

FRICTIONAL AND ELECTROSTATIC CHARGE PROPERTIES OF TEXTILE MATERIALS

El-Abd A. H.², Ali W. Y.¹, Samy A. M.¹ and Ameer A. K.¹

¹Dept. of production engineering and mechanical design, faculty of Engineering, Minia University, El-Minia, EGYPT.

²Dept. of Mechanical Power Engineering, El-Arish High Institute of Engineering and Technology, Ministry of Higher Education, Egypt.

ABSTRACT

Electrostatic charges caused by the rubbing of technical materials have a negative effect on their applications. The increasing employ of polymeric materials confirm the interested in studying this effect. Electrostatic charges that build up on human body and/or are carried out of direct contact with the human skin are highly hurtful and can reason critical health problems.

Textile electrification is the main factors that appropriate the goodness of cloths. The textile electrostatic charge can be predominately valued by the contact of human skin to feeling the shock. Voltage produced from electrification of the fabric by sliding against car padding materials (synthetic leather), poly vinyl chloride (PVC) and cotton should not exceed certain limit to avoid serious health problems. In the present work, electric static charge generated from the friction of textile sliding against three different types of counter face materials has been measured.

The quality of the textile fiber can be influenced by the amount of the electrostatic charge stored on the textile surface, where lower static values are better quality. For cotton textiles sliding on leather, the electrostatic charge and the friction coefficient increase with increasing normal load. The electrostatic charge of the acrylic textile sliding against the PVC shows the maximum values. Coefficient of friction decreases with increasing normal load for acrylic textile.

KEYWORDS

Electrostatic charge, textile, friction coefficient, cotton.

INTRODUCTION

The increased awareness in the argumentation of electrostatic belongings has been compulsory by the squab utilize of polymeric fibrils in the textile industry. Filling charge in the human body meanwhile contact on the ground was conscientious. The secure voltage of body should be less than 100 volts, [1]. Therefore, the influence of polymeric textiles on the obstetrics of static electricity must be worked out in order to avert the risk of static electricity in households. The tremendous use of polymeric fibers in clothes requires discuss their electrification when rubbing other surfaces. Electrostatic charge growth from the rubbing of different polymeric clothes sliding on cotton fibers used as an indication material has been examine, [2]. Researches have been done to measure the electrostatic charge produced by the rubbing of different polymeric textiles when sliding versus cotton fibers under modify sliding distance and speed in addition to the normal load. It has been found that raising the cotton content reduces the stress produced. Most of the time, the rising speed increased the tension. The growing in voltage with rising speed may relate to the increase in mobility of the liberated electrons to one of the surfaces being scrubbed. The visibility

of the fibers highly influences the motion of the liberation electrons, [3-5]. The influence of surface roughness on the output voltage of a tribo-electric nano-generator (TENG) was studied, [6]. It is concluded that emery paper works as a cheap method of roughening one of the two surfaces of a TENG, and increasing the number of contacting asperities leading to the increase of electrostatic charge. It was found that as the value of the applied load increases, the output voltage increases, due to the increase of the actual contact area of the TENG.

The electrostatic charge generated by the rubbing of polytetrafluoroethylene (PTFE) fibers has been examined to suggest proceeding clothes materials with minimal or indifferent electrostatic charge that can be used for manufacturing implementation, mostly as textile materials, [7]. Survey on the hazards of electrostatic discharge when illuminated out of textiles is outstanding for distance wayfarer safety. The possibility of ESD lighting consists on the medium and various models used to mimic ESD disasters, [8]. Materials can be evaluated for static electricity dangerous by measuring charge degeneration and by measuring capacitance loading, [9]. Static electricity implies potentially risky electric shocks that can lead to burns and explosions. It can also cause serious deterioration of vulnerable electronic parts.

Triboelectric charging is the convey of electrons produced when two materials contact and then liberation. One material gains a profusion of negative ions and the other a profusion of positive ions. The charge produced can be in overflowing of 25,000 volts. It is well familiar that two various materials can produce charges when they contact. This tribocharging original trespass is also referred to as triboelectrification when materials rubbing against each other [10 - 12]. The charge transfer technique in tribocharge can be demonstrated by three techniques: electron displacement, ion displacement and material displacement, [13-16]. Metal to metal electrification is successfully demonstrated by the electron convey technique.

When two various materials come into approach, electrons are transmitting until their Fermi scale is the same. The variation in working conditions between these is the main imperious, [17]. Many studies have been done for enhancing the Flooring Materials in dry and wet conditions to avoid the risk of electrostatic charging and slipping accidents with improving the tribological and triboelectrification Properties, [18-26]. With insulators, electron transfer occurs only at the surfaces of insulators, where electrons flow from the charged surface of one non-conductor to the swollen surface of the other non-conductor [27-30]. Few studies have reported triboelectric series to predict the polarity of charge transfer from surface to another one [31]. When two materials approach each other, the top of the triboelectric series becomes positively charged and the bottom becomes negatively charged. It is increasingly appealing that more than one of these mechanisms can occur together [32]. The goal of the current work is to investigate the electrostatic charging of everyday textiles caused by contact and separation. This goal can be achieved by examining the sliding of the textile in relation to the upholstery materials car (artificial leather), polyvinyl chloride (PVC) and cotton.

EXPERIMENTAL WORK

The (Ultra Stable Surface Voltmeter) device was used for measuring the electrostatic charge (electric static field) after contact and separation of the samples against rubber to measure the charge generated under applied loads, Fig. 1. It measures from 1/10 volt up to 20,000 volts (20 kV) on the surface. With distance 25mm from the surface, readings (volts) are normally taken with the sensor under test.



Fig. 1 Device of measuring electrostatic charge (voltage).



Fig. 3 Textiles and clothes used in day life.

Friction tests were conducted using a test device designed and prepared to measure normal loading during gloves against textiles of clothing and between cotton and clothing. The tested textiles are located on a pad that supported with two load cells, the first measuring the vertical

force (normal load) and the second measuring the horizontal force (frictional force). The layout of the test stand is shown in Fig. 2.

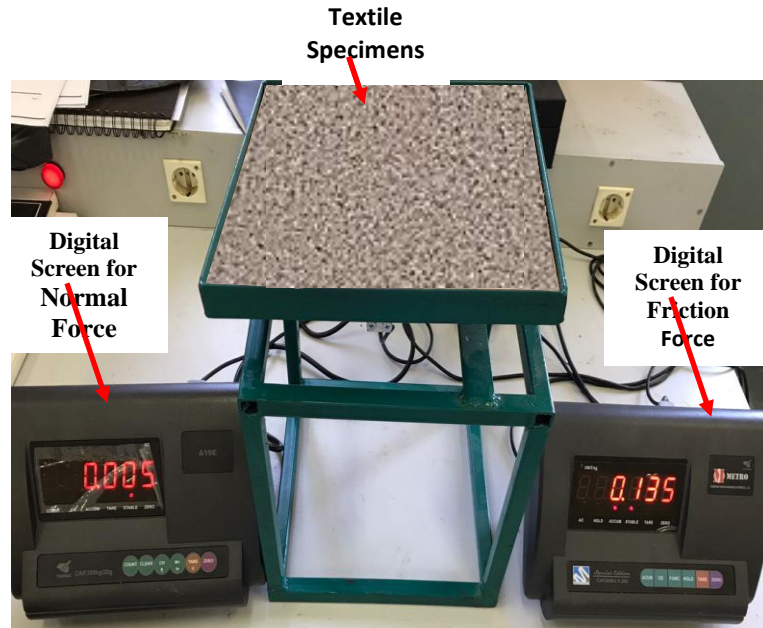


Fig. 2 Test rig of sliding.

The textile specimens are observed in Fig. 3. The counter face positioned on a table supported with two load cells measuring the applied load from textile specimens on counter face. For the period of sliding the electrostatic charge produced on the contact surface where, the electrostatic charge collected on textile samples in addition to counter face. Static charge was measured on the surface of textile. The tests of Friction and electrostatic were done at room temperature under applied normal loads 20, 40, 60 and 80 N.

Experiments were carried out by sliding the test specimens against the three types of counter face material under applied normal loads.

- 1- Car padding materials (synthetic leather),
- 2- Poly vinyl chloride (PVC) ,and
- 3- Cotton textile.

RESULTS AND DISCUSSION

Figure 4 investigates the behavior of electrostatic charge and friction coefficient of cotton sliding against synthetic leather. It can be observed that the friction coefficient and electrostatic charge increase with the increasing of normal load. The cotton textile is neutral charge. The cotton with thin fiber displays the highest friction coefficient and electrostatic charge, this behavior due to increasing of the adhesion between cotton with thin fiber with leather.

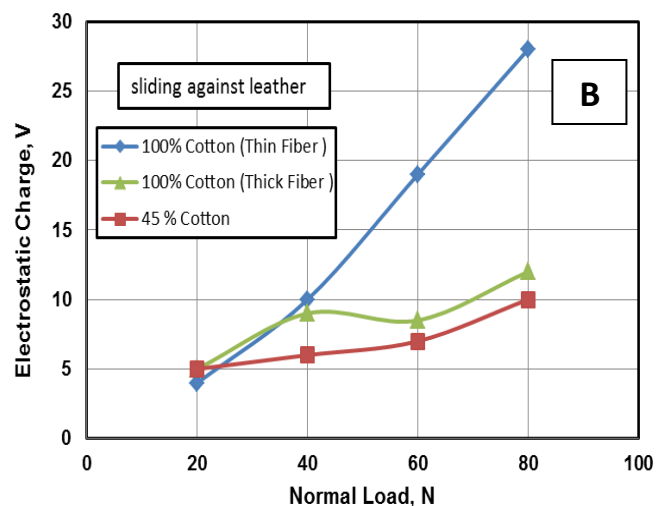
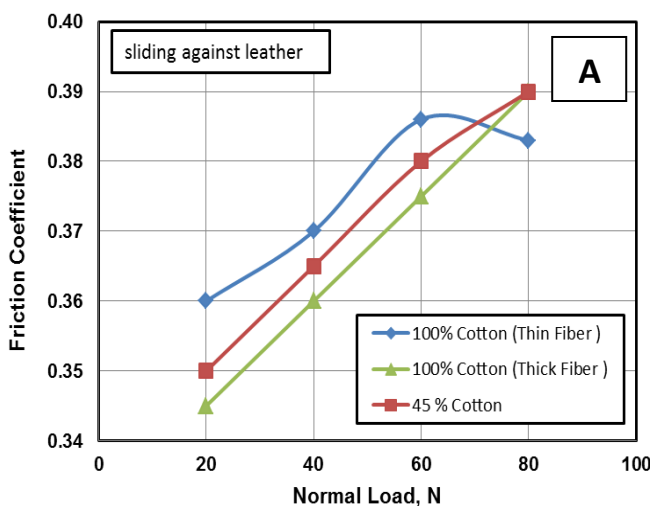


Figure 5 shows the friction coefficient and electrostatic charges produced from sliding of textiles against leather. The friction coefficient decreases with the increasing of normal load, this behavior is due to the slipping of specimens on PVC surface. With the increasing of normal load, the values of static charge increase. This behavior is due to the very slippery of PVC surface and increasing the sliding speed.

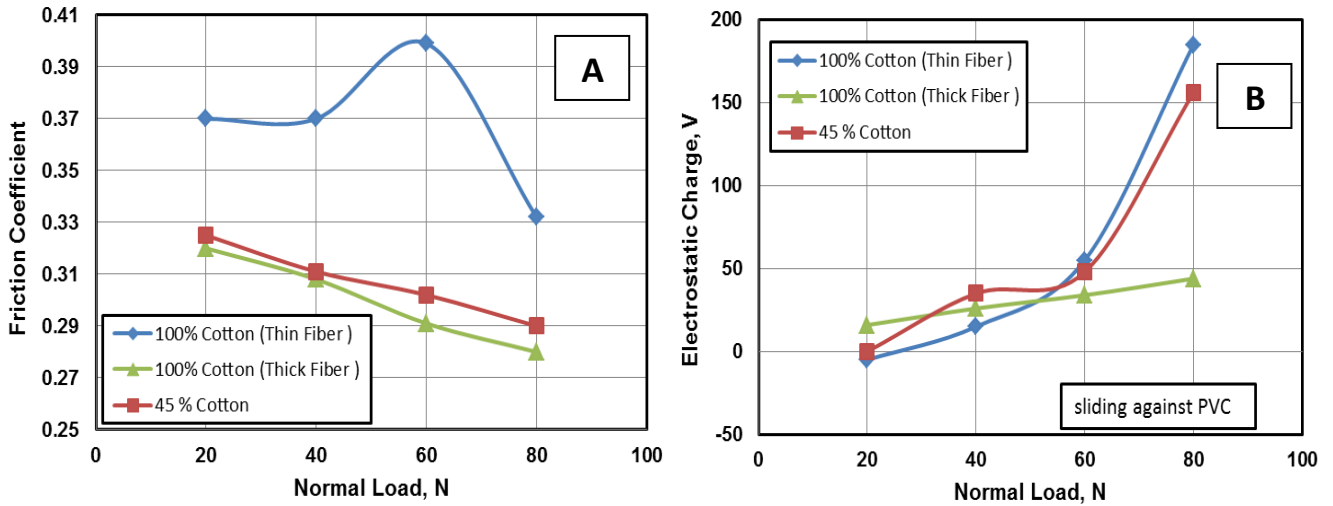


Fig. 5 Friction coefficient and Electrostatic charges produced from sliding of textiles against PVC.

The electrostatic charge of the cotton sliding on the cotton textile is investigated in Fig. 6. The electrostatic charge increases slightly with the increasing of normal load. The highest values of static charge were by the cotton with thick fibers; this behavior is related to the saving of charge of thick fibers. The coefficient of friction of fine- and coarse-fiber cotton decreases with increasing normal load. For samples with 45% cotton, with increasing normal load the increasing of coefficient of friction. This behavior is related to the sticking of fibers.

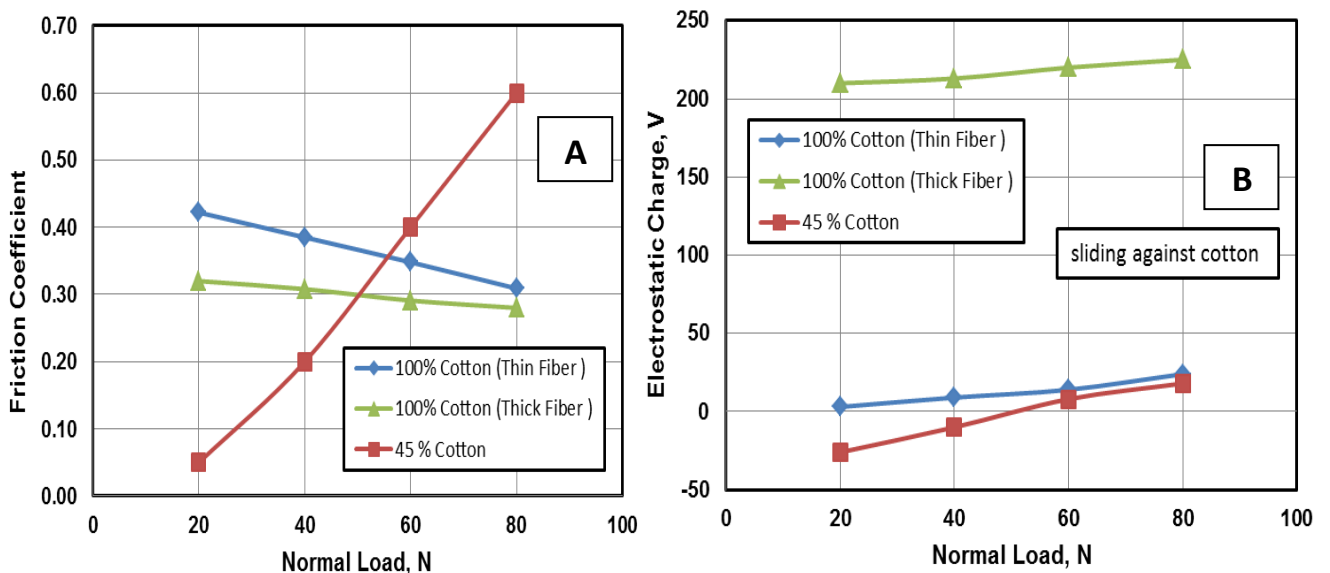


Fig. 6 Friction coefficient and Electrostatic charges produced from sliding of textiles against cotton.

Figure 7 displays the behavior of electrostatic charge with normal load, for acrylic textile sliding against synthetic leather. It can be observed that the electrostatic charge increases with the increasing of normal load. The highest value of electrostatic charge observed at specimens contain 16% Acrylic.

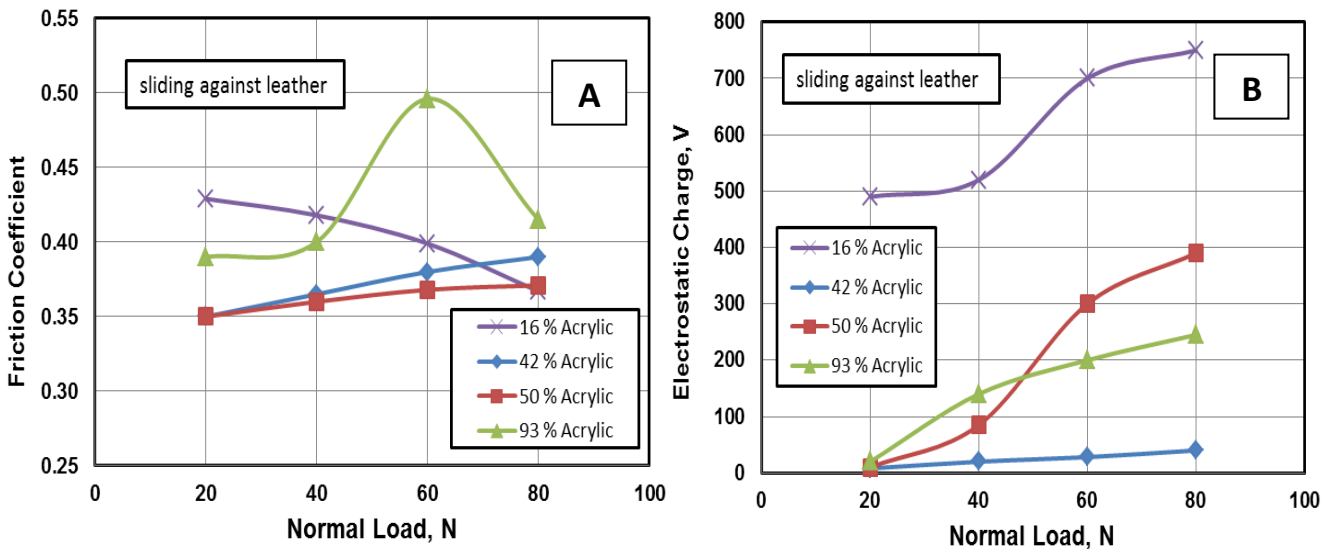


Fig. 7 Friction coefficient and Electrostatic charges produced from sliding of textiles against leather.

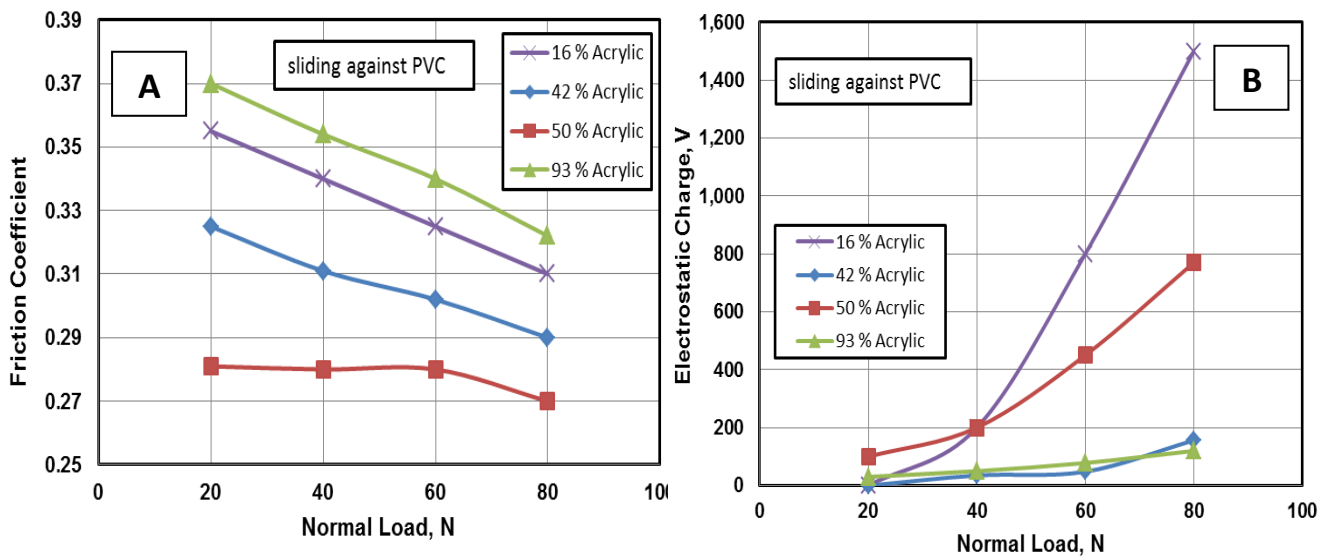


Fig. 8 Friction coefficient and Electrostatic charges produced from sliding of textiles against PVC.

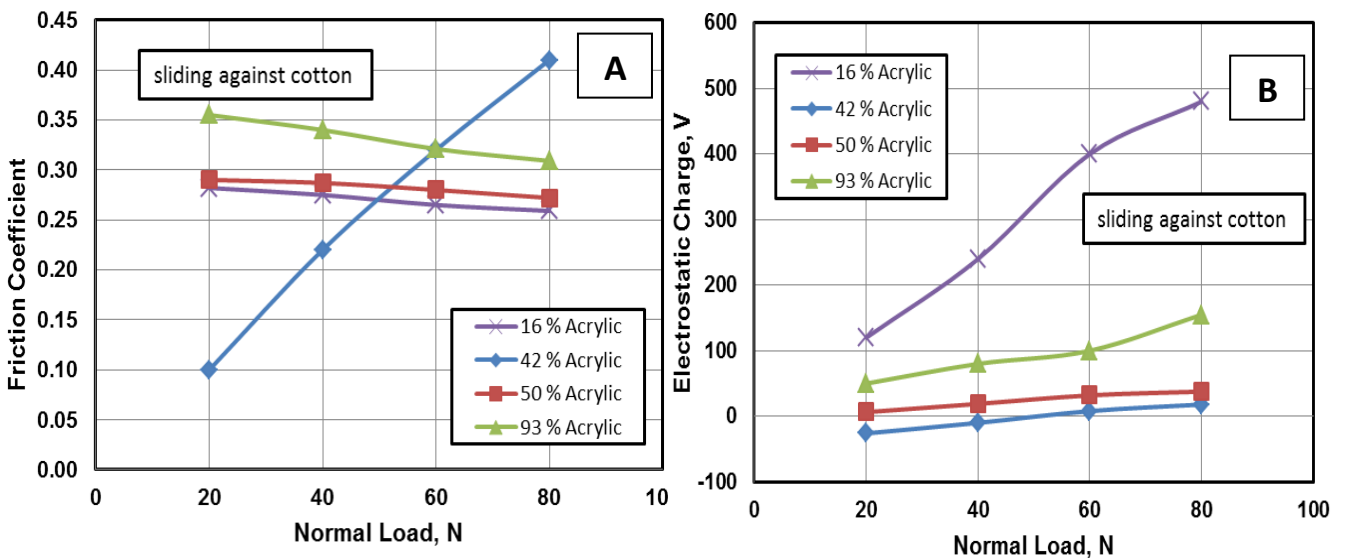


Fig. 9 Friction coefficient and Electrostatic charges produced from sliding of textiles against cotton.

Electrostatic charge of acrylic textile sliding against PVC surface is shown in Fig. 8. Electrostatic charge increase with increasing normal load. This behavior may be related to the polymeric content of contact surface. The maximum value of static charge was investigated at 16 % Acrylic. The friction coefficient decrease with increasing normal load, this behaviour related to the strong bonding between contact surface. Figure 9 displays the behavior of electrostatic charge with normal load, for Acrylic textile sliding against cotton textile. It can be observed that the electrostatic charge increases with the increasing of normal load. The highest value of static charge observed at specimens contain 16 % Acrylic. The friction coefficient slightly decrease with increasing of normal load.

CONCLUSIONS

1. The quality of the textile fiber influenced by the value of the electrostatic charge collected on the textile surface, where lower levels of static are the best quality.
2. For cotton fabrics sliding against leather, the static electricity and coefficient of friction increase by increasing normal load.
3. The acrylic textiles sliding on PVC displays the highest values of the electrostatic charge.
4. The friction coefficient for acrylic textiles decreases with increasing normal load.

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