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ISO
7887

Second edition
1994-09-01

Water quality — Examination and determination of colour

iTeh STANDARD PREVIEW
Qualité de l'eau — Examen et détermination de la couleur
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Reference number
ISO 7887:1994(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 7887 was prepared by Technical Committee ISO/TC 147, *Water quality*, Subcommittee SC 2, *Physical, chemical, biochemical methods*.

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This second edition cancels and replaces the first edition (ISO 7887:1985), which has been technically revised.

Annex A of this International Standard is for information only.

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Introduction

Pure water observed by transmitted light through a depth of several metres exhibits a light blue colour which may be modified in the presence of pollutants to produce an infinite variety of colours. Natural waters are mostly coloured yellowish brown by particular components of iron, clay particles, or by humic matter (or coloured green due to a content of algae) and the observed colour may not be entirely due to completely soluble substances. For analytical purposes, however, it is the “true colour” of a sample which is of interest. The true colour is described as that due to dissolved substances (i.e. all materials that pass a 0,45 µm filter). Colour observed in the presence of undissolved suspended matter is described as “apparent colour”. The inherent colour of water can be neglected in analytical practice.

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The term colour, in its strict sense, describes the attribute of visual perception consisting of any combination of chromatic and achromatic content (see CIE Publication No. 17.4:1987, term No. 845-02-18). In this International Standard the term colour is used in a looser sense, for describing the absorption at specified wavelengths.

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Water quality — Examination and determination of colour

Section 1: General

1.1 Scope

This International Standard specifies three methods for the examination of colour.

Section 2 specifies a method for the examination of apparent colour by visually observing a water sample in a bottle. This gives only preliminary information, for example for use in field work. Only the apparent colour can be reported.

Section 3 specifies a method for the determination of the true colour of a water sample using optical apparatus and is applicable to raw and potable water and to industrial water of low colour. For interferences, see 3.3.

Section 4 specifies a method for the determination of the colour by visual comparison with hexachloroplatinate standard solutions and may be applied to raw and drinking water. For interferences, see 4.2.

Under certain circumstances, strongly coloured water samples need to be diluted before examination or determination.

When stating the result, it is absolutely necessary to refer to the applied method.

1.2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions

of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 10523:1994, *Water quality — Determination of pH*

CIE Publication No. 17.4:1987, *International lighting vocabulary*.

1.3 Definitions

For the purposes of this International Standard, the definitions given in CIE Publication No. 17.4, and the following, apply.

1.3.1 colour of water: Optical property that causes the changing of the spectral composition of transmitted visible light.

1.3.2 apparent colour of water: Colour due to dissolved substances and undissolved suspended matter; determined in the original water sample without filtration or centrifugation.

1.3.3 true colour of water: Colour due only to dissolved substances; determined after filtration of the water sample through a membrane filter of pore size 0,45 µm.

Section 2: Visual examination

2.1 Apparatus

2.1.1 Colourless bottle, preferably glass, clean and clear, of capacity at least 1 litre.

2.2 Sampling and samples

Maintain all glassware that will come into contact with the sample in a scrupulously clean condition by washing with hydrochloric acid [$c(\text{HCl}) \approx 2 \text{ mol/l}$] or with surfactant cleaning solution which is recommended for laboratory use. Finally rinse with distilled water and allow to drain.

Collect samples in glass bottles of capacity at least 1 litre and carry out the colour test as soon as possible after collection. If storage is unavoidable, store the samples in the dark at 4 °C. Prevent contact between water samples and air during storage, especially in

cases where colour-changing redox reactions are likely to occur. Also avoid variations in temperature.

2.3 Procedure

Put the unfiltered water sample into a bottle (2.1) and examine the sample in diffused light against a white background for colour intensity and hue. If the sample contains suspended matter, if possible allow the suspended matter to settle before examination.

2.4 Expression of results

State the intensity of the colour (nil, pale, light or dark) and the hue (e.g. yellow, yellowish brown).

EXAMPLE

Apparent colour according to ISO 7887 Section 2: Visual examination: pale, yellowish brown.

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Section 3: Determination of the true colour using optical instruments

3.1 General

The intensity of the colour of a water sample is characterized by its light absorption at the wavelength of maximum absorption and quantified by measuring the absorption coefficient with a filter photometer or spectrometer. Normally, most of the yellow-brown coloured natural waters, and the coloured waste-water samples of discharges of domestic treatment plants can be measured at 436 nm. Waste water from industrial waste-water treatment plants does not show sufficiently sharp and distinguished absorption maxima. Those waters shall be examined using the wavelengths specified in 3.2.

3.2 Principle

Characterization of the intensity of colour of a water sample by measuring the attenuation (absorption) of light. Different colours cause maximum absorption at different wavelengths of the incident radiation. According to this International Standard, the colour of the water is determined using a photometer or a spectrometer at at least three different wavelengths distributed over the range of the visible spectrum:

$$\lambda (1) = 436 \text{ nm}$$

$$\lambda (2) = 525 \text{ nm}$$

$$\lambda (3) = 620 \text{ nm}$$

The wavelength $\lambda = 436 \text{ nm}$ (Hg 436 nm) is always used, whereas $\lambda (2)$ and $\lambda (3)$ may differ slightly from the values specified above, depending on the type of filter employed. For a better characterization, measurements at additional wavelengths near the absorption maximum can be performed.

3.3 Interferences

Prior to measurement, the water sample is filtered (3.7) to avoid interferences by undissolved matter. This filtration can, however, lead to further interferences (for example, due to oxidation reactions caused by contact with air or due to precipitations initiated by the filtration step).

As an example, iron and manganese compounds can be retained on the filter or transferred to a coloured oxidation state.

In some cases, particularly in the presence of colloidal solids, for example clay or other finely dispersed matter, it may not be possible to obtain a clear filtrate. In this case, mention in the test results that colloidal solids are present.

NOTE 1 Colours often depend on temperature and pH. Therefore, the temperature and pH of the water sample are regularly determined in parallel with optical measurements and these results are reported with the other findings.

3.4 Reagent

3.4.1 Optically pure water.

Soak a bacteriological filter, of pore size 0,1 μm , in distilled or deionized water for approximately 1 h.

Pass approximately 1 litre of distilled or deionized water through the prepared filter, discarding the first 50 ml of filtrate.

NOTE 2 If freshly distilled or deionized water has no measurable absorbance, it can be used.

3.5 Apparatus

3.5.1 Spectrometer for continuous or discontinuous measurement, suitable for the visible range of the spectrum (approximately from 330 nm to 780 nm)

or

3.5.2 Filter photometer for discontinuous measurements, equipped with spectral line filters having a bandwidth which is as small as possible (about 20 nm), allowing measurements to include wavelengths 436 nm, 525 nm and 620 nm.

3.5.3 Membrane filter assembly, with filters of pore size 0,1 μm and 0,45 μm .

3.5.4 pH-meter.

3.5.5 Thermometer.

3.6 Sampling and samples

See 2.2.

3.7 Procedure

Set up either the spectrometer (3.5.1) or photometer (3.5.2) and strictly observe the operating manual supplied by the manufacturer of the instrument.

Prior to examination, filter the water sample through a membrane filter of pore size 0,45 μm (3.5.3).

In parallel with each colour determination, measure the pH and temperature of the filtered sample.

In the case of strong colours, dilute the water sample with a measured volume of optically pure water (3.4.1), as appropriate, after filtration. The pH shall be measured before and after dilution.

NOTE 3 The volume of water used for dilution should be taken into account when stating the result.

Transfer the water sample to the optical cell of the photometer or spectrometer and place optically pure water (3.4.1) in the reference cell.

NOTE 4 If the spectral absorption coefficient α of the wavelength (λ) is less than 10 m^{-1} , the optical path length of the cell should be greater than 10 mm.

Measure natural waters at 436 nm against optically pure water.

Perform further measurements at 525 nm and 620 nm.

NOTE 5 In order to determine the absorption maximum, the entire absorption spectrum between 350 nm and 780 nm may be taken, using a spectrometer (3.5.1).

3.8 Calculation

Calculate the spectral absorption coefficient $\alpha(\lambda)$ (absorption per unit path length) as follows:

$$\alpha(\lambda) = \frac{A}{d} \times f \quad \dots (1)$$

where

A is the absorbance of the water sample at wavelength λ ;

d is the optical pathlength, in millimetres, of the cell;

f is a factor used to give the spectral coefficient, in reciprocal metres ($f = 1\ 000$).

NOTE 6 Most spectrometers are calibrated directly in terms of absorbance units. For instruments calibrated only in terms of transmittance $T = \phi_{\text{tr}}/\phi_0$, the absorbance is given by the equation

$$A = \lg \frac{\phi_0}{\phi_{\text{tr}}} \quad \dots (2)$$

where

ϕ_0 is the incident flux;

ϕ_{tr} is the transmitted flux.

3.9 Expression of results

Apart from the absorption coefficient $\alpha(\lambda)$, the wavelength of the incident light (e.g. 436 nm) shall be reported. For radiation which is not strictly monochromatic, the spectral half-intensity width ($\Delta\lambda$) (bandwidth) shall also be reported.

The spectral absorption coefficient shall be rounded to the nearest $0,1 \text{ m}^{-1}$.

EXAMPLE (true colour according to ISO 7887 Section 3)

Spectral absorption coefficient, Hg λ 436 nm:	5,2 m^{-1}
Spectral absorption coefficient, λ 525 nm, $\Delta\lambda = 21 \text{ nm}$:	1,8 m^{-1}
Spectral absorption coefficient, λ 620 nm, $\Delta\lambda = 18 \text{ nm}$:	2,3 m^{-1}
Water temperature:	18,2 $^{\circ}\text{C}$
pH-value:	6,4

Section 4: Visual method for the determination of the colour in natural water

4.1 Principle

Determination of the intensity of the yellowish brown colour of a sample by visual comparison against a series of matching solutions. Expression of the colour in terms of mg/l Pt units representing the intensity of colour produced by the matching solutions.

4.2 Interferences

Interferences will arise if the colour of the sample differs appreciably from the colour of the matching solutions. In these cases, a meaningful comparison may be impossible to obtain and the determination shall be carried out according to Section 3.

For additional interferences, see 3.3.

4.3 Reagents

During the analysis, unless otherwise stated, use only reagents of recognized analytical grade.

4.3.1 Stock colour matching solution, corresponding to 500 mg/l Pt units.

Dissolve $1,245 \text{ g} \pm 0,001 \text{ g}$ of potassium(IV) hexachloroplatinate (K_2PtCl_6) and $1,000 \text{ g} \pm 0,001 \text{ g}$ of cobalt(II) chloride hexahydrate ($\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$) in about 500 ml of water (3.4.1).

Add $100 \text{ ml} \pm 1 \text{ ml}$ of hydrochloric acid ($\rho = 1,18 \text{ g/ml}$) and make up to the mark with water in a 1 litre volumetric flask.

Store the solution in a well-stoppered glass bottle in the dark at a temperature not exceeding $30 \text{ }^\circ\text{C}$.

The solution is stable for at least 3 months.

4.3.2 Colour matching solutions

Pipette 2,5 ml; 5,0 ml; 10,0 ml; 15,0 ml; 20,0 ml; 25,0 ml; 30,0 ml and 35,0 ml of stock solution (4.3.1) into a series of 250 ml volumetric flasks and make up to the mark with water (3.4.1).

These solutions contain 5 mg/l Pt, 10 mg/l Pt, 20 mg/l Pt, 30 mg/l Pt, 40 mg/l Pt, 50 mg/l Pt, 60 mg/l Pt and 70 mg/l Pt, respectively.

Store the solutions in well-stoppered glass bottles in the dark at a temperature not exceeding $30 \text{ }^\circ\text{C}$.

The solutions are stable for one month.

4.4 Apparatus

4.4.1 Standard observation tubes, for example Nessler tubes, tall form, length about 20 cm, of capacity 50 ml, made of optically clear glass with shadowless bottoms, or special observation tubes.

NOTE 7 Larger non-standard tubes may be used.

4.4.2 Comparators (commercially available).

The manufacturer's operating instructions shall be observed. Cells for the blank, or for the reference, shall be filled with optically pure water.

4.4.3 Permanent glass standards, covering a similar range of standard colours, in terms of milligrams of Pt per litre, as the matching solutions.

Their use is permissible provided that they are checked at intervals of 3 months against the matching solutions (4.3.2) and recalibrated if necessary.

4.5 Sampling and samples

See 2.2.

4.6 Procedure

If the laboratory sample is turbid, filter it through a membrane filter of pore size $0,45 \text{ } \mu\text{m}$ (see 3.5.3) before carrying out the determination of colour (see note 8).

In the presence of clay, or other finely dispersed suspended matter, it may not be possible to obtain a clear filtrate, in which case only apparent colour is measured.

If the colour is greater than 70 mg/l Pt, dilute the sample with measured amounts of optically pure water (3.4.1), until the colour is within the range of the matching solution.

The pH of the sample can change because of the dilution. Therefore measure it prior to and after dilution.