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Nanotechnologies — Textiles containing nanomaterials and nanostructures — Superhydrophobic characteristics and durability assessment

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National foreword

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Foreword

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This document was prepared by Technical Committee ISO/TC 229, *Nanotechnologies*.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

Recently superhydrophobic textiles (woven and nonwoven) have gained significant scientific and industrial interest for its potential applications in outdoor wear and protective clothing. The superhydrophobic textile surfaces refer to superior water repellency with a water contact angle exceeding 150° and low contact angle hysteresis of less than 10° (see Annex A). For this superhydrophobic textile, dirt and soils are loosely attached, and a rolling water drop can easily attach and remove them from the surface, giving self-cleaning properties. According to Young's, Wenzel and Cassie-Baxter Models superhydrophobicity of textile surface can be made by both the surface treatment with very low surface free energy materials and making nano-roughness (see Annex B).

Nanotechnology is employed to artificially change the surface free energy and/or cause nano- roughness on the surface. The following methods are normally utilized in this respect:

— using nano-objects such as silica, TiO_2, CNT, ZnO, etc., in various ways;

— surface etching, i.e. nano roughening (UV-laser or plasma), followed by grafting or physically/ chemically attaching compounds with low surface energy;

— using nanofibres.

The establishment of superhydrophobic relies on

a) superhydrophobic (non-polar) surface chemistry, and

b) nanostructured surface texture (nano-roughness).

One of the most important obstacles affecting the market growth of textiles containing nanomaterials and nanostructures (TCNNs) showing superhydrophobic response is their relevant durability under different utilization and working conditions. This includes, laundering (washing), ironing, mechanical abrasion (rubbing) and light radiation exposure. If superhydrophobic properties are not durable, the TCNNs are useless in long term applications. Therefore, durability of superhydrophobic TCNNs over repeated use and wash are necessary.

In this regard, the durability and persistence of superhydrophobic behaviour of TCNNs needs to be assessed under above mentioned condition based on standard methods. Generally, from the consumer's perspective, the superhydrophobic durability of TCNNs is very important. However, there is no specific measurement method to evaluate the superhydrophobic durability. In fact, there is a lack of grading procedure for this characteristic.

This document both specifies the characteristics, performance and durability of the TCNNs subjected to laundry (washing), ironing, mechanical abrasion (rubbing) and light exposure. The superhydrophobic durability of such textiles are assessed and reported based on contact angle and hysteresis measurement of the samples before and after subjected to mentioned conditions. In fact, a specific grading method is established in this document. Further, this document also recommends relevant measurement methods to promote communication and mutual understanding of TCNNs for superhydrophobic application between buyers and sellers.

This document supports less water consumption and less waste water production. In addition, this document supports responsible production in terms of superhydrophobic durability of textile. Furthermore, this document can provide a potential for the economic growth for small and medium size enterprises. These items conform with several Sustainability Development Goals (SDGs) defined by United Nations.

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Nanotechnologies — Textiles containing nanomaterials and nanostructures — Superhydrophobic characteristics and durability assessment

1 Scope

This document specifies the characteristics and performance(s) of the superhydrophobic textiles containing nanomaterials and nanostructures (TCNNs) based on contact angle measurement before and after being subjected to washing/drying (laundry), ironing processes, light sources and abrasion, that are to be determined by agreement between customer and supplier. This document solely covers woven and nonwoven fabrics.

This document does not address safety and health related issues.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1.1
contact angle
θ
angle to the base line within the drop, formed by means of a tangent on the drop counter through one of the three-phase points

Note 1 to entry: See Figure 1.

Note 2 to entry: The contact angle is preferably indicated in degrees (°). 1° = (π/180) rad. If the system is in thermodynamic equilibrium, this contact angle is also referred to as thermodynamic equilibrium contact angle.

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