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REDUCING THE ELECTROSTATIC CHARGE OF POLYESTER BY BLENDING BY POLYAMIDE STRINGS

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ABSTRACT
Electrostatic charge (ECS) is generated all around us from the contact of any two surfaces, but because it has many hazards and negative effects on human health, many methods are being used to reduce it in the environments where it may cause problems. This study aims to test a method of reducing ESC generated by polyester strings by mixing by polyamide strings.

It was found that, the value of ESC generated from the test specimens made from polyamide and polyester showed from half to quarter the value of the ESC of raw polyester when in contact with cotton, but the reduction was much greater in the case of contact with human skin. It is recommended to use this approach to reduce the value of ESC generated by polymeric fibers.

INTRODUCTION
It is well known that when two surfaces are in contact, an ESC is generated on both surfaces, where this phenomenon is known as triboelectrification, [1 - 3]. The type of charge that will be generated on each surface and its intensity can be predicted by a series that ranks materials according to the probability of the material to develop positive or negative charge when it contacts another material. This is called the triboelectric series, [4 - 6]. Triboelectrification usually happens when two different materials contact each other. But, it can also happen for identical materials, [7 - 9]. ESC can have negative effects, such as accelerating the growth of cancer, [10], start fires, [11 - 14], and it can also damage sensitive electrical appliances, [15]. In addition to that, ESC can also increase the friction coefficient between two surfaces, [16 - 18].

Polyester (PET) is one of the most widely used polymers in all different aspects. It can be used in a fabric in clothes and it can even be used as a resin. It is also used in nanomaterials and nanocomposites, [19 - 22]. This wide variety of uses is because of its interesting properties and its situated in the bottom part of the triboelectric series. Polyamide (PA) also known as nylon. It is also used in many areas, [23] and has lots of interesting properties, [24, 25]. It is situated at the top part of the triboelectric series.

Due to the negative electrostatic properties of PET and the positive electrostatic properties of PA, the idea of the present study comes out to investigate the effect of weaving PA and PET strings to have a fabric that has more neutral electrostatic properties than both PA and PET alone.

ESC generated from the friction of polytetrafluoroehylene (PTFE) textiles was tested, [26]. PTFE blended by cotton, wool and nylon, in a percentage up to 50 vol. % decreased ESC and consequently the proposed composites will become environmentally safe textile materials. It is necessary to reduce friction-induced injuries to skin such as blistering, [27, 28]. Sports may cause injuries induced by friction between the skin and sport textiles. The textile of socks that influence foot skin was studied. It was proved that textiles containing earthed conductive threads did not cause blisters, [29]. Isolated textiles caused ignitions.

ESC generated from the friction of hair and head scarf of different textiles materials were measured, [30]. Textile fibers such as cotton, nylon and polyester slid against African and Asian hair. The results showed that ESC measured for nylon represented relatively lower values due to the ranking in the triboelectric series where the gap between human hair and nylon is smaller than the gap between hair and cotton as well as hair and polyester. ESC generated from different polymeric textiles sliding against cotton was investigated, [31], where increase of cotton content in 100% polyester decreased ESC. The finer fibers, of the two rubbed textiles charged by free electrons easily exchanged the electrons of dissimilar charges, where the resultant indicated relatively lower ESC. The effect of dry sliding of hair against disposable cap as well as skin against face mask of people who are working in hospitals on ESC was investigated, [32], where the disposable cap showed negative and much higher values (-4000 volts). This observation necessitate to developing new materials for face mask of low ESC.

The present study aims to investigate a proposed method of reducing ESC generated from polyester by blending by polyamide strings.

EXPERIMENTAL

Test specimens were prepared from 0.48 mm radius PET strings weaved with 0.37 mm radius PA strings with a double weave as shown in Fig. 1in a 2.1 to 1 volume ratio of PET and PA respectively.

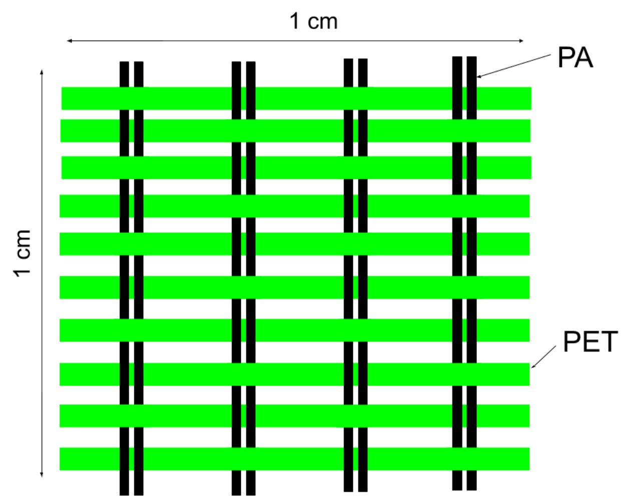

Fig.1. Test specimen.

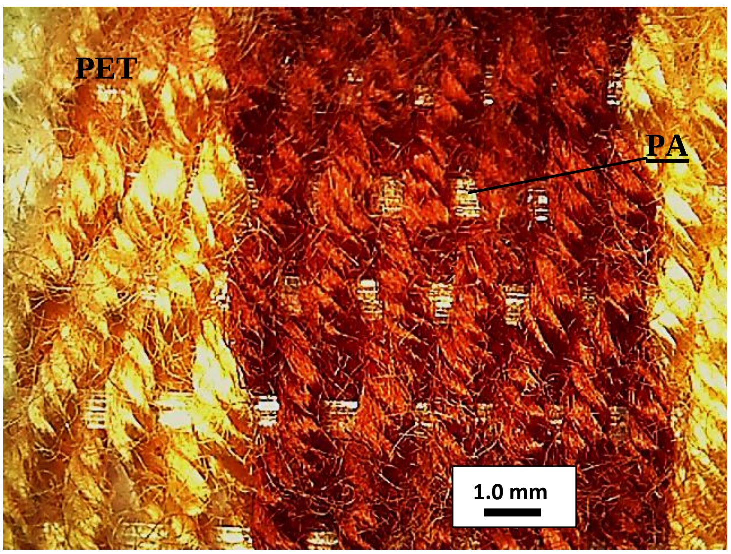

Fig. 2 Microscopic image of test specimen.

Three types of textiles were tested and compared, PET, PA as well as the blend of PET and PA specimens, where each textile was tested 4 times by sliding on cotton and human skin varying the distance and the load. ESC generated on the surface of every textile was measured using an AlphaLab inc. Surface DC Voltmeter SVM2, Fig. 3, where the values of ESC were recorded and the charges on the different types of textiles were compared.

Fig. 3 Surface DC Voltmeter SVM2.

RESULTS AND DISCUSSION

When varying the distance, the value of the charge was directly proportional to the ESC generated. ESC generated from the sliding of various textiles on cotton while varying the distance of each slide is shown in Fig. 4, where the value of the ESC generated by the test specimens was almost half the value of the charge generated by PET when slid on cotton. It was also displayed less than the value of the charge generated by PA.

The value of ESC generated by the test specimens (blend) was lower than that generated by PET when slid on skin. ESC dropped from -228.3V in the case of PET to -22V in the case of the test specimens, but the value of the charge generated by the test specimens was not generally different from the value of that generated by PA as shown in Fig. 5.

ESC slightly increased with increasing applied load. Values of ESC generally increased in the case of PA. ESC was negative in case of the specimen and PET due to PET being in the lower part of the triboelectric series. Because the value of the electrostatic charge increased with increasing load, ESC generated on both the specimen and PET decreased with load as shown in Fig. 6. The same behavior that was observed for the contact with cotton was displayed again for the contact with skin as shown in Fig. 7.

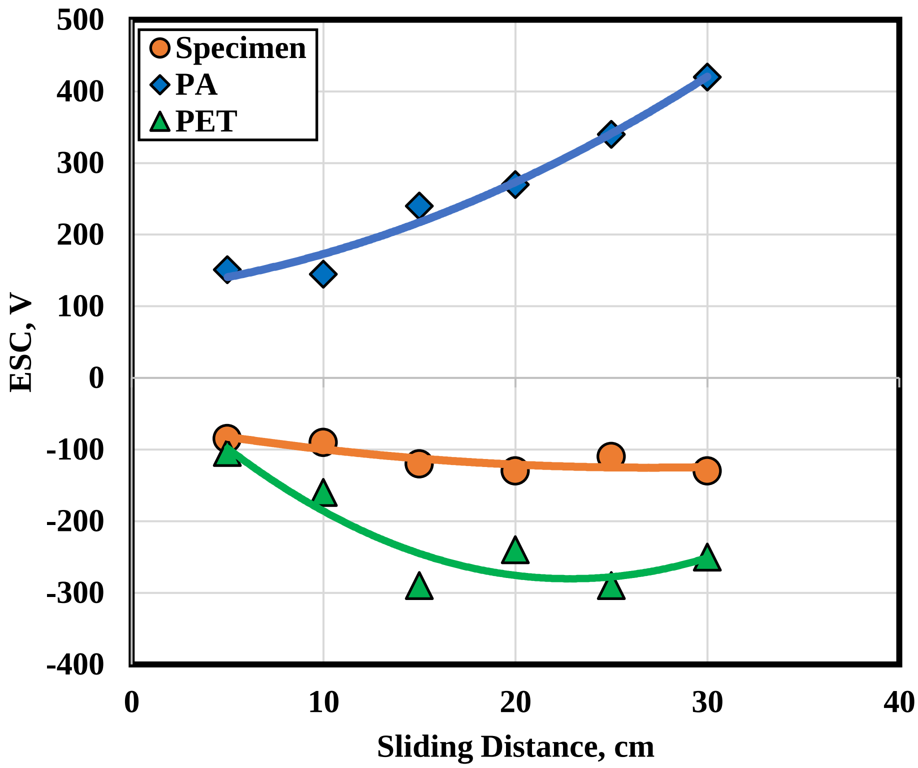

Fig. 4 ESC generated from the sliding of various textiles on cotton.

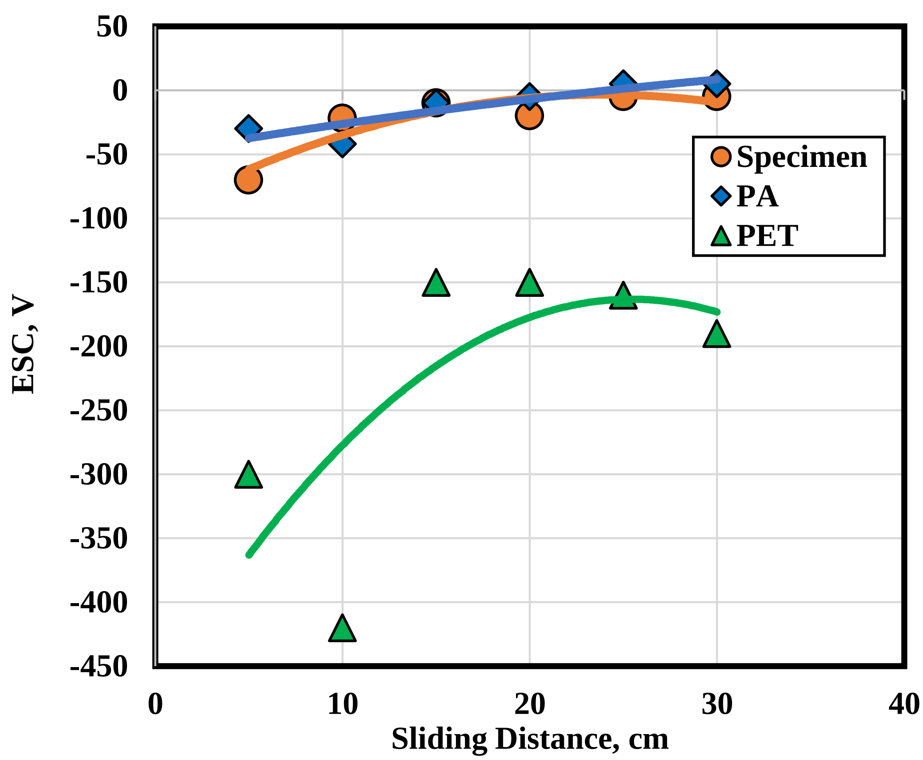

Fig. 5 ESC generated from the sliding of various textiles on skin.

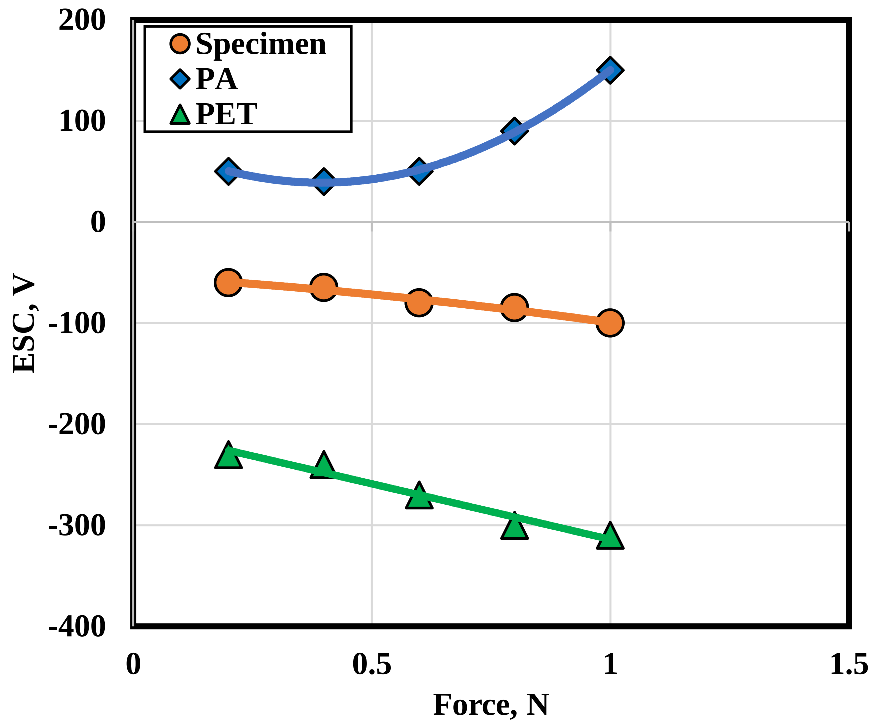

Fig. 6 ESC generated from the sliding of various textiles on cotton.

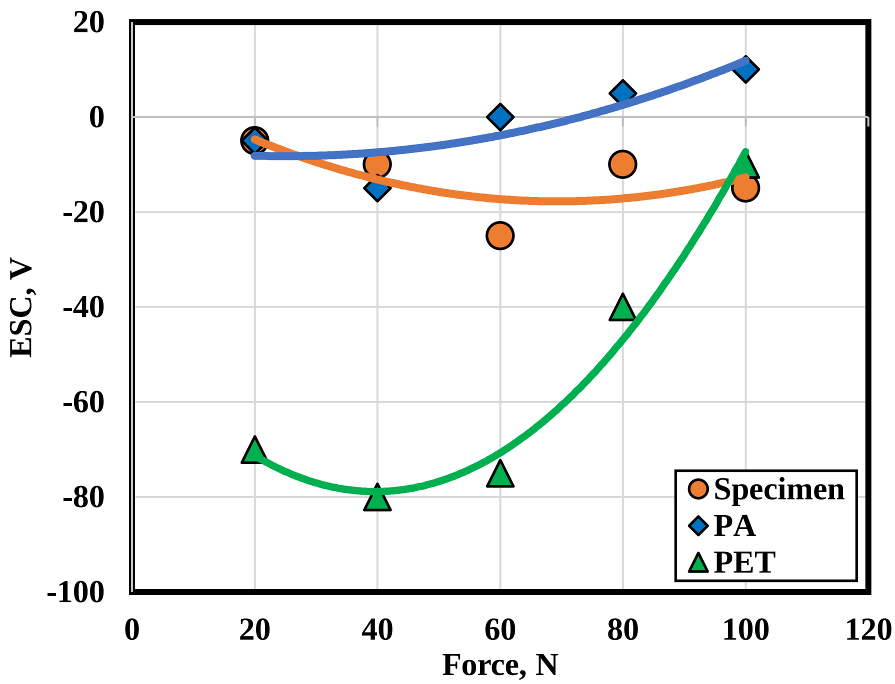

Fig. 7 ESC generated from the sliding of various textiles on skin.

CONCLUSIONS

From the above results, some points can be withdrawn as follow:

1. Blending PA with PET can reduce the value of ESC generated by PET strings greatly when in contact with an electrostatically positive material like human skin.

2. Adding PA to PET strings does reduce the value of the ESC generated by PET strings when in contact with an electrostatically neutral material like cotton.

3. The proposed test specimens generated ESC lower that than PET and PA.

4. In general, it seems that weaving an electrostatically positive material with an electrostatically negative material by a double weave with the right proportions can result in a textile with better electrostatic properties.

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