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Textiles — Man-made fibres — Determination of dye uptake of cationic dyeable modified polyester fibres

Textiles — Fibres fabriquées — Détermination de l'absorption des colorants par les fibres de polyester à pression normale

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Foreword

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This document was prepared by Technical Committee ISO/TC 38, *Textiles*, Subcommittee SC 23, *Fibres and yarns*.

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

Typical polyester fibres as sold on the market can be dyed at temperatures above 100 °C and high pressures by using disperse dye. As part of the highly modified polyester products, cationic dyeable polyester (CDP) can be dyed at lower temperatures by using cationic dye. For some modified species in particular, easy cationic dyeable polyester (ECDP) can be dyed under 100 °C at normal pressure. Due to this key improvement, cationic dyeable modified polyester fibres are becoming more and more popular on the market. This test method is used to evaluate the dye uptake rate of cationic dyeable modified polyester fibres by using cationic dye.

Textiles — Man-made fibres — Determination of dye uptake of cationic dyeable modified polyester fibres

WARNING — The use of this document can involve hazardous materials, operations, and equipment. It does not purport to address all of the safety risks associated with its use.

1 Scope

This document specifies a method for determining the dye uptake of cationic dyeable modified polyester fibres by using cationic dye.

It is applicable to cationic dyeable modified polyester fibres, including staple fibres and filament yarns.

It is not applicable to polyester partially oriented yarns.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 105-C10, *Textiles — Tests for colour fastness — Part C10: Colour fastness to washing with soap or soap and soda*

ISO 139, *Textiles — Standard atmospheres for conditioning and testing*

ISO 3696, *Water for analytical laboratory use — Specification and test methods*

3 Terms and definitions

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

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

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

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

3.1
cationic dyeable modified polyester fibre
polyester fibre modified with third monomer or fourth monomer copolymerization which can be dyed by using cationic dyestuffs

EXAMPLE Cationic dyeable polyester (CDP) and easy cationic dyeable polyester (ECDP).

Note 1 to entry: The third monomer, such as a sulfonic acid group, is applied as a modifying agent to polymerize CDP.

Note 2 to entry: The third monomer, such as a sulfonic acid group, and the fourth monomer, such as carboxylic acid groups or other flexible groups, are applied as modifying agents to polymerize ECDP.

3.2
dye uptake
ratio of dye absorption into the specimen in both chemical and physical ways

4 Principle

Samples are dyed with a specified cationic dye and then the absorbance of the dye solution is measured by the spectrophotometer at the specified wavelength. The dye uptake of the samples is calculated by comparison with a dye solution used as a blank sample.

5 Reagents and materials

Unless otherwise specified, use only reagents of recognized analytical grade.

5.1 Grade 3 water, meeting the requirements of ISO 3696.

5.2 Cationic red X-GRL, CAS No. 12221-69-1.

5.3 Acetic acid and sodium acetate buffer solution, pH = 5.

Transfer 10 g of sodium acetate and 20 ml of acetic acid into a 100 ml volumetric flask, dilute with water (5.1) to volume and mix.

5.4 Soap, meeting the requirements of ISO 105-C10.

6 Apparatus

The usual laboratory apparatus and, in particular, the following.

6.1 Spectrophotometer, with 1 cm cuvette.

6.2 Dyeing machine, with a dyeing temperature of (100 ± 3) °C and a heating rate of (1,5 ± 0,5) °C/min.

6.3 Laundering device, meeting the requirements of ISO 105-C10.

6.4 Balance, accurate to 0,1 mg.

6.5 Volumetric flasks, 100 ml, 250 ml and 1 000 ml.

6.6 Graduated Pipettes, 5 ml, 10 ml and 50 ml.

6.7 Dyeing cups, 300 ml.

6.8 Beakers, 25 ml and 250 ml.

6.9 Glass rods.

7 Test preparation

7.1 Pre-treatment of samples

Remove the oil of samples with the laundering device (6.3). Dissolve 5 g of soap (5.4) in 1 l of water (5.1). Use a liquor ratio of 50:1. Wash the samples for 30 min at 70 °C and then rinse them with water (5.1). Dry the samples in air at a temperature not exceeding 60 °C.

This pre-treatment may be omitted when evidence shows that the oil content does not affect test results, especially for staple fibres.

7.2 Conditioning of samples

Condition the samples at the standard atmosphere specified in ISO 139 after pre-treatment.

7.3 Preparation of dye stock solutions

Weigh 1 g of cationic red dye (5.2) to an accuracy of 0,1 mg and dissolve with water (5.1) in a beaker (6.8). Transfer to a 100 ml volumetric flask (6.5), dilute with water (5.1) to volume and mix. The solution contains 10 g/l of cationic dye.

The dye stock solution should be stored in shade and its validity period is 14 days.

8 Procedure

8.1 Weigh two specimens (see 7.2) of 1,5 g each, accurate to 0,01 g.

8.2 Transfer 8 ml of cationic dye stock solution (see 7.3) and 1 ml of buffer solution (5.3) into one 1 000 ml volumetric flask. Dilute with water (5.1) to volume and mix. The 80 mg/l cationic dye solution is prepared.

If another concentration of dyeing liquid is used, indicate it in the report.

8.3 Transfer 150 ml of the solution (see 8.2) into three dyeing cups (6.7), one for blank test (without samples) and the other two for specimen test. The liquor ratio is 100:1.

8.4 Start dyeing at 50 °C. Then raise the temperature to 100 °C with a heating rate of 1,5 °C/min. Dye specimens for 60 min at 100 °C. Then cool the dye solution to room temperature.

8.5 Take out the specimens. Dilute the blank-sample dye solution (without samples) and the residual dye solutions (with samples) to suitable concentration with water (5.1) in order to ensure that the absorbance of solutions is between 0,1 and 0,5.

8.6 After adjusting the spectrophotometer (6.1) to zero absorbance against water (5.1), measure the absorbance of solutions at the highest wave peak (532 nm).

9 Calculation and expression of the results

Calculate the dye uptake of each specimen according to Formula (1).

$$\omega = \left(1 - \frac{A_i \times n_i}{A_0 \times n_0}\right) \times 100 \quad (1)$$

where

ω is the dye uptake of the specimen, expressed in %;

A_i is the absorbance of the diluted residual solutions (with samples);

n_i is the dilution ratio of the residual solutions (with samples);

A_0 is the absorbance of the diluted blank-sample dye solution (without samples);

n_0 is the dilution ratio of the blank-sample dye solution (without samples).

The result is expressed as the arithmetic mean value of the two specimens, rounded to the nearest 0,1.