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Fine bubble technology — Cleaning applications —

Part 4: Test method for oil removal from polyester-based textile

Technologie des fines bulles — Applications de nettoyage —

Partie 4: Méthode d'essai pour l'élimination de l'huile sur un tissu en polyester

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Foreword

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This document was prepared by Technical Committee ISO/TC 281, *Fine bubble technology*.

A list of all parts in the ISO 21256 series can be found on the ISO website.

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.

Introduction

In recent years, the market has witnessed a proliferation of new products using fine bubble technology. In the field of textile industry, the introduction of fine bubbles can bring many interesting effects. Using fine bubbles can increase the cleaning efficiency by removal of the residual surface oil of textile in large-scale manufacturing in order to improve the quality of dyeing and finishing process. Especially, polyester-based textile takes very important role in the textile industry since its outstanding features. In addition, fine bubble washing is a physical cleaning method which can reduce the pollution of detergent to the water environment. So, it is needed to design a general test method, for textile manufacturers and related researchers, to evaluate the cleaning efficiency by removal of fine bubble water on polyester-based textile.

In order to adapt to complex usage scenarios in large-scale textile manufacturing, the proposed method uses the mass fraction of oil on polyester-based textile after and before washing to characterize the cleaning effect, and uses ISO brightness (R457)[1] to assist in expressing the degree of cleanliness. To demonstrate, a lubricant, whose main composition is high molecular hydrocarbon, is used as an identical contaminant in production, and an edible oil, whose main composition is fatty acid, is used as an identical contaminant in daily washing. The method is simple, reproducible and highly versatile.

With this method, the oil removal ability of fine bubble water with different bubble sizes and concentrations can be compared. Furthermore, it will further promote the civil and industrial application of oil removal from textile of fine bubbles, for example, washing during fabric recycling process or cleaning with less detergent.

Fine bubble technology — Cleaning applications —

Part 4: Test method for oil removal from polyester-based textile

1 Scope

This document specifies a test method to evaluate the oil removal performance from polyester-based textile with fine bubbles.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

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/

4 Principle

In the textile industry, various types of manufacturing machines use different kinds of oils, surfactants and detergents. During the production either the oils are coated over the whole surface of the strings uniformly or the whole surface of the textile in different processes. To test the removal ability, identical samples should be used, e.g. always to use polyester-based textile, for better comparative consistency in the method.

The test method consists in determining the mass fraction of oil on a textile sample before and after cleaning. A weighed polluted sample is soaked in the circulated bubble water. To evaluate the degree of cleanliness, the mass fraction of residual oil on the sample is determined, and the brightness according to ISO[1],[2] is also evaluated.

5 Test methods

5.1 Equipment and material

5.1.1 Drying Oven

Figure 1 shows the drying oven's appearance. The power is 4 kW, and the working temperature range is approximately +10 °C to 250 °C with ±1 °C accuracy.

Figure 1 — Drying oven

5.1.2 Digital electronic scale

Figure 2 shows the digital electronic scale used in this test, whose maximum range is 220 g and resolution is 0,001 g.

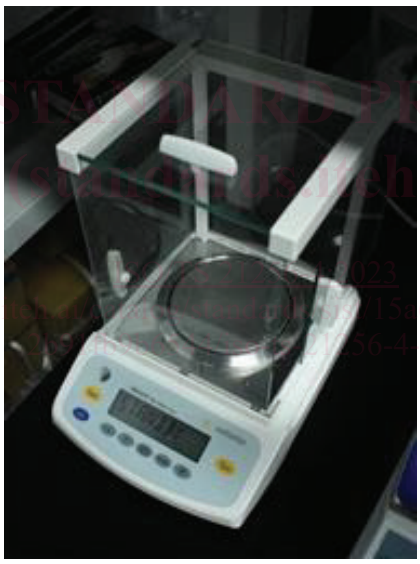

Figure 2 — Digital electronic scale

5.1.3 Dye

Sudan Red III ($C_{22}H_{16}N_4O$), AR.

5.1.4 Oil

Lubricant, whose main composition is high molecular hydrocarbon, and edible oil, whose main composition is fatty acid. The two typical kinds of oils are described in Annex A.

5.1.5 Substrate

The polyester-based textiles, such as Polyethylene terephthalate (PET), Polybutylene terephthalate (PBT) and Polytrimethylene terephthalate (PTT) are used as substrates. The ability of oil removing depends on all of their characteristics, i.e. weaving types of manufacturing, the diameter of thread. Therefore, the specification of the textile characteristics should be clarified in detail for cleaning

applications to obtain the repeatability of the experiments. Annex A describes an example of oil removal performance comparison between tap water and fine bubble water, in which the substrate is clearly described.

5.1.6 Micropipette

Figure 3 shows the micropipette used in this test, whose resolution is 0,01 ml.

Figure 3 — Micropipette

5.1.7 Beaker

250 ml and 2 000 ml.

5.1.8 Tripod stand

Load polyester-based textile pieces at the tripod stand presented in Figure 4.

Figure 4 — Tripod stand

5.1.9 Portable brightness meter

The portable brightness meter used in this test is shown in Figure 5, which resolution is 0,1 %.

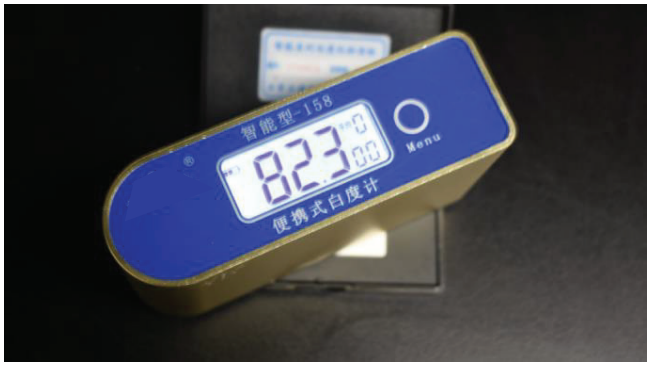

Figure 5 — Portable brightness meter

5.1.10 Suspended stirring bar

The suspended stirring bar as shown in Figure 6 is used to reduce the influence of uneven flow on the performance of oil removal.

Figure 6 — Suspended stirring bar

The test method allows to use other equipment or materials different from those specified in 5.1, provided their technical characteristics are satisfying and not inferior to those described and specified in 5.1.

5.2 Procedure

— Fully dry the sample to minimize the moisture content.

— Weigh the dried sample within 30 s to avoid the influence of environmental humidity as the initial mass of textile.

— Dye the oil with Sudan Red III.

— Contaminate the sample with specific amount of coloured oil and weigh out the net weight of oil.

— Allow the coloured oil to spread for better stability.

— Test the ISO brightness (R457)[1] as the initial brightness of textile.

— Preset a water flow rate to 2 l/min, allow the test water to overflow out of a 2 000 ml container.

— Soak the sample. The sample is fixed at the centre of the water diffuser in a container. The duration of soaking is 5 min.

— Fully dry the sample to minimize the moisture content.

— Weigh the dried sample within 30 s as the weight of the textile sample after soaking and drying.

— Test the ISO brightness (R457) as the brightness of the textile sample after soaking and drying.

5.3 Oil removal determination

The oil removal rate, R is calculated by Formula (1):

$$R = \frac{m_t + m_o - m_w}{m_o} \quad (1)$$

where

m_t is the initial mass of textile sample after drying;

m_o is the net weight of polluted oil;

m_w is the weight of the textile sample after soaking and drying.

6 Test report

The test report should include at least the following information:

a) the sample;

b) a reference to this document, i.e. ISO 21256-4:2023;

c) the test date;

d) the ambient temperature and humidity of the test facility;

e) fine bubble property;

f) the test conditions:

   1) the flow rate of cleaning liquid;

   2) dyeing ratio;

g) the test result:

   1) number of repetitions;

   2) initial mass of textile sample before soiling after drying;

   3) mass of oil;

   4) mass of the textile sample after soaking and drying;

   5) oil stain removal rate;

   6) brightness;

h) any deviations from the procedure;

i) any unusual features observed.