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BSI Standards Publication

Clothes washing machines and washer-dryers for household and similar use - Method for the determination of rinsing effectiveness by measurement of the surfactant content at textile materials

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National foreword

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Clothes washing machines and washer-dryers for household and similar use - Method for the determination of rinsing effectiveness by measurement of the surfactant content at textile materials

Machines à laver le linge et machines à laver et à sécher pour usages domestiques et analogues - Méthode pour la détermination de l'efficacité de rinçage par la mesure de la teneur en tensioactifs des matières textiles

Waschmaschinen und Waschtrockner für den Hausgebrauch und ähnliche Zwecke - Verfahren zur Bestimmung der Spülwirkung durch Messung des Tensidgehalts an Textilien

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European foreword

This document (CLC/TS 50677:2019) has been prepared by CLC/TC 59X "Performance of household and similar electrical appliances".

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1 Scope

This Technical Specification provides a method for the evaluation of the rinsing effectiveness of household clothes washing machines, washer dryers and commercial washing machines. The amount of residual linear alkylbenzene sulfonate surfactant (LAS) extracted from the unstained test swatches of the strips used in the washing performance test is determined. This is accomplished by measuring the ultraviolet (UV) light absorbance at the wavelength particular to LAS, a key ingredient of the detergent.

Assuming a fixed linear relationship between LAS amount and quantity of detergent mixture and using a concentration versus absorbance curve developed as part of this procedure, the absorbance values are then converted into detergent concentrations, which together with the test solution mass data, yields detergent quantities. This assumption is done, because in the frame of this test it is not possible to determine the exact amount of LAS involved, even in the concentration curves, but only the amount of detergent used.

On the textiles, this linear relationship is not given, but it is nevertheless used to express the amount of LAS as determined by UV light absorbance measurements in terms of a detergent amount.

Using a concentration versus absorbance curve developed as part of this procedure, the absorbance values can then be converted into detergent concentrations, which together with the test solution mass data, yields detergent quantities.

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.

EN 60456:2016, *Clothes washing machines for household use — Methods for measuring the performance (IEC 60456)*

3 Terms and definitions

No terms and definitions are listed in this document.

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

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

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

4 Symbols and abbreviated terms

4.1 The variables for Rinse Effectiveness calculations are defined as:

Asp_a average absorbance

$Asp_{avg,j}$ average net absorbance of the sample j [1)]

Asp_i net absorbance for specimen i [1)]

$Asp_{i,223}$ absorbance reading at 223 nm for specimen i [1)]

$Asp_{i,330}$ absorbance reading at 330 nm for specimen i [1)]

Asp_m peak absorbance at wavelength m [1)]

[1)] Care shall be taken in the calculations of Clause 6, as these variables are depending on additional parameters, e.g. index of the sample, swatch or test run.

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$Asp_{r,m}$	relative peak absorbance at wavelength m [1)]
Cs_j	concentration of detergent in sample j [1)]
Ds_j	mass of detergent recovered from sample j [1)]
$Dsw_{avg,l}$	average ratio of mass of detergent recovered per gram of test swatch from the test run l
Dsw_k	ratio of mass of detergent of test swatch k [1)]
DL_l	ratio of mass of detergent of test run l
i, j, k and l	index of specimens, samples, swatches and test run
m	slope of the detergent concentration curve
n	number of cuvettes, specimens, samples, swatches or test runs[2)]
R	Rinse Effectiveness (average of all test runs)
Re	Rinse Evenness Score
S_R	standard deviation of the Rinse Effectiveness
$S_{r,l}$	standard deviation of the ratio of mass of detergent recovered per gram of test swatch for test run l
Wsw_k	weight of test swatch k [1)]
Ws_j	weight of water in sample j [1)]

4.2 Symbols relating to Annex A

b	intercept of the detergent concentration curve
$CWSS$	detergent concentration of Working Standard Solution
m_{det}	mass of detergent
m	slope of the detergent concentration curve
m_1	mass of transferred Stock 1 solution
m_2	mass of transferred Stock 2 solution
St_1	concentration of Stock 1 solution
St_2	concentration of Stock 2 solution
y	absorbance value of the sample
x	concentration of the detergent in the sample

5 Requirements

(Not available in this document.)

[2)] Care shall be taken, as numbers of different parameters are different.

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6 Test method

6.1 Equipment and materials

NOTE This materials list is additional to the materials list in EN 60456:2016, 5.4.

6.1.1 Climate chamber

The ambient temperature and relative humidity in the climate chamber shall be maintained at:

— temperature: (20 ± 2) °C

— relative humidity: (65 ± 5) %.

6.1.2 Ultraviolet (UV) spectrophotometer

The absorption of the ultraviolet light shall be measured with a ultraviolet spectrophotometer with the following specifications:

— wavelength range: 190 nm to 1100 nm

— spectral bandwidth: ≤ 1 nm

— wavelength accuracy (at D_2 peak 656,1 nm): - 0,2 to 0,2 nm

— wavelength repeatability (10 measurements at 656,1 nm, slit width 1 nm): - 0,05 to 0,05 nm

— photometric range: - 0,1 to 3,0 A

— photometric accuracy (UV with $K_2Cr_2O_7$, Ph.Eur. at 1 A): - 0,02 to 0,02 A

— photometric repeatability (10 measurements with $K_2Cr_2O_7$, Ph.Eur. at 1 A): - 0,002 to 0,002 nm.

The spectrophotometer has to be calibrated regularly according to the manufacturer's specification.

6.1.3 Quartz cuvette

The cuvettes to be used for the measurement of the ultraviolet absorption shall be rectangular with a path length of 10 mm and be made from quartz

6.1.4 Cuvette rack

(Not specified in this document.)

6.1.5 Orbital shaker

The device for the extraction of the linear alkylbenzene sulfonate shall be an orbital shaker. The orbital shaker shall have a device for securing sample bottles on it.

Orbit: 4 mm to 20 mm

Shaker speed: ≥ 350 r/min

NOTE The speed of the shaker can be checked by a tachometer, either optical by light beam reflection or mechanical by a magnetic sensor. For details it is advised to refer to the manufacturer's specification.

6.1.6 Scale for weighing detergent and samples

Minimum specification: 0 to 150 g range with

Minimum resolution: 0,001 g

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Accuracy: ± 0,002 g

6.1.7 Weigh bowl

(Not specified in this document.)

6.1.8 Volumetric flask

For the preparation of the working standards for calibration volumetric flasks with a volume of 100 ml and 1 000 ml shall be used.

6.1.9 Graduated cylinder, 100 ml

(Not specified in this document.)

6.1.10 Magnetic stirrer

(Not specified in this document.)

6.1.11 Magnetic stir bar

Small, medium and large stir bars shall be used.

6.1.12 Pipette

Pipette of volume 1, 2, 5, 10 and 25 ml shall be used.

6.1.13 Disposable glass pipettes (e.g. Pasteur pipettes)

Disposable glass pipettes without cotton stoppers, non sterile and with a volume of 2 ml or greater shall be used for transferring the extract to the cuvettes.

NOTE A transfer pipette with disposable plastic tips can be used in place of glass pipettes after correlation tests.

6.1.14 Pipette bulbs, 2 ml or greater

(Not specified in this document.)

6.1.15 Sample bottle with cap (for test swatch extraction)

For the extraction of the test swatches plastic bottles with cap made from high-density polyethylene with a volume of 125 ml and a diameter of 5 cm shall be used.

6.1.16 Laboratory wipes

(Not specified in this document.)

6.1.17 Distilled water

All water used for extractions, dilutions and the preparation of calibration standards shall meet the following criteria:

Conductivity at 25 °C: ≤ 1 µS/cm.

Net absorbance (223 nm to 330 nm): - 0,002 to 0,002 A.

Absorbance curve spectrum 200 nm to 350 nm: no relative peak absorbance greater than ± 0,002 A in the range between 223 nm to 330 nm.

The procedure for calculating these values is given in 6.2.4.

NOTE Water prepared by methods other than distillation having equivalent specifications can be used instead of distilled water.

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6.1.18 Squirt bottle

Material: high-density polyethylene

6.1.19 Funnel

(Not specified in this document.)

6.1.20 Reference detergent A* base powder

The detergent used for calibration is IEC-A* as described in EN 60456:2016. Only the base powder IEC-A* shall be used for the determination of the calibration curve. The calibration shall be done with the batch of detergent used for washing.

NOTE This document only refers to IEC-A* as detergent. It is possible to use other detergents than IEC-A*. For all cases the calibration shall be done with the detergent used for washing.

6.2 Preparation of equipment

(Not specified in this document.)

6.2.1 UV spectrophotometer check

Turn on the UV spectrophotometer. It should be run approximately 30 min before measurements (refer to the manufacturer's specification).

If the instrument has a built-in self-check function, perform the self-check once a day before measuring data. This may be included in the calibration report.

6.2.2 Cleanliness

All materials that come in contact with detergent, distilled water, Stock 1, Stock 2 or the working standard solutions shall be cleaned and thoroughly rinsed with distilled water then dried before use. A professional laboratory dishwasher may be used for this purpose.

6.2.3 Cuvette filling and cleaning

The cuvettes should be handled by the opaque sides only. Do not touch the clear sides of the cuvettes.

To avoid air bubbles, fill by running the solution down the side of the cuvette. Fill cuvettes without soiling or wetting the exterior measuring surface. If air bubbles are present, eliminate them by holding the cuvette at a slight angle and tapping the opaque side as many times as necessary to release the bubbles.

To prevent liquid from running down the cuvette surface after discharging, place the cuvette head first on a clean position of a lint-free tissue for some seconds. Replace the tissue from time to time if no clean position is left.

If a cuvette gets wet on the outside, clean the cuvette and re-check with distilled water. Do not only wipe/dry the cuvette surface with a tissue. Remaining residues in the UV-area are not visible.

NOTE See Annex D (informative), Quartz cuvette and glassware cleaning and handling.

6.2.4 Checking the quality of the distilled water

6.2.4.1 General

Take a spectrum (200 nm to 350 nm) of the distilled water used for testing as described in 6.2.4.2 f).

If

a) the calculated net absorbance value (223 nm to 330 nm) is greater than ± 0,002 A

or

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b) any relative peak absorbance value in the range between 223 nm to 330 nm is greater than ± 0,002 A

Check the spectrum for abnormality and repeat this section with a different batch of distilled water. Such water is likely to contain impurities which could interfere with this test method and lead to unreliable results.

6.2.4.2 Spectrum from 200 nm to 350 nm

a) Start Spectrophotometer and wait for warm up

b) Use only one cuvette

c) Place a DRY and CLEAN and EMPTY cuvette into the position for zeroing the cuvette. The positioning of the cuvette may vary according to the type of spectrophotometer used:

— for double beam devices, place the cuvette in the measuring position and leave the reference/blank position empty;

— for single beam devices with a carrousel, place the cuvette in the reference/blank position.

d) Zero the device (baseline correction)

e) Fill the cuvette with distilled water (rinse twice, keep the third for measurement), place cuvette into the measuring position, leave the reference/blank position empty if applicable.

f) Run a spectrum with the following settings (or the closest available on the spectrophotometer used):

— range: 200 nm to 350 nm

— bandwidth: 1 nm

— speed: 10 nm/s

— integration time: 0,1 s

— switch light source (UV to visual light): ≥ 360 nm

An example of a typical spectrum is given in Figure 1, Example spectrum of distilled water.

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