INTERNATIONAL STANDARD

ISO 5815-2

First edition
2003-04-01

Water quality — Determination of biochemical oxygen demand after n days (BOD_n) —

Part 2: Method for undiluted samples

Qualité de l'eau — Détermination de la demande biochimique en oxygène après n jours (DBO_n) —

Partie 2: Méthode pour échantillons non dilués

Reference number
ISO 5815-2:2003(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 5815-2 was prepared by Technical Committee ISO/TC 147, *Water quality*, Subcommittee SC 2, *Physical, chemical and biochemical methods*.

This first edition of ISO 5815-2, together with ISO 5815-1, cancels and replaces ISO 5815:1989, which has been technically revised.

ISO 5815 consists of the following parts, under the general title *Water quality — Determination of biochemical oxygen demand after n days (BOD_n)*:

— *Part 1: Dilution and seeding method with allythiourea addition*

— *Part 2: Method for undiluted samples*

ISO 5815-2 is the equivalent of European Standard EN 1899-2.

Introduction

This part of ISO 5815 is intended for analysis of biochemical oxygen demand (BOD) in waters with a BOD in the range 0,5 mg/l to 6 mg/l of oxygen.

The times of incubation specified in this part of ISO 5815 are 5 days, as in ISO 5815:1989 and as applied in many European countries, or 7 days, as applied in several Nordic countries for many years. The 7-day incubation typically gives higher BOD results than the 5-day incubation.

With an incubation period of 5 days, weekend work can only be avoided if samples are collected Wednesdays, Thursdays or Fridays. With an incubation period of 7 days, samples collected on the first five weekdays can be analysed without implying weekend work. For this reason, a 7-day incubation period can be considered more convenient than the conventional 5-day incubation.

A new, modified 7-day incubation period is described in Annex A. Early investigations indicate that BOD results obtained by this modified method are identical to results obtained by the 5-day method described in the main text of this part of ISO 5815. It is hoped that more comparative data on these two incubation methods will be obtained during the coming years, so that the modified 7-day incubation method can be included fully at the time of review and revision of this part of ISO 5815.

For the determination of BOD_n of water samples, the respirometric method described in ISO 9408 may also be used.

In this part of ISO 5815, the limit of determination, D_L, is defined as

$$D_L = t_{0,95(f)} \cdot 2 \cdot s_B \cdot \sqrt{1+\frac{1}{n}} \quad (1)$$

where

s_B is the within-series standard deviation;

$t_{0,95(f)}$ is the Student t-value;

f is the degrees of freedom for the determination of s_B;

n is the number of analyses for determination of the blank in an analytical series;

s_B is calculated from determinations of real samples with a BOD content near the estimated D_L.

In cases where the analytical method does not require any blank correction, the term

$$\sqrt{1+\frac{1}{n}} \quad (2)$$

is omitted.

Water quality — Determination of biochemical oxygen demand after n days (BOD_n) —

Part 2: Method for undiluted samples

WARNING — Persons using this part of ISO 5815 should be familiar with normal laboratory practice. This part of ISO 5815 does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any national regulatory conditions.

1 Scope

This part of ISO 5815 specifies determination of the biochemical oxygen demand (BOD) of waters of undiluted samples. It is applicable to all waters having biochemical oxygen demands greater than or equal to 0,5 mg/l of oxygen (the limit of determination) and not exceeding 6 mg/l of oxygen.

The results obtained are the product of a combination of biochemical and chemical reactions. They do not have the rigorous and unambiguous character of those resulting from, for example, a single, well-defined, chemical process. Nevertheless, they provide an indication from which the quality of waters can be estimated.

The test can be influenced by the presence of various substances. Those which are toxic to microorganisms, for example bactericides, toxic metals or free chlorine, inhibit biochemical oxidation. The presence of algae or nitrifying microorganisms can produce artificially high results. In these situations a modification of the method may be necessary.

Annex A describes alternative incubation periods.

Annex B describes procedures for modification of the method by addition of seeding material, salts, inhibition of nitrification by allylthiourea (ATU) addition, neutralization, homogenization and/or filtration. These modifications may be found necessary for specific evaluations of the water quality of receiving waters.

Annex C provides precision data.

2 Normative references

The following referenced documents are indispensable for the application 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 3696:1987, *Water for analytical laboratory use — Specification and test methods*

ISO 5813:1983, *Water quality — Determination of dissolved oxygen — Iodometric method*

ISO 5814:1990, *Water quality — Determination of dissolved oxygen — Electrochemical probe method*

3 Terms and definitions

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

3.1
biochemical oxygen demand after n days
BOD_n
mass concentration of dissolved oxygen consumed under specified conditions by the biochemical oxidation of organic and/or inorganic matter in water, where n is the incubation time equal to 5 days or 7 days

NOTE 1 Adapted from ISO 6107-2.

NOTE 2 For the purposes of this part of ISO 5815, “biochemical oxidation” is taken to mean “biological oxidation”.

4 Principle

It is absolutely essential that tests conducted according to this part of ISO 5815 are carried out by suitably qualified staff.

The sample of water to be analysed is equilibrated to 20 °C followed by, if necessary, aeration. Incubation at 20 °C for a defined period, 5 days or 7 days, in the dark, in a completely filled and stoppered bottle. Determination of the dissolved oxygen concentration before and after incubation. Calculation of the mass of oxygen consumed per litre of sample.

5 Apparatus

The glassware used shall be clean, i.e. free from adsorbed toxic or biodegradable compounds, and shall be protected from contamination.

5.1 Incubation bottles, BOD bottles, with glass stoppers, of capacity preferably 250 ml to 300 ml or 100 ml to 125 ml and preferably with straight shoulders, or any equivalent bottles.

It is important that the bottles are thoroughly cleaned before use. If the iodometric method (ISO 5813) for determining dissolved oxygen is used, it is normally sufficient to rinse the bottle several times with tap water then deionized water. If the electrode method (ISO 5814) is used, a more stringent cleaning procedure, for example as follows, is required. Add to the empty bottle 5 ml to 10 ml of a wash solution (for example 2,5 g of iodine plus 12,5 g of potassium iodide per litre of 1 % (volume fraction) sulfuric acid, shaking well to coat the bottle walls. Let stand for 15 min, pour off the solution and rinse thoroughly with tap water and finally deionized water.

5.2 Incubator, capable of being maintained at (20 ± 2) °C.

5.3 Equipment for determining dissolved oxygen concentration, in accordance with ISO 5813 and ISO 5814.

5.4 Means of refrigeration at 0 °C to 4 °C, for transport and storage of the sample.

5.5 Aeration equipment, e.g. bottle of compressed air or a compressor.

The air quality shall be such that the aeration does not lead to any contamination, especially by the addition of organic matter, oxidizing of reducing materials, or metals. If contamination is suspected, the air shall be filtered and washed.

6 Storage of the sample

Store the sample at 0 °C to 4 °C in a filled and hermetically stoppered bottle immediately after sample collection and until the analysis is performed. Begin the determination of the BOD_n as soon as possible and within 24 h of completion of sample collection.

7 Procedure

7.1 Preparation of test solutions

Bring the test sample to a temperature of (20 ± 2) °C and aerate if necessary. In case of aeration, let the sample stand about 15 min. Remove air bubbles and possible supersaturation of oxygen.

7.2 Procedure

7.2.1 Measurement of dissolved oxygen using iodometric method (in accordance with ISO 5813)

Using each sample (7.1), fill two incubation bottles (5.1), allowing them to overflow slightly. During filling operations, take precautions to prevent changing the oxygen concentration of the medium.

Allow any air bubbles adhering to the walls to escape. Stopper the bottles, taking care to avoid trapping air bubbles.

Divide the bottles into two series, each containing one bottle of each sample.

Put the first series of bottles in the incubator (5.2) and leave in darkness for n days ± 4 h.

In the second series of bottles, measure the dissolved oxygen concentration in each of the bottles at time zero after 15 min, using the method specified in ISO 5813 with the addition of azide in the alkaline iodide-azide reagent.

After the incubation, determine the dissolved oxygen concentration in each of the first series of bottles, using the method specified in ISO 5813.

7.2.2 Measurement of dissolved oxygen using electrochemical probe (in accordance with ISO 5814)

Using each sample (7.1), fill an incubation bottle (5.1), allowing it to overflow slightly. During filling operations, take precautions to prevent changing the oxygen concentration of the medium.

Allow any air bubbles adhering to the walls to escape.

Measure the dissolved oxygen concentration in each of the bottles at time zero, using the method specified in ISO 5814.

Stopper the bottles, taking care to avoid trapping air bubbles.

Put the bottles in the incubator (5.2) and leave in darkness for n days ± 4 h.

After the incubation, determine the dissolved oxygen concentration in each of the bottles, using the method specified in ISO 5814.

7.2.3 Control analysis

For each series of determinations, include at least one double determination of a sample (BOD_{n1}, BOD_{n2}).

Plot the relative percentage difference (r_i) of each series (i) on quality control charts:

$$r_i = \frac{(\mathrm{BOD}_{n1} - \mathrm{BOD}_{n2}) \cdot 100}{0{,}5(\mathrm{BOD}_{n1} + \mathrm{BOD}_{n2})} \ \% \tag{3}$$

where

BOD_{n1} is the result of the first BOD_n determination of sample;

BOD_{n2} is the result of the second BOD_n determination of sample.

Consider the upper control limit as:

$$3{,}267\ 8 \cdot \bar{r}\ \% \tag{4}$$

where $\bar{r}$ is the average value of r_i values.

The repeatability coefficient of variation (CV) can be calculated as:

$$\mathrm{CV} = \frac{\bar{r}}{1{,}128}\ \% \tag{5}$$

After incubation, the residual dissolved oxygen concentration should be at least 2 mg/l. The oxygen consumption should be at least the limit of determination of the laboratory for BOD measurement.

Care should be taken that representative samples are collected.

8 Calculation and expression of results

Calculate the biochemical oxygen demand after n days (BOD_n), expressed in milligrams per litre of oxygen, using the equation

$$\mathrm{BOD}_n = (\rho_1 - \rho_2) \tag{6}$$

where

ρ_1 is the dissolved oxygen concentration of the test sample at time zero, in milligrams per litre;

ρ_2 is the dissolved oxygen concentration of this same test sample after n days, in milligrams per litre.

The results shall be reported to two significant figures, e.g. 4,5 mg/l of oxygen.

The results of interlaboratory testing on the trueness and precision of results are given in Annex C.

9 Test report

The test report shall include the following information:

a) a reference to this part of ISO 5815, i.e. ISO 5815-2;

b) the number of days of incubation (n);

c) the results in milligrams per litre of oxygen (reported as described in Clause 8);

d) for results below the working range, documentation for an adequate limit of determination;

e) any special details which may have been noted during the test;

f) details of any operations not specified in this part of ISO 5815, or regarded as optional, such as aeration (7.1), alternative incubation (BOD_{2+5}) (in accordance with Annex A) and modifications such as freezing and homogenization (in accordance with Annex B).

Annex A
(informative)

Alternative incubation periods and temperatures

The rate of oxidation of carbon during the first stage of the BOD test is expressed by Phelps' law:

$$\log_{10} \frac{L}{L-x} = kt$$

where

L is the ultimate BOD at infinite time, in milligrams per litre of oxygen;

x is the BOD at time t in milligrams per litre of oxygen;

t is the time, in days;

k is the rate constant, expressed as the reciprocal day.

For a given type of organic matter and microorganisms, the effect of temperature on the rate constant k and on the value of L can be predicted to a first approximation. This may be useful when considering the use of the BOD test in warm climates, or in studies of long rivers which traverse a number of climatic regions. It is essential that such relationships, however, are used with caution.

The standard BOD result is obtained after a 5-day or 7-day incubation at 20 °C.

By incubating for 2 days at 0 °C to 4 °C followed by 5 days at 20 °C, a BOD_{2+5} result is obtained.

In an interlaboratory comparison performed in 1992, the correlation between BOD_5 and BOD_7 results and between BOD_5 and BOD_{2+5} results were measured. In this exercise, 76 laboratories from nine countries participated. The results are shown in Table A.1. In practice there is no difference between BOD_5 and BOD_{2+5} determinations.

Table A.1 — Interlaboratory Comparison 46:1992 — Comparison of BOD_5 and BOD_{2+5} determinations

Sample type		BOD_5 mg/l of oxygen median	BOD_{2+5} mg/l of oxygen median	Significant difference [a]	Number of laboratories included in calculations	BOD_{2+5}/BOD_5
Stabilized fresh water	A	2,15	2,12	No	71	—
	B	4,87	4,92	No	71	—
Natural fresh water	C_s	0,68	0,62	No	15	—
	C_j	1,29	1,28	No	28	—
Natural fresh water	D_s	4,69	4,68	No	16	—
	D_j	3,03	3,22	Yes	28	1,06

[a] Level of significance level α = 0,05.

When determining BOD_{2+5}, read paragraph 4 of 7.2.1 as follows:

"Put the first series of bottles in the refrigerator in darkness at 0 °C to 4 °C for 2 days ± 2 h[1)] and then put them in the incubator (5.2), with the temperature of the samples equilibrated at (20 ± 1) °C, and leave in darkness for 5 days ± 2 h [1)]."

and read paragraph 5 of 7.2.2 as follows:

"Put the bottles in the refrigerator in darkness at 0 °C to 4 °C for 2 days ± 2 [1)] and then put them in the incubator (5.2), with the temperature of the samples equilibrated at (20 ± 1) °C, and leave in darkness for 5 days ± 2 h [1)]."

When BOD_5 determinations are substituted by BOD_{2+5} determinations, it is necessary for the laboratory to have checked that their procedure for BOD_{2+5} determinations gives results equivalent to those of BOD_5 determinations.

1) A fan-assisted incubator may be necessary to ensure the change in incubation temperature within the required time interval.

Annex B
(informative)

Modifications for specific evaluations

B.1 General

For specific evaluations of the quality of waters, it may be necessary to modify the standard method. The procedures for some modifications are described in this Annex. Appropriate corrections of results shall be made for the dilution due to addition of reagents.

If the time between sampling and start of analysis cannot be kept to less than 24 h, due to time of transportation, as a result of geographical circumstances, freezing of samples is permitted. Frozen samples shall be homogenized after thawing and seeding water shall be used. It is recommended that, wherever possible, local laboratory facilities be found to limit the time of transportation.

For specific investigations of BOD_n in undiluted samples, seeding may be required. For this purpose add, according to its source, 5 ml to 20 ml of seeding water (B.2.2) per litre of sample. Results shall be corrected for the oxygen demand of the seeding water as follows. Seeding water diluted with water is treated as other test samples in accordance with Clause 7 of this part of ISO 5815.

The extent of dilution should be such that, after incubation, the residual oxygen concentration will be between one-third and two-thirds of the initial concentration. The biochemical oxygen demand BOD_n, expressed in milligrams per litre of oxygen, is given by the equation:

$$\mathrm{BOD}_n = \left[(\rho_1 - \rho_2) - \frac{(\rho_3 - \rho_4) \cdot V_\mathrm{s}}{V_\mathrm{d}} \right] \cdot \frac{1\,000}{1\,000 - V_\mathrm{s}}$$

where

ρ_1 is the dissolved oxygen concentration of the seeded test sample at time zero, in milligrams per litre;

ρ_2 is the dissolved oxygen concentration of the seeded test sample after n days, in milligrams per litre;

ρ_3 is the dissolved oxygen concentration of the seeding water diluted with water at time zero, in milligrams per litre;

ρ_4 is the dissolved oxygen concentration of the seeding water diluted with water after n days, in milligrams per litre;

V_s is the volume of seeding water, in millilitres, per litre of seeded test sample;

V_d is the volume of seeding water, in millilitres, per litre of seeding water diluted with water.

For samples with low content of salts, there may be a need to add salt solutions. For this purpose, add 1 ml of each of the salt solutions (B 2.2.1, B 2.2.2, B 2.2.3 and B 2.2.4) per litre of sample.

For specific investigations of BOD_n in undiluted samples, there may be a need for suppression of nitrification. For this purpose, add 2 ml of allylthiourea solution (B.2.3) per litre of sample.

Neutralization may be required if the pH of the sample is not between 6 and 8. Perform neutralization after having determined by a separate test the volume of hydrochloric acid solution (B.2.4) or of sodium hydroxide solution (B.2.5) necessary. Ignore any precipitate which may be formed.

Neutralization of any excess of free and combined chlorine in the sample may be required. Perform neutralization by adding the required volume of sodium sulfite solution (B.2.6). Take care to avoid adding an excess.

NOTE Methods for the determination of free and combined chlorine are given in ISO 7393-1 and ISO 7393-2.

Carry out homogenization with a laboratory blender or equivalent, if found necessary for specific purposes, e.g.:

a) when testing a sample containing large particles;

b) when samples have been frozen (see Clause 10).

Filtration of samples containing algae may be required to avoid producing unusually high results. Filtering can change BOD results radically, and it shall only be performed if deemed necessary in the evaluation of the quality of the water. A filter pore size of 1,6 µm is appropriate. Record in the test report the specifications of particle sizes detained by filtration.

B.2 Reagents

Use only grade 3 water in accordance with ISO 3696. However, the water shall not contain more than 0,01 mg/l of copper, nor chlorine or chloramines.

B.2.1 Seeding water

Obtain seeding water from one of the following sources:

a) settled effluent from a waste water treatment plant;

b) commercially available seeding material.

B.2.2 Salt solutions, stored in glass bottles in the dark.

The following solutions are stable for at least 1 month. Discard them at the first sign of precipitation or biological growth.

B.2.2.1 Phosphate buffer solution, pH 7,2.

Dissolve 8,5 g of potassium dihydrogen phosphate (KH_2PO_4), 21,75 g of dipotassium hydrogen phosphate (K_2HPO_4), 33,4 g of disodium hydrogen phosphate heptahydrate ($Na_2HPO_4 \cdot 7H_2O$) and 1,7 g of ammonium chloride (NH_4Cl) in about 500 ml of water. Dilute to 1 000 ml and mix.

The pH of this buffer solution should be 7,2 without further adjustment.

B.2.2.2 Magnesium sulfate heptahydrate solution, ρ = 22,5 g/l.

Dissolve 22,5 g of magnesium sulfate heptahydrate ($MgSO_4 \cdot 7H_2O$) in water. Dilute to 1 000 ml and mix.

B.2.2.3 Calcium chloride solution, ρ = 27,5 g/l.

Dissolve 27,5 g of anhydrous calcium chloride ($CaCl_2$) or equivalent, (for example, if hydrated calcium chloride is used: 36,4 g of $CaCl_2 \cdot 2H_2O$) in water. Dilute to 1 000 ml and mix.

B.2.2.4 Iron(III) chloride hexahydrate solution, ρ = 0,25 g/l.

Dissolve 0,25 g of iron(III) chloride hexahydrate ($FeCl_3 \cdot 6H_2O$) in water. Dilute to 1 000 ml and mix.

B.2.3 Allylthiourea (ATU) solution.

Dissolve 200 mg of allylthiourea ($C_4H_8N_2S$), in water, dilute to 200 ml and mix. Store the solution at 4 °C.

B.2.4 Hydrochloric acid (HCl) or sulfuric acid (H_2SO_4) solution, $c(H_2SO_4) \approx 0{,}25$ mol/l, $c(HCl) \approx 0{,}5$ mol/l, or as appropriate.

B.2.5 Sodium hydroxide (NaOH) solution, $\rho \approx 20$ g/l or as appropriate.

B.2.6 Sodium sulfite (Na_2SO_3) solution, $\rho \approx 50$ g/l or as appropriate.

Annex C
(informative)

Trueness and precision

The standard deviations of the BOD_n analyses were determined by an interlaboratory comparison in 1992 where 76 laboratories in nine countries performed 2 to 4 analyses on two stabilized fresh, surface-water samples and two locally collected fresh, surface-water samples. The results are shown in Table C.1.

Table C.1 — Interlaboratory Comparison 46:1992 — Results

	Sample type		Median	Repeatability standard deviation	Relative standard deviation within laboratories	Reproducibility standard deviation	Relative standard deviation between laboratories	Number of laboratories included in calculations	Outlier laboratories
			mg/l of oxygen	mg/l of oxygen	%	mg/l of oxygen	%		
BOD_5	Stabilized fresh water	A	2,15	0,10	4,3	0,53	24	72	2
	Stabilized fresh water	B	4,87	0,13	2,7	0,85	18	72	3
	Natural fresh water	C	1,56	0,12	7,4	–	–	24	3
	Natural fresh water	C_0	0,68	0,13	18	0,26	36	16	1
	Natural fresh water	C_1	1,29	0,13	9,4	0,34	26	28	1
	Natural fresh water	D	2,06	0,15	5,0	–	–	24	1
	Natural fresh water	D_s	4,69	0,22	4,8	0,30	6,4	16	0
	Natural fresh water	D_j	3,03	0,15	4,7	0,31	10	28	0
BOD_{2+5}	Stabilized fresh water	A	2,12	0,13	5,9	0,37	17	71	2
	Stabilized fresh water	B	4,92	0,17	3,6	0,85	18	71	3
	Natural fresh water	C	1,29	0,12	7,4	–	–	24	2
	Natural fresh water	C_0	0,62	0,10	17	0,21	36	16	1
	Natural fresh water	C_1	1,28	0,11	9,1	0,27	21	28	0
	Natural fresh water	D	1,90	0,10	3,9	–	–	24	3
	Natural fresh water	D_s	4,68	0,15	3,1	0,39	8,4	16	1
	Natural fresh water	D_j	3,22	0,13	3,9	0,38	12	28	1
BOD_7	Stabilized fresh water	A	2,57	0,11	4,3	0,40	15	71	6
	Stabilized fresh water	B	5,82	0,15	2,7	0,94	17	71	4
	Natural fresh water	C	2,02	0,13	7,5	–	–	24	4
	Natural fresh water	C_0	0,90	0,08	9,8	0,26	30	16	4
	Natural fresh water	C_1	1,50	0,14	8,9	0,38	25	28	2
	Natural fresh water	D	2,67	0,17	4,9	–	–	24	2
	Natural fresh water	D_s	5,51	0,29	5,3	0,42	7,7	16	0
	Natural fresh water	D_j	4,74	0,16	3,4	0,44	9,3	28	0

In this interlaboratory comparison, a repeatability standard deviation of 0,10 mg/l to 0,29 mg/l of oxygen and a reproducibility standard deviation of 0,26 mg/l to 0,94 mg/l of oxygen was found.

It is possible to establish factors for conversion between BOD_5 and BOD_7 data within a single type of water.

The value of conversion factors can be obtained for each water type from parallel analyses of BOD_5 and BOD_7 measurements of the same samples. If a factor is not available the correlation between BOD_5 and BOD_7 can be estimated from the above mentioned interlaboratory comparison. The results are shown in Table C.2.

Table C.2 — Interlaboratory Comparison 46:1992 — Comparison of BOD_5 and BOD_7 determinations

Sample type		BOD_5 mg/l of oxygen Median	BOD_7 mg/l of oxygen Median	Significant difference[a]	Number of laboratories included in calculations	BOD_7/BOD_5
Stabilized fresh water	A	2,15	2,57	Yes	71	1,20
	B	4,87	5,82	Yes	71	1,20
Natural fresh water	C_s	0,68	0,90	Yes	15	1,32
	C_j	1,29	1,50	Yes	28	1,16
Natural fresh water	D_s	4,69	5,51	Yes	16	1,28
	D_j	3,03	4,74	Yes	28	1,56

[a] Level of significance $\alpha = 0,05$.

Bibliography

[1] ISO 6107-2:1997, *Water quality — Vocabulary — Part 2*

[2] ISO 7393-1, *Water quality — Determination of free chlorine and total chlorine — Part 1: Titrimetric method using N,N-diethyl-1,4-phenylenediamine*

[3] ISO 7393-2, *Water quality — Determination of free chlorine and total chlorine — Part 2: Colorimetric method using N,N-diethyl-1,4-phenylenediamine, for routine control purposes*

[4] ISO 9408:1999, *Water quality — Evaluation of ultimate aerobic biodegradability of organic compounds in aqueous medium by determination of oxygen demand in a closed respirometer*

ICS 13.060.50

Price based on 13 pages