



Standard Practice for Calculation and Adjustment of Sulfate Scaling Salts (CaSO_4 , SrSO_4 , and BaSO_4) for Reverse Osmosis and Nanofiltration¹

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1. Scope

1.1 This practice covers the calculation and adjustment of calcium, strontium, and barium sulfates for the concentrate stream of a reverse osmosis or nanofiltration system. The calculations are used to determine the need for scale control in the operation and design of reverse osmosis and nanofiltration installations. This practice is applicable for all types of reverse osmosis devices (tubular, spiral wound, and hollow fiber) and nanofiltration devices.

1.2 This practice is applicable to both brackish waters and seawaters.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

2. Referenced Documents

2.1 ASTM Standards:²

- D511 Test Methods for Calcium and Magnesium in Water
- D516 Test Method for Sulfate Ion in Water
- D1129 Terminology Relating to Water
- D3352 Test Method for Strontium Ion in Brackish Water, Seawater, and Brines
- D4194 Test Methods for Operating Characteristics of Reverse Osmosis and Nanofiltration Devices
- D4195 Guide for Water Analysis for Reverse Osmosis and Nanofiltration Application
- D4382 Test Method for Barium in Water, Atomic Absorption Spectrophotometry, Graphite Furnace
- D6161 Terminology Used for Microfiltration, Ultrafiltration, Nanofiltration and Reverse Osmosis Membrane Processes

¹ This practice is under the jurisdiction of ASTM Committee D19 on Water and is the direct responsibility of Subcommittee D19.08 on Membranes and Ion Exchange Materials.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3. Terminology

3.1 *Definitions*—For definitions of terms used in this practice, refer to Terminology D1129 and D6161.

3.2 *Definitions of Terms Specific to This Standard*—For definitions of terms relating to reverse osmosis, refer to Test Methods D4194.

4. Summary of Practice

4.1 This practice consists of calculating the potential for scaling by CaSO_4 , SrSO_4 , and BaSO_4 in a reverse osmosis or nanofiltration concentrate stream from the concentration of Ca^{++} , Sr^{++} , Ba^{++} , and SO_4^{--} in the feed solution and the recovery of the reverse osmosis or nanofiltration system.

4.2 This practice also presents techniques to eliminate scaling by decreasing the recovery, by decreasing the Ca^{++} , Sr^{++} , and Ba^{++} concentrations in the feed water, and by addition of scale inhibitors.

5. Significance and Use

5.1 In the design and operation of reverse osmosis and nanofiltration installations, it is important to predict the CaSO_4 , SrSO_4 , and BaSO_4 scaling properties of the concentrate stream. Because of the increase in total dissolved solids and the increase in concentration of the scaling salts, the scaling properties of the concentrate stream will be quite different from those of the feed solution. This practice permits the calculation of the scaling potential for the concentrate stream from the feed water analyses and the reverse osmosis or nanofiltration operating parameters.

5.2 Scaling by CaSO_4 , SrSO_4 , and BaSO_4 will adversely affect the reverse osmosis or nanofiltration performance. This practice gives various procedures for the prevention of scaling.

6. Procedure

6.1 Determine the concentrations of Ca^{++} , Sr^{++} , Ba^{++} , and SO_4^{--} in the feed stream in accordance with Test Methods D511, D3352, D4382, and D516, respectively.

NOTE 1—If H_2SO_4 is used for control of CaCO_3 scale, measure the SO_4^{--} after acid addition.

6.2 Determine the concentration of all major ions using the appropriate methods given in Guide D4195. At a minimum, the