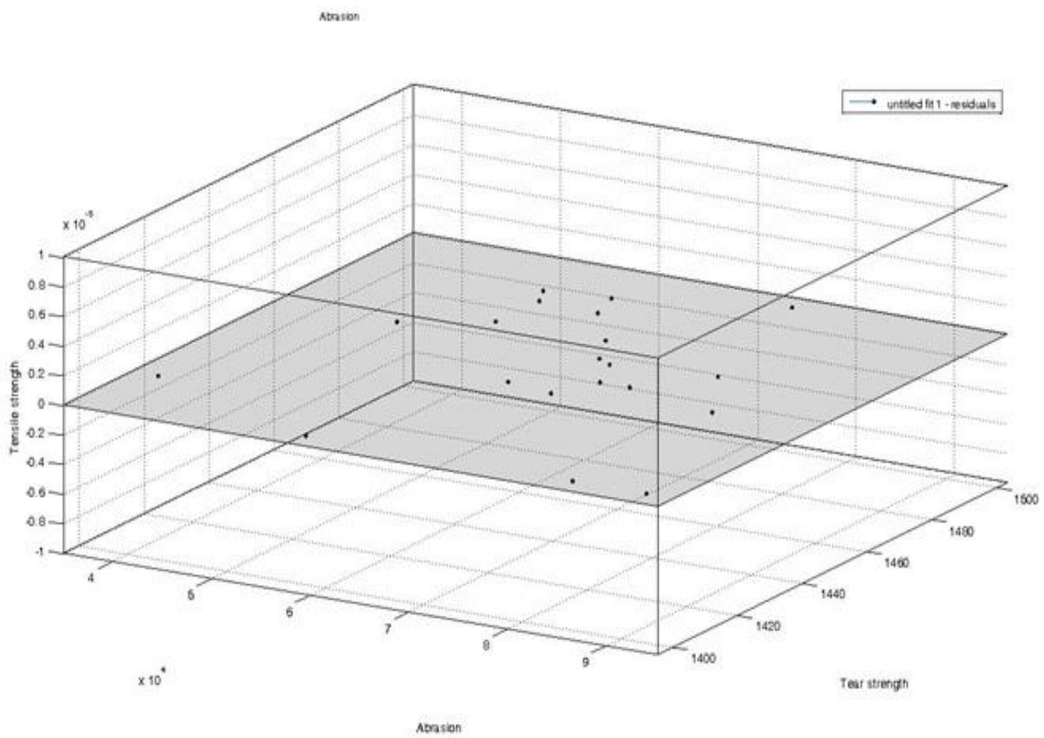


Fig. 5. Residual values Tear strength = f (abrasion, tensile strength).

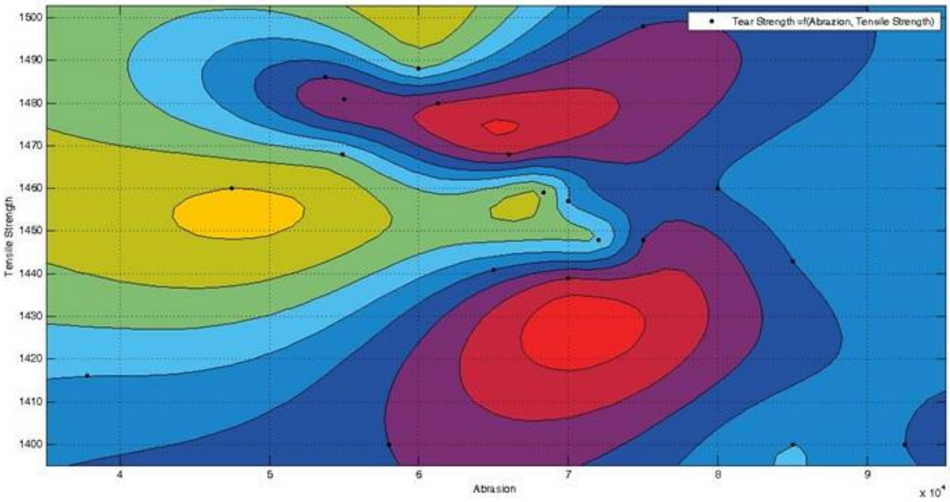


Fig. 6. Tensile strength (*Oy*) and abrasion (*Ox*) values mapping for highlight tear strength correlation with *x*, *y* values.

The evolution of values for physic-mechanical parameters, tensile strength, abrasion resistance and tear strength can be observed from histograms – figure 7, 8 and 9. After 20 minutes oxygen plasma was observed the tear strength, abrasion resistance and tensile strength have the higher values. After 90 minutes these physic-mechanical parameters know have very low values, which indicate that the textile material suffer an accentuated depolymerisation [8] (figure 7, 8 and 9).

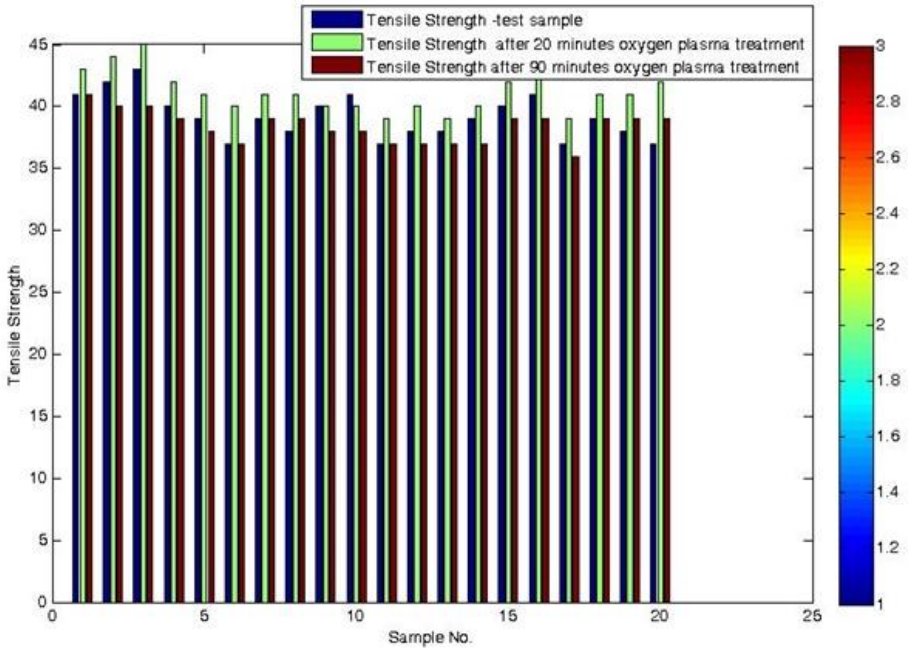


Fig. 7. Tensile strength histogram.

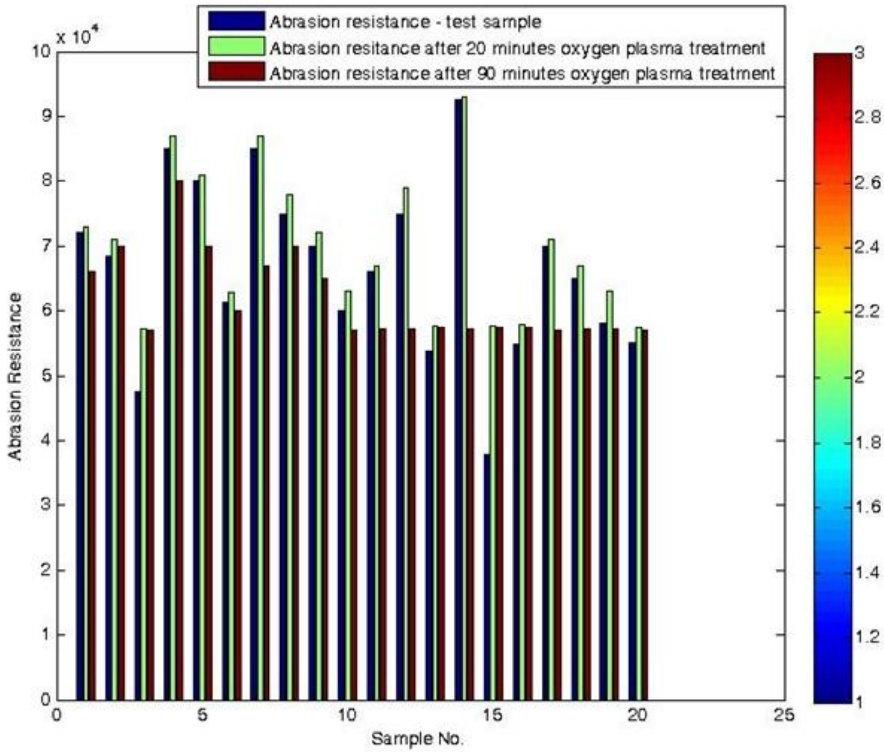


Fig. 8. Abrasion resistance histogram.

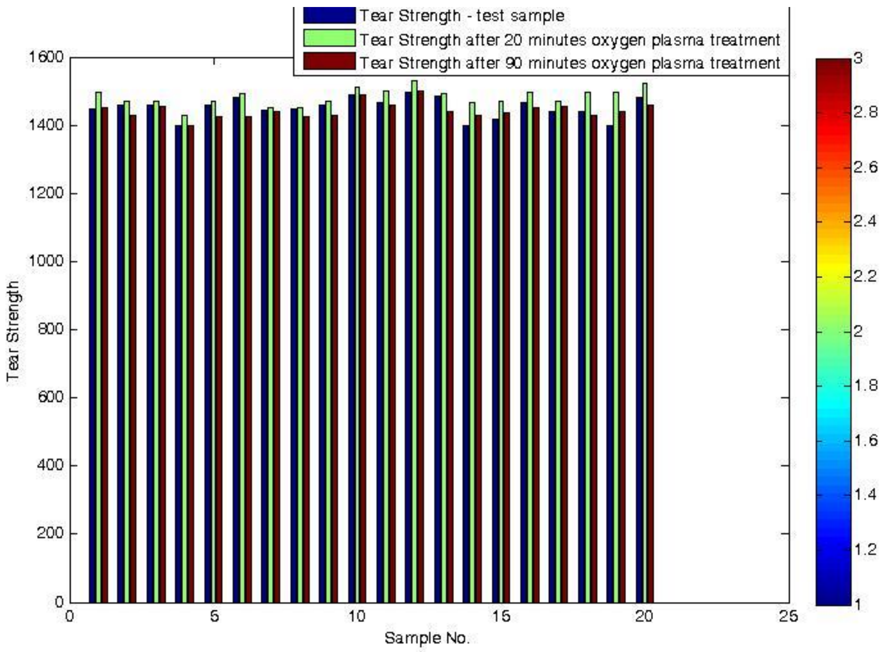


Fig. 9. Tear strength histogram.

6. Conclusions

The usage of plasma technology conducts to increasing the cost-efficiency for textile materials. Also the quantity of the waste chemicals substances from finishing process is minimized.

For obtaining clean and antimicrobial surfaces designed for hospital usage the treatment in plasma oxygen increase material surface affinity for sanitized substance.

The treatment with Sanitized solution is optimal for 0.6 g/L concentration, having a high presence of Ag and Ti particles on the polyester fabric surface.

Also the plasma technology has the advantage that obtains the surface activation in short time and saving energy, chemical substances and ensures environment protection.

Polyester fabric activated in oxygen plasma has the high values for mechanical parameters after 20 minutes [8, 9]. When the fabric is treated for 90 minutes it's occur an accentuated aging process, the resistances have lower values and practically the polymer is destroyed [9].

R E F E R E N C E S

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