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An American National Standard

Standard Guide for Water Analysis for Reverse Osmosis Application[1]

This standard is issued under the fixed designation D 4195; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide covers the analyses that should be performed on any given water sample if reverse osmosis application is being considered.

1.2 This guide is applicable to waters including brackish waters and seawaters but is not necessarily applicable to waste waters.

1.3 This is a guide only and should not be construed as a delineation of all ions known to exist in waters.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 511 Test Methods for Calcium and Magnesium in Water[2]
D 512 Test Methods for Chloride Ion in Water[2]
D 513 Test Methods for Total and Dissolved Carbon Dioxide in Water[2]
D 515 Test Methods for Phosphorus in Water[3]
D 516 Test Method for Sulfate Ion in Water[2]
D 857 Test Method for Aluminum in Water[2]
D 858 Test Methods for Manganese in Water[2]
D 859 Test Method for Silica in Water[2]
D 888 Test Methods for Dissolved Oxygen in Water[2]
D 1068 Test Methods for Iron in Water[2]
D 1129 Terminology Relating to Water[2]
D 1179 Test Methods for Fluoride Ion in Water[2]
D 1253 Test Methods for Residual Chlorine in Water[2]
D 1293 Test Methods for pH of Water[2]
D 1428 Test Methods for Sodium and Potassium in Water and Water-Formed Deposits by Flame Photometry (Method A)[4]
D 1888 Test Methods for Particulate and Dissolved Matter in Water[4]
D 1889 Test Methods for Turbidity of Water[2]
D 2579 Test Method for Total and Organic Carbon in Water[5]
D 3352 Test Method for Strontium Ion in Brackish Water, Seawater, and Brines[6]
D 3370 Practices for Sampling Water from Closed Conduits[2]
D 3561 Test Method for Lithium, Potassium, and Sodium Ions in Brackish Water, Seawater, and Brines by Atomic Absorption Spectrophotometry[6]
D 3867 Test Methods for Nitrite-Nitrate in Water[2]
D 4189 Test Method for Silt Density Index (SDI) of Water[2]
D 4194 Test Methods for Operating Characteristics of Reverse Osmosis and Nanofiltration Devices[6]
D 4382 Test Method for Barium in Water, Atomic Absorption Spectrophotometry, Graphite Furnace[2]

2.2 *American Public Health Association:*

Standard Methods for the Examination of Water and Wastewater, Sixteenth Edition, 1985, pp. 470–478, Part 427, Sulfite[7]

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this guide, refer to Terminology D 1129.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 For description of terms relating to reverse osmosis, refer to Test Method D 4194.

4. Summary of Guide

4.1 This guide consists of analyzing water samples for ions, gases, suspended material, and organics, as well as measuring the pH and temperature of the water.

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[1] This guide is under the jurisdiction of ASTM Committee D19 on Water, and is the direct responsibility of Subcommittee D 19.08 on Membranes and Ion Exchange Materials.

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[2] *Annual Book of ASTM Standards*, Vol 11.01.

[3] Discontinued. See 1996 *Annual Book of ASTM Standards*, Vol 11.01.

[4] Discontinued. See 1989 *Annual Book of ASTM Standards*, Vol 11.01.

[5] Discontinued. See 2001 *Annual Book of ASTM Standards*, Vol 11.01.

[6] *Annual Book of ASTM Standards*, Vol 11.02.

[7] American Public Health Associatin, 1015 Fifteenth St., N.W., Washington, DC 20005.

5. Significance and Use

5.1 The performance of reverse osmosis membranes is strongly influenced by the composition of the feed solution. Overall salt rejection is dependent upon the ratio of monovalent to polyvalent ions as well as the sum total of ions present. The permeate flow rate of reverse osmosis devices is also dependent upon the sum total of the ions present and the operating temperature, pressure, and recovery rate. Analyses and measurements performed in this guide will provide vital data for salt rejection and permeate flow projections of reverse osmosis systems for specific feedwaters.

5.2 The recovery at which a reverse osmosis system can be safely operated is dependent upon the composition of the feed solution. The analyses and measurements performed inthis guide will provide data for the calculation of the maximum recovery of a reverse osmosis system for a given feed solution.

5.3 The analyses and measurements performed in this guide will be of great assistance in determining the pretreatment requirements for a reverse osmosis system on a given feedwater.

6. Procedure

6.1 Collect a sample of the water to be tested in accordance with Practices D 3370.

6.2 Determine the concentration of:

Calcium (Ca)	Manganese (Mn) (total and dissolved)	Carbonate ($CO_3^{=}$)
Magnesium (Mg)	Iron (Fe) (total, dissolved, and ferrous)	Nitrate (NO_3^{-})
Sodium (Na)	Potassium (K)	Fluoride (F^{-})
Strontium (Sr)	Bicarbonate (HCO_3^{-})	Phosphate ($PO_4^{\equiv}$) (total)
Barium (Ba)	Sulfate ($SO_4^{=}$)	Silica (SiO_2) (total and dissolved)
Aluminum (Al) (total and dissolved)	Chloride (Cl^{-})	Total dissolved solids (TDS)

in accordance with the documents referenced in Section 2 of this guide. The results may be expressed as (*a*) mg/L as the ion; (*b*) mg/L as calcium carbonate; or (*c*) meq/L as the ion.

NOTE 1—If the analysis is complete, the total cations and total anions (expressed as mg/L calcium carbonate or meq/L as the ion) should balance within 5 %. That is:

$$([\textit{total cations}] - [\textit{total anions}])/([\textit{total cations}]) \times 100 < \pm 5\ \%$$

NOTE 2—ASTM methods for aluminum, iron, manganese, and nitrate may not be applicable for seawater.

6.3 Determine the organic carbon content of the water using Method D 2579.

6.4 Determine the concentration of:

Hydrogen sulfide (H_2S) (see 2.2)	Oxygen (O_2)
Free chlorine (Cl_2)	Carbon dioxide (CO_2)

in accordance with the documents referenced in Section 2 of this guide. Express the results as mg/L.

6.5 Measure the pH, temperature, turbidity, and silt density index in accordance with the ASTM standards referenced in Section 2 of this guide.

6.5.1 Turbidity should be obtained by the nephelometric method.

6.5.2 Temperature, pH, and silt density index should be measured on-site at the time the sample is collected.

7. Precision and Bias

7.1 The precision and bias of this guide are a function of each individual analysis and are given where applicable in the documents that are referenced.

8. Keywords

8.1 reverse osmosis; water analysis