SLOVENSKI STANDARD
SIST EN 1557:1997

01-december-1997

Površinsko aktivne snovi - Kolorimetrično določanje transmisijskih standardiziranih barvnih vrednosti X, Y, Z bistrih obarvanih tekočin

Surface active agents - Colorimetric characterization of optically clear coloured liquids (products) as X, Y, Z tristimulus values in transmission

Grenzflächenaktive Stoffe - Farbmetrische Charakterisierung von optisch klaren, gefärbten Flüssigkeiten (Produkten) als X-, Y-, Z-Transmissions-Farbwert

Agents de surface - Caractérisation colorimétrique des liquides (produits) colorés optiquement clairs par composantes trichromatiques X, Y, Z en transmittance

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English version

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

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Contents

Foreword

This European Standard has been prepared by the Technical Committee CEN/TC 276 "Surface active agents" the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 1997, and conflicting national standards shall be withdrawn at the latest by March 1997.

Annexes A, B, C and D are informative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom.

0 Introduction

The basic disadvantage of visual subjective comparisons of coloured solutions is that individuals differ in their perception of colour ; added to this is the difficulty of describing shade variations verbally with reference to agreed scales for coloured liquids.

1 Scope

This European Standard specifies a method for the colorimetric characterization of optically clear, slightly tinted liquids (products) by broad-band measurement of pure transmittance with tristimulus value measuring filters as T_X, T_Y and T_Z.

Since the tristimulus value measuring filters of simple tristimulus colorimeters meet the Luther condition to a limited extent only it is necessary to deliberately restrict the liquids (products) to slightly tinted ones in order to be able to measure them sufficiently exactly with a single calibration against uncoloured distilled water.

If the colour of heavily coloured solutions is measured with simple tristimulus colorimeters, it is necessary to calibrate the instrument with a spectrometrically measured standard of very similar colour.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

ISO 4630	1981	Binders for paints and varnishes - Estimation of colour of clear liquids by Gardner colour scale
ISO 6271	1981	Clear liquids - Estimation of colour by the platinum-cobalt scale
ISO 7724-1	1984	Paints and varnishes - Colorimetry - Part 1 : Principles

3 Principle

The principle of the method is the broad-band transmission measurement with X, Y, Z - tristimulus value measuring filters in simple tristimulus colorimeters with special equipped spectral photometers.

The tristimulus colorimeter is calibrated with the tristimulus value measuring filters in each case of 100,0 with a 1 cm square cuvette filled with distilled water.

The slightly tinted, optically clear liquid is measured in the calibrated filter photometer in 1 cm square cuvette with X, Y, Z - tristimulus value measuring filters.

The T_N ($N = X$, Y and Z) transmittance characterises the sample directly.

NOTE 1 : Different types of colour numbers are compared in Annex A.

NOTE 2 : Measurement with other layer thicknesses and conversion by the Bouguer-Lamber-Beer law is permissible (with optically clear, i.e. non-diffusing, solutions), provided that the light passes through the solutions at a specific angle and the law is applicable to the solution in question.

Conversion to the CIE tristimulus values X, Y and Z is also possible (see clause 7).

4 Apparatus and reagents

4.1 Tristimulus colorimeter equipped with X, Y, Z - tristimulus value measuring filters for the 2° standard observer and CIE illuminant C or suitable spectral photometer.

4.2 1 cm glass or plastics cuvettes.

NOTE : It is possible and advantageous to use cheap disposable plastics cuvettes.

4.3 Distilled water or water of equivalent purity.

5 Preparation of the test sample

The slightly tinted, optically clear liquid shall be filled into 1 cm cells. Air bubbles shall be prevented from adhering to the cell walls. Bubbes can be eliminated by allowing the liquid level to rise slowly, e.g. by filling through (plastic disposable) pipettes.

Pastes or solids shall be melted first. Turbid liquids shall be filtered until they are clear.

If it is not desirable or possible to filter an optically turbid liquid the diffusing solutions shall be measured under special conditions, usually with an Ulbricht sphere (Integrating sphere).

Conversion to other layer thicknesses is not possible in this case.

NOTE : The temperature during the sample preparation has an influence to the colour depending on the chemical composition of the sample. In practice because of the short time of sample preparation this effect can be neglected.

6 Procedure

Equip the tristimulus colorimeter with a 1 cm cell, which is filled with bubble-free distilled water (4.3). Insert the tristimulus filter (e.g. for T_Z) and calibrate the display to 100,0. Carry out the same procedure for filters T_X and T_Y if required.

Insert the 1 cm cuvettes containing the optically clear liquids to be investigated and measure the T_Z transmittances (if necessary T_X and T_Y as well) for the CIE 2° Standard observer and CIE illuminant C.

NOTE 1 : For better differentiation very pale, optically clear solutions should be measured in a thicker layer, for example in a 5 cm cell, so as to obtain a reliable reading. The results are then converted to those for a 1 cm thick layer at the evaluation stage.

NOTE 2 : Results of a ring test of APHA-measurements are given in Annex D.

State every deviation from these conditions in the test report.

7 Calculation

The instrument readings T_N ($N = X$, Y or Z) measured with a 1 cm path length can be used directly. Examples of instrument readings see table 1.

Those measured with a layer of any other thickness shall be converted to those for a 1 cm thick layer by equation (1) :

$$T_N = 100\left[\frac{T_{N,d}}{100}\right]^{\frac{1}{d}} \qquad (1)$$

where :

d is the layer thickness in centimeters ;

T_N is the transmittance in percent.

The transmittances T_N relative to the 1 cm layer thickness can be used either directly or after conversion to the decimal absorbency (also known as Extinction/Absorbence A) according to equation (2) :

$$A = \lg\frac{100}{T_N} \qquad (2)$$

The T_N ($N = X$, Y or Z) transmittances can be converted to the CIE tristimulus values X, Y and Z for CIE illuminant C according to the following equations[1] :

$$X = 0{,}7832\ T_X + 0{,}1975\ T_Z \qquad (3)$$

$$Y = T_Y \qquad (4)$$

$$Z = 1{,}1822\ T_Z \qquad (5)$$

From these the CIE chromaticity co-ordinates can be calculated by using equation (6) :

$$x = \frac{X}{X+Y+Z} \text{ or } y = \frac{Y}{X+Y+Z} \qquad (6)$$

NOTE : In calculating the CIE tristimulus value X from equation (3) it is assumed that in the tristimulus colorimeter the CIE spectral tristimulus value $X(\lambda)$ is formed a long-wave T_X-filter and a short-wave T_Z- filter, as is usually the cas in practice.

[1] See CIE Publication N° 15.2 (1986).

Further conversions of the CIE tristimulus values into colour difference systems with almost uniform colour difference scale, e.g. the CIELAB system, can be realized in accordance with ISO/CIE 10526, ISO/CIE 10527 and ISO 7724-1.

Table 1 : Examples of instrument readings T_N (N = X, Y, Z)

Liquid	Transmittances		
	T_X	T_Y	T_Z
Pale yellowish beer	93,7	89,1	61,0
White wine	97,5	96,4	86,1
Red wine	49,2	27,9	10,6
(Blue) copper sulfate solution (20 %) (solution of 20 g $CuSO_4 . 5 H_2O$ in 100 ml water)	26,1	59,6	98,2
(Green) nickel sulfate (20 %) (solution of 20 g $NiSO_4 . 6 H_2O$ in 100 ml water)	32,1	62,7	45,2

8 Test report

The test report shall state the following information :

a) type and identification of the sample ;

b) transmittance T_X, T_Y and T_Z and corresponding X, Y, Z - tristimulus values ;

c) deviations from the cuvette layer thickness of 1 cm, the standard illuminant C and the 2° (small-field) standard observer ;

d) date of test.