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Evaluating the Quality of Clothes and Gloves Used in the Hospitals in Saudi Arabia

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Abstract. In a hospital, doctors use anesthetic gases during operations. Some of these gases are explosive. If the gas escapes into the air, a tiny spark from static charge could make it explode. The reduction or avoidance of static charge in operating theatres and other rooms is necessary. The present work aims to investigate the quality of textiles in hospitals in terms of the electrostatic charge generated from the contact and separation. This can be achieved by studying the sliding of latex gloves of doctors, nurses, and other workers in hospitals against the textiles of clothes in dry working conditions.
Based on the results, the amount of static charge collected on the textile surface determines its quality. The finest grade textiles have the lowest static charge values. The static charge is created when sliding the gloves accumulates charge on the material and clothing. In dry conditions, the larger value of static charge was 240 volts, as shown on yellow clothing worn by physicians in operating theatres. For safe working in various workplaces, It's indeed necessary that pay careful attention to the particulars that impact performance in order to enhance the working environment of health care professionals. The following quality management policies and selection of textiles and clothing based on electrostatic charge is strongly advised. Hand and glove performance is extremely important for health care professionals. Glove makers, hospital administration, and health-care personnel all need to be more aware of the issues surrounding gloves. There is a need for procedures and tools that can detect issues with medical gloves.
Keywords: quality, textile, gloves, electrostatic charge

1. Introduction

Texts on learning the fundamentals of electrostatic phenomena, learning how to regulate electrostatic risks, and manufacturing and designing goods to defend against electrostatic hazards may be found in the literature of national and international standards across the world. Adoption and implementation of electrostatic norms are critical for the safety of life [1]. The criteria in this study enable businesses and people to put in place procedures to save products throughout their manufacturing, transportation, and usage, as well as workers in hazardous environments. Every standards body has a system for surveying and reviewing standards on a regular basis. Electrostatic guidelines are updated to reflect technical advancements and changes in our understanding of electrostatics. In order to distinguish between the context of circumstances for secure employment, when dangers to safety, loss, and protection of life and equipment in explosive atmospheres are vital, and regular living settings, the idea of electrostatic rest is offered. However a method which accounts for electrostatic relief necessitates a thorough comprehension of electrostatics and calls for particular answers, electrostatic relief has not been widely acknowledge. Static electricity problems are frequently misunderstood, with electrostatic discharges being blamed depending [2] or the AC magnetic or electric forces, or even the electrical assembly. Unrelieved tension and psychosomatic weariness can be caused by electrostatic discomfort. A technical reference sheet on electrostatic rest connotation might be extremely valuable for designers to utilize as a guide. It may also be suggested in construction codes to avoid situations that are difficult to recover from.

In addition to technical specifications, sensory assessment plays an important part in the correspondence of materials. Textiles differ from one another due to their fabricated structures; a good one should be strong, have good performance qualities, and be pliable, elastic, easy to pleat and shape, as well as pleasing to the eye and the senses [3]. The idea of "fabric hand" is widely employed to come up with a strategy for evaluating fabrics spectacularly. The obsession of the textile industry with "handle," or more broadly, "skin spectacular wear comfort," or "tactile comfort," has given rise to an intriguing field of study known as "handle," or more broadly, "skin spectacular wear comfort," or "tactile comfort."," as a result of current debates on understanding and measuring consumer preferences [4, 5] which also describes the full range of sensations experienced when handling or manipulating a fibers in the hands. Because textile handling is dependent on human tastes, It is obvious that to various people and consumers, it means different things [6]. Confirmed fabric type choices are numerous, and in some cases, even contradicting [7]. Hand has an impact on consumer preferences and perceptions of product utility, as well as the ability of retailers to sell clothing. This fabric specification is having precise criteria for developing and selecting fabric materials, which are mostly textiles prepared for use in apparels, for manufacturers, wear designers, and merchandisers [8].

When identifying materials and technical specifications, sensory evaluation is crucial. Textiles integration of relevant must be strong enough to fulfil their intended functions while also being flexible, elastic, simple to pleat and form, and pleasing to the eye and the senses. The term "fabric hand" is frequently used to identify a technique for the sensational appraisal of textiles [9]. Current textile industry research has focused on terms like as "handling," "skin sensational wear comfort," and "tactile comfort" [7, 10], that relate to the total feelings felt when a fabric is stroked or handled in the hands. have become important fields of interest. Identifying and quantifying consumer preferences has become one of these topics. Fabric handles clearly have different meanings for different persons and consumers from various ethnicities. because they are based on people's subjective tastes. There are many different and, in some cases, even opposing preferences for particular fabric types [11]. Hand has an impact on consumers' tastes and how useful they perceive a product to be, which in turn affects retailers' ability to sell the clothing. When creating and choosing textile materials, particularly those intended for use in clothes, manufacturers, garment designers, and merchandisers must take this fabric feature into consideration [12].

It is well-known that electrostatic discharge's unintended effects can result in major issues in a variety of circumstances, including product damage during electronic assembly, item quality problems, issues with worker numerous others [13]. Textiles (textiles, fabrics, and upholstery fabrics) common materials with a reputation for storing electrical charge. Textile materials must be created to have acceptable electrostatic characteristics in order to prevent the aforementioned negative impacts. Textile materials act as an electric fee capacitor because the dielectric substance is composed up of fibers and air voids [14]. There existence of an air gap in fibers and textiles can be described as a mixed-type capacitor dielectric layer to specify the electrical properties of textile materials. As a result, a wide range of electrical properties of fabrics or textile products are affected by topography, compactness, chemical and thermal treatment of the final product, as well as the atmospheric conditions in which the textile products are employed, or electronic conductivity is measured. Fabric material buyers seek out goods created with acceptable electrostatic characteristics. It is essential to measure and evaluate their properties.

The majority of materials used to make textile items are electric insulators, and the primary electric characteristic that is measured is surface resistance, which fluctuates wildly between 1013 and 106 [15]. Highly surface-resistance materials can carry an electrostatic charge, as is common knowledge. A significant electrostatic environment can be generated. be created and maintained by an amassed electric charge. A measurably large surface potential can be used to identify this electric field. When studied, Therefore, the basic electrostatic properties of the textile material can be revealed by the surface voltage and voltage dynamics. The European standards, which specify the test techniques for evaluating surface resistivity, are available here give widely-used techniques for determining the electrostatic characteristics of textile materials [16], Research and assessment facilities for textile materials use Electrically charged deterioration and electric conductivity via a material [17, 18]. The Chinese standards for evaluating static properties, static voltage semi-decay of textile materials, and electrostatic discharge testing of textiles [19] also cover assessments of electrostatic characteristics. Analyzing test procedures in further detail reveals that measurements textile materials are based on methods that, in some cases, cannot provide accurate measurements of electrostatic characteristics. enough details about the tested products. The technique outlined below has a few advantages from measuring the total area voltages plus amount of charges since the samples is affected by the ion flux. at the same time to provide more textile-related data. The technique can be modified to measure the dispersion of contact energy. So, in this post, we'll talk about a method for directly measuring electrostatic variables and how it might be used to look at the electrostatic characteristics of textiles.

The present work aims to investigate the quality of textiles in hospitals based on the electrostatic charge generated from the contact and separation. This is done by studying the sliding of gloves doctors, nurses and workers use in hospitals against textiles of clothes used in dry working conditions.

2 Experimental Work

During operations in hospitals, doctors use anesthetic gases. Some of these gases are explosive. (i.e. oxygen). If the gas escapes into the air, a tiny spark could make it explode. The avoidance of static charge in operating theatres and in the other rooms is necessary.

After measuring the electric static charge (electric static field) with an electrostatic charge meter, the (Ultra Stable Surface Voltmeter), the contact and separation of the specimens against rubber and to measure the generated charge under applied loads; see Fig. 1. This device measures electrostatic charge down to 0.1 volt on a surface, and up to 20 kV. Readings (Volts) are normally done with the sensor 25 mm from the surface being tested.

Fig. 1 Electrostatic charge (voltage) measuring device.

Using a test setup created and produced to measure friction, the normal load while rubbing the gloves against the textile of clothes, and between cotton and clothes. Two load cells are used to quantify the horizontal force (friction force) and vertically force applied to the tested textiles, which are put in a base (normal load). Figure. 2 depicts the test rig's configuration.

Sliding gloves of doctor and nurses in the hospital against the textile is shown in Fig. 3. The textile specimens were fixed on the table and attached with the load cells. The load cells measure the normal load applied from gloves on the textile. While sliding, the electrostatic charge was generated on the contact surface. The electrostatic charge accumulated on the gloves as well as the textile. Then the static charge was measured on the surfaces of both gloves and textile.

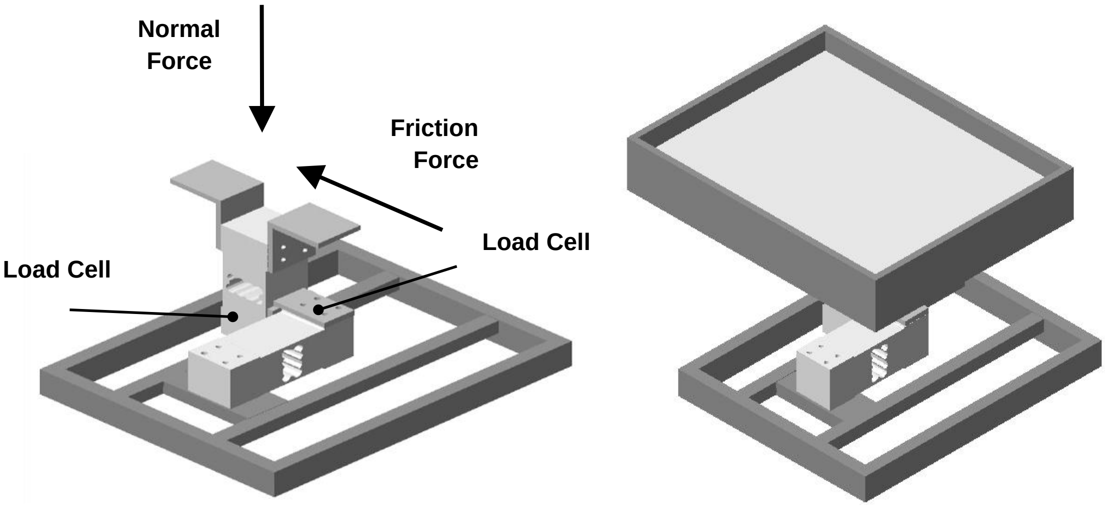


Fig. 2 Sliding test rig

Fig. 3. Gloves sliding against textile specimens.

Latex gloves for workers in hospitals

Latex gloves for doctors and nurses in hospitals

Fig. 4. Gloves used in hospitals

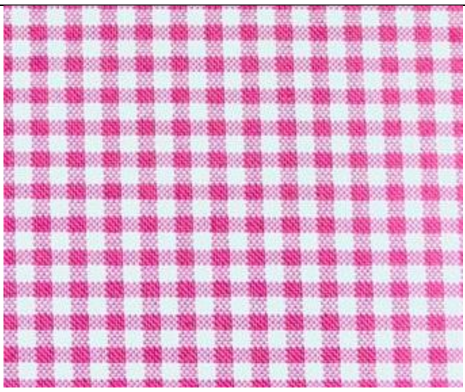
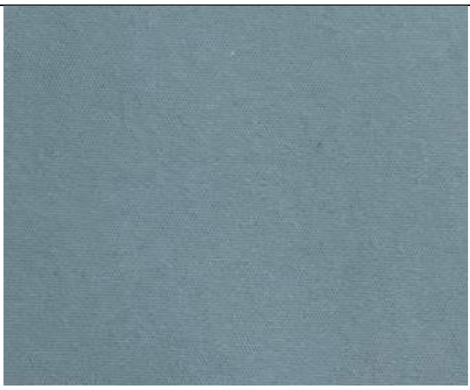
 **Bed sheet** **50%Polyester + 50%Cotton**	 **Clothes for diseased male**
 **Clothes for diseased female**	 **Yellow clothes for doctors in operating theatres**
 **Clothes for doctors in operating theatres, 65%Polyester + 35%Cotton**	 **Blue clothes for doctors in operating theatres**

Fig. 5 Textiles and clothes used in hospitals

3 Results and discussion

Along with technical specifications, quality evaluation is crucial for identifying materials. The integration of relevant of textiles vary from one another in that a fabric must be strong and function well while also being supple, stretchy, simple to form and pleat, and comfy in terms of sensory perspective. The term "fabric hand" is frequently to use when discussing a technique for evaluating textiles based only on their tactile qualities. Figure 6 shows the relation between electrostatic charge and the normal load on sliding the doctor's gloves against a bed sheet in dry condition. It is depicted in Fig. 6 with increasing the normal load of electrostatic charge. A large value of electrostatic charge is generated from the bed sheet. The maximum value of electrostatic charge was 140 volts at 120 N normal loads. This study recommends not using the bed sheet under a higher load.

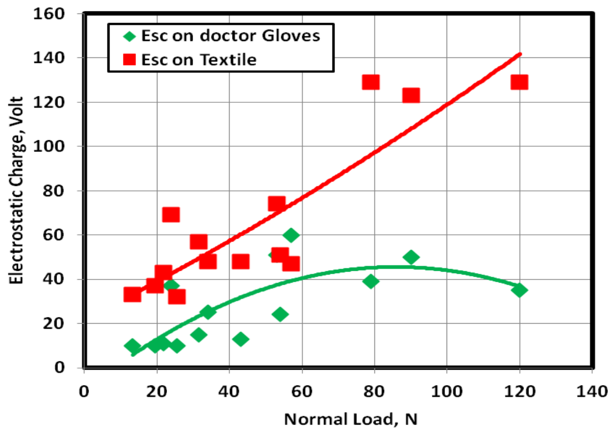


Fig. 6. ESC generated from sliding of doctor's gloves against bed sheet with content 50% cotton + 50% polyester, dry condition

The electrostatic charge of worker's gloves while sliding against the bed sheet in dry conditions is shown in Fig. 7. Electrostatic charge increases when normal load is increased. Worker's gloves generated greater electrostatic charge than doctor's gloves. The maximum value of electrostatic charge was 170 volt at 80 N normal loads. Hence, while using these types of gloves, a light load is beneficial to avoid the danger of static charges.

The electrostatic charge of doctor's gloves sliding against the clothes of male patients in dry conditions is represented in Figure. 8. The graph indicates that electrostatic charge increases with increased normal loads. This behavior may be related to more friction between the gloves and textile. Decreasing friction increases static charge and the gap between gloves and textile increases static charge. The maximum value of static charge was observed on the textile (170 volt).

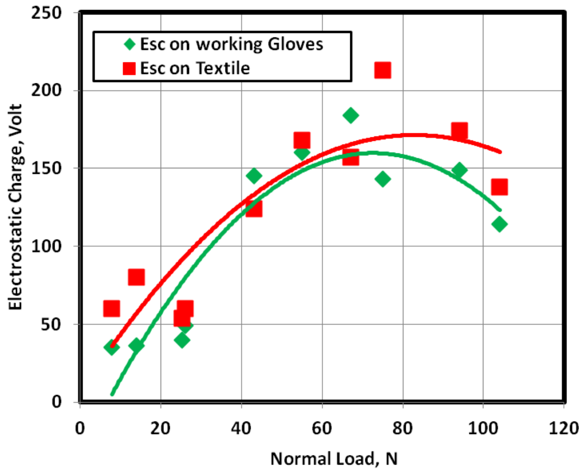


Fig. 7. Electrostatic charge generated from sliding of worker's gloves against bed sheet with content 50% cotton + 50% polyester, dry condition

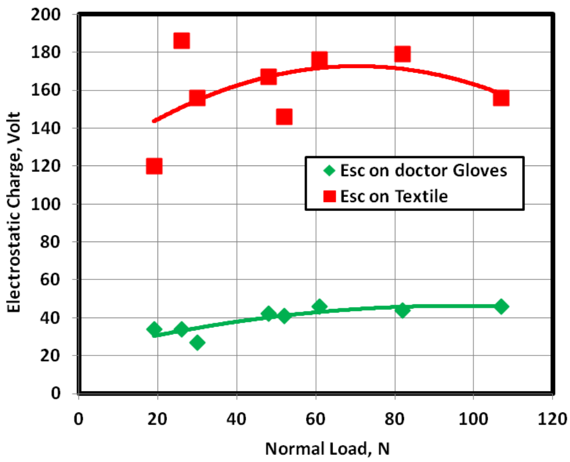


Fig. 8. Electrostatic charges generated from sliding of doctor's gloves against clothes for male patients, dry Conditions.

Figure 9 shows the static charge produced when employees' gloves are pressed to against clothing of male patients. Voltage generated from the sliding of workers gloves against clothes for male patients in dry conditions is illustrated. The static charge increases to maximum values with the increase in normal loads to 70 N. Static charge decreases when normal load is increased above 70 N. The textile accumulated a larger amount of static charge than the gloves.

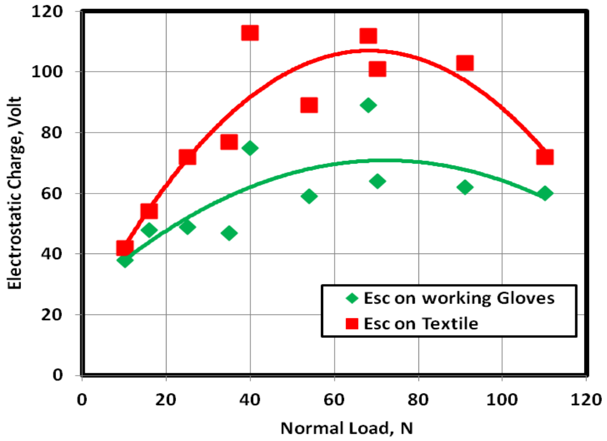


Fig. 9. Electrostatic charges generated from sliding of workrs gloves against clothes for male patients, dry condition

Electrostatic charge of doctor's gloves sliding against the clothes of female patients is shown in Fig. 10. Electrostatic charge increased when normal loads were increaseding normal loads. Increased static charge is related to decreasing friction as the normal load increases; this action increases the gap between gloves and textile. The maximum value of static charge was 67 volts observed at 80 N normal loads. The content of the textile may have generated more static charge.

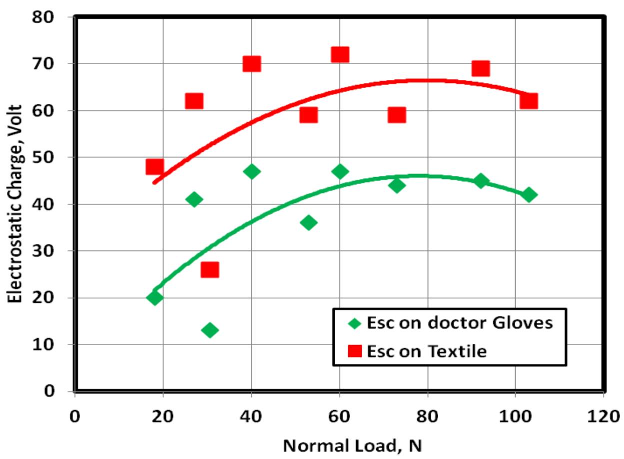


Fig. 10. Electrostatic charges generated from sliding of doctor's gloves against clothes for female patients, dry condition

Fig. 12 Shows the relation between electrostatic charge and normal load, for doctor's gloves sliding against the yellow clothes for doctor's in operating theatres. It can be observed that when the normal traffic rises, its electrostatic charge also does. This behavior may be related to decreasing friction as the normal load increases. The maximum static charge was 230 volts, as observed on the textile at 110 N normal load.

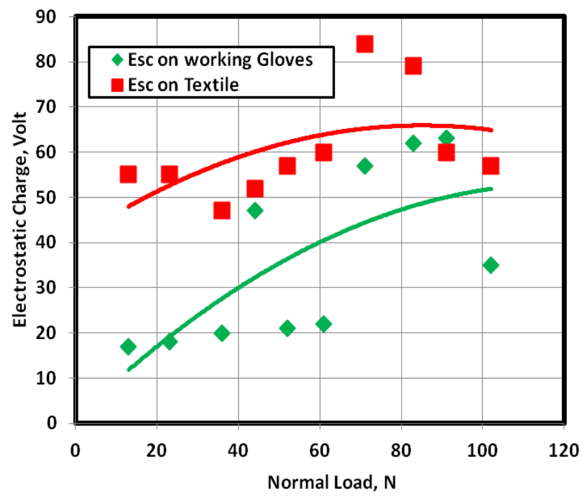


Fig. 11. Electrostatic charges generated from sliding of worker's gloves against clothes for female patients, dry condition

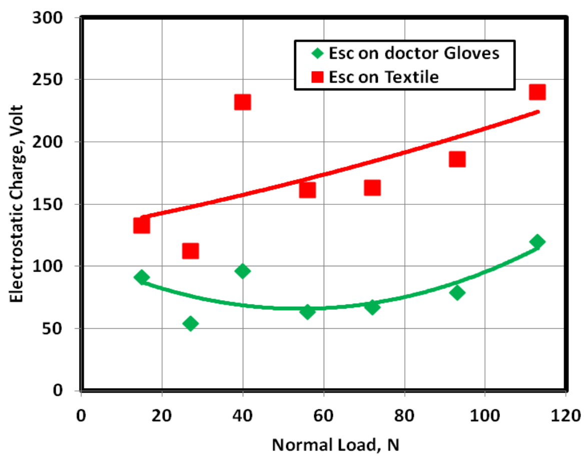


Fig. 12. Electrostatic charges generated from sliding of doctor's gloves against yellow clothes for doctors in operating theatres, dry condition

Electrostatic charge of worker's gloves sliding against dry yellow clothes for doctors in operating theatres is shown in Fig. 13. When the usual load increased to 60 N, the static charge grew a little, then shrank as the normal load increased. 240 volts was the maximum electrostatic charge it was observed at 60 N normal loads. The reason for increasing static charge is the lesser thickness of latex gloves.

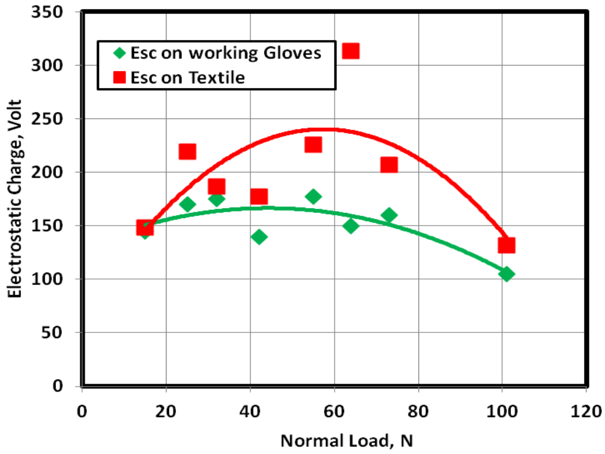


Fig. 13 Electrostatic charges generated from sliding of worker's gloves against yellow clothes for doctor's in operating theatres, dry condition.

Electrostatic charge of doctor's gloves sliding against clothes for doctor's in operating theatres, 65%, Polyester + 35% Cotton, dry condition, as shown in Fig. 14. Static charge decreases with increasing normal loads. This behavior may be related to the increase and decrease in friction between the gloves and textile. The maximum value of static charge was observed on the textile at lower loads. The minimum value of static charge was observed at higher loads.

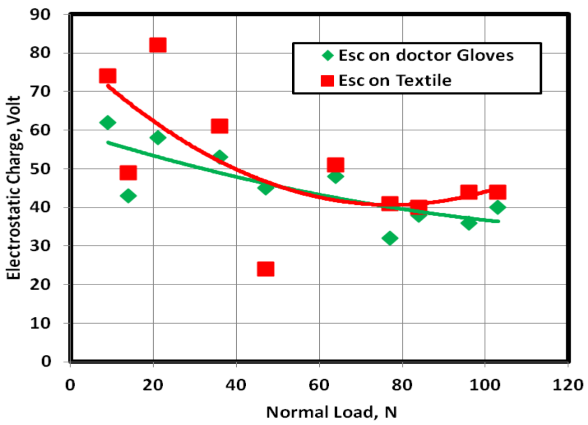


Fig. 14. Electrostatic charges generated from sliding of doctor's gloves against clothes for doctor's in operating theatres, 65%Polyester + 35%Cotton, dry condition

Figure 15 Depicts the relation between electrostatic charge and the normal load for the worker's gloves sliding against clothes for doctor's in operating theatres i.e.,65%Polyester + 35% Cotton, in dry condition. It is evident it as the typical load is increased up to 60 N, the static electricity increases.. Increase normal load over 60 N, shows deduction in the static charge value. The maximum value of static charge was 72 volts observed at 60 N normal load.

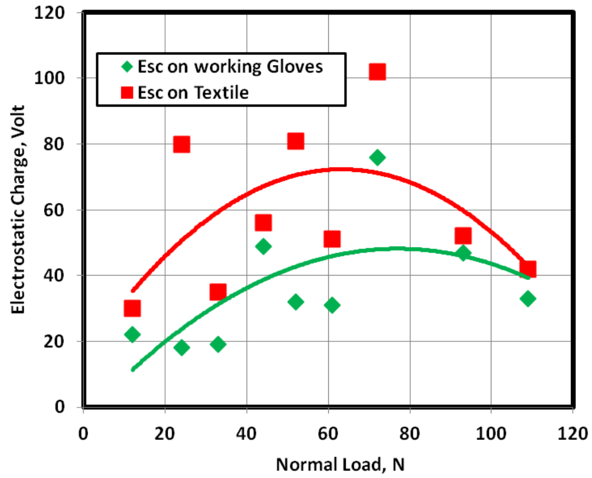


Fig. 15. Electrostatic charges generated from sliding of worker's gloves against clothes for doctor's in operating theatres, 65%Polyester + 35%Cotton, dry condition

Electrostatic charge generated from sliding of doctor**'s** gloves against blue clothes for doctor's in operating theatres, dry condition is shown in Fig. 16. As the typical power is increased, electrostatic charge also rises. The static charge levels represent the heights values on textile materials, this value is may be related to the damage of some devices in the OT's. The maximum value of static charge was 95 volts observed at 120 N normal loads. This study recommends using this type of clothes under light load.

Electrostatic charge of worker**'s** gloves sliding against the blue clothes for doctor's in operating theatres, in dry condition is shown in Fig. 17. As the typical power is increased, electrostatic charge also rises. Even after the maximum static charge on clothing fabric exceeds 70 volts, the static charge values are still significant.

Previous studies have shown that the amount of static charge that is deposited on textile surfaces affects the material's quality. In places with little static electricity, the quality is at its greatest. The fabrics with the largest electrostatic charge, which reached 70 volt, were made of 97 percent cotton and 3 percent elastane. When cotton fabric is slid against various garments, the amounts of static charge vary on the composition of the various fibres in the apparel [20].

At moist working circumstances, a larger amount of static charge was measured, indicating that the water was well conductive. It is possible to propose the usage of cotton clothing in various healthcare settings based on this finding.

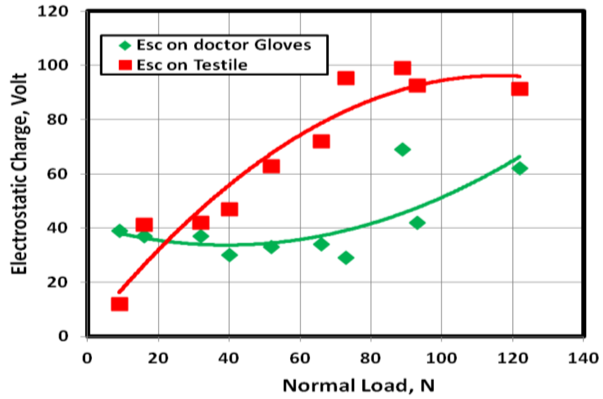


Fig. 16. Electrostatic charges generated from sliding of doctor's gloves against blue clothes for doctor's in operating theatres, dry condition

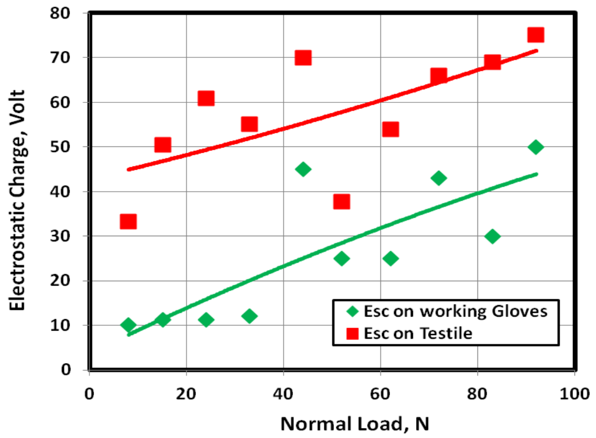


Fig. 17. Electrostatic charges generated from sliding of doctor's gloves against blue clothes for worker's in operating theatres, dry condition

4 Conclusions

1. To achieve effective work, the performance of gloves and garments must be reevaluated at medical institutions using quality management concepts. The amount of static charge collected on the textile surface determines its quality.
2. The finest grade textiles have the lowest static charge values. More than the gloves, the static charge created when sliding the gloves accumulates on the material and clothing.
3. In dry conditions, the larger value of static charge was 240 volts, as shown on yellow clothing worn by physicians in operating theatres.
4. For safe working in various workplaces, by following quality management policies and selecting textiles and clothing based on electrostatic charge is pstrongly advised.
5. In order to improve the work place for healthcare workers, it is crucial to give the nuances that affect performance enough consideration. Hand and glove performance is extremely important for health care professionals.
6. Glove makers, hospital administration, and health-care personnel all need to be better aware of the issues surrounding gloves. There is a need for procedures and tools that can detect issues with medical gloves.

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تقييم جودة الملابس والقفازات المستخدمة في مستشفيات المملكة العربية السعودية

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[٢]قسم الهندسة الصناعية ,كلية الهندسة , جامعة جازان, المملكة العربية السعودية

مستخلص. يستخدم الأطباء في المستشفيات غازات التخدير أثناء العمليات وبعض هذه الغازات قابلة للانفجار. و إذا تسرب الغاز إلى الهواء فإن شرارة صغيرة من الشحنة الساكنة قد تجعله ينفجر. لذا فإنه من الضروري تقليل أو تجنب الشحنات الاستاتيكيه في غرف العمليات والغرف الأخرى. يهدف العمل الحالي إلى التحقق من جودة المنسوجات في المستشفيات من حيث الشحنة الكهروستاتيكية الناتجة عن التلامس والفصل، ويمكن تحقيق ذلك من خلال دراسة انزلاق قفازات اللاتكس للأطباء والممرضات وغيرهم من العاملين في المستشفيات ضد منسوجات الملابس في ظروف العمل الجافة.

بناءً على النتائج فإنه كمية الشحنات الساكنة التي يتم جمعها على سطح النسيج ستحدد جودته. حيث تتميز افضل أنواع المنسوجات بأقل قيمة للشحنات الإستاتيكية، وتتولد الشحنات الاستاتيكية عندما تتراكم خلال انزلاق القفازات على المنسوجات والملابس. و في الظروف الجافة ، كانت القيمة الأكبر للشحنة الساكنة ٢٤٠ فولت ، كما هو موضح في الملابس التي يرتديها الأطباء في غرف العمليات. و من أجل العمل الآمن في أماكن العمل المختلفة فإنه من الضروري حقًا أن نولي اهتمام دقيق للتفاصيل التي تؤثر على الأداء من أجل تحسين بيئة العمل للعاملين في اماكن الرعاية الصحية. حيث يُنصح بشدة باتباع سياسات إدارة الجودة واختيار المنسوجات والملابس بناءً على الشحن الكهروستاتيكي. و يعد أداء اليد والقفازات أمرًا بالغ الأهمية لأخصائيي الرعاية الصحية. كما أنه يحتاج صانعو القفازات وإدارة المستشفى وموظفو الرعاية الصحية إلى أن يكونوا أكثر وعياً بخصائص القفازات. و توصي هذه الدراسة باختيار المنسوجات والملابس بناءً على الشحنات الكهروستاتيكية لضمان الجودة والعمل الآمن في أماكن العمل المختلفة.

الكلمات الرئيسية: الجودة , المنسوجات , القفازات ، الشحنات الاستاتيكية