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American Water Works Association

The Authoritative Resource on Safe Water®

AWWA Standard

Sodium Fluoride

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Contents

All AWWA standards follow the general format indicated subsequently. Some variations from this format may be found in a particular standard.

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Foreword

This foreword is for information only and is not a part of ANSI/AWWA B701.*

I. Introduction.

I.A. *Background.* Community water fluoridation is an effective, safe, and inexpensive way to prevent tooth decay. Sodium fluoride (NaF) is one of several fluoride compounds presently being added to drinking water to reduce the incidence of dental caries. Since the first fluoridation installation in 1945, studies have shown that this method of fluoride delivery benefits Americans of all ages and socioeconomic status. Dental decay can be reduced by 20 to 40 percent among persons who have consumed fluoridated water since birth.

Sodium fluoride is a white, odorless material available as a coarse crystalline material, as free-flowing crystals, or a combination of both. It is stable at temperatures up to and beyond its melting point (990°C), is nonflammable, and does not react with air or moisture. Its formula weight is 42.00, its specific gravity is 2.79, and its solubility is practically constant at 4 g/100 mL of water at the temperatures generally encountered in water treatment plants. The pure material produces solutions with pH values close to 7.0.

Sodium fluoride is either produced by neutralizing hydrofluoric acid with soda ash, or reacting sodium fluorosilicate with caustic soda or soda ash. The various particle sizes are obtained by grinding and screening the dried crystals.

Sodium fluoride is proportionally added to the water being treated as a dry, coarse crystalline material or as a solution. Its constant solubility is particularly valuable in producing a saturated solution automatically and continuously in a tank or saturator specially designed for this purpose. This tank does require a water meter to measure the amount of water that is used to make up a solution of known strength.

Refer to AWWA Manual M4, *Water Fluoridation Principles and Practices*,† for additional technical information concerning the use of sodium fluoride.

I.B. *History.* The AWWA Standard for Sodium Fluoride was tentatively approved by the AWWA Board of Directors on July 21, 1950. Subsequent revisions to ANSI/AWWA B701 were approved on May 15, 1960; Jan. 24, 1971; Jan. 28, 1978; Jan. 30, 1984; Jan. 29, 1989; Jan. 30, 1994; June 20, 1999, and Feb. 12, 2006. This edition was approved on June 12, 2011.

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* American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.
† AWWA Manual M4, *Water Fluoridation Principles and Practices*, AWWA, Denver, Colo.

I.C. *Acceptance.* In September 1985, the US Environmental Protection Agency (USEPA) entered into a cooperative agreement with a consortium led by NSF International (NSF) to develop voluntary third-party consensus standards and a certification program for direct and indirect drinking water additives. Other members of the original consortium included the American Water Works Association Research Foundation (AwwaRF, now Water Research Foundation*) and the Conference of State Health and Environmental Managers (COSHEM). The American Water Works Association (AWWA) and the Association of State Drinking Water Administrators (ASDWA) joined later. In April 1990, USEPA formally withdrew its list of acceptable drinking water additives, and regulatory oversight of direct and indirect drinking water additives passed to the process developed by the consortium under the leadership of NSF.

In the United States, authority to regulate products for use in, or in contact with, drinking water rests with individual states.† Local agencies may choose to impose requirements more stringent than those required by the state. To evaluate the health effects of products and drinking water additives from such products, state and local agencies may use various references, including two standards developed under the direction of NSF, NSF‡/ANSI 60, Drinking Water Treatment Chemicals—Health Effects (NSF/ANSI 60), and NSF/ANSI 61, Drinking Water System Components—Health Effects (NSF/ANSI 61). NSF, in cooperation with ASDWA, does a biennial survey of the US states and Canadian provinces/territories to determine which states and provinces/territories require by legislation, regulations, or policies that products and drinking water additives be evaluated by NSF/ANSI 60 and 61. Survey results from 2009 show adoption of NSF/ANSI 60 by 47 states and 9 provinces/territories, and adoption of NSF/ANSI 61 by 46 states and 11 provinces/territories.

Several organizations are accredited by national or international third-party agencies to certify products in accordance with NSF/ANSI 60. States, provinces/territories, local agencies and water utilities can determine which certification organizations are acceptable within their individual jurisdictions.

Annex A, "Toxicology Review and Evaluation Procedures," to NSF/ANSI 60 does not stipulate a total allowable concentration (TAC) or a specific product allowable concentration (SPAC) of a contaminant for substances not regulated by a USEPA final maximum contaminant level (MCL). The TACs and SPACs of an unspecified list of

* Water Research Foundation, 6666 W. Quincy Avenue, Denver, CO 80235.
† Persons outside the United States should contact the appropriate authority having jurisdiction.
‡ NSF International, 789 N. Dixboro Road, Ann Arbor, MI 48105.

"unregulated contaminants" are based on toxicity testing guidelines (noncarcinogens) and risk characterization methodology (carcinogens). Use of Annex A procedures may not always be identical, depending on the certifier.

ANSI/AWWA B701 addresses additives requirements in Sec. 4.3 of the standard. The transfer of contaminants from chemicals to processed water or to residual solids is becoming a problem of greater concern. Sec. 4.3.3 recommends that material covered by this standard be certified by an accredited agency for compliance with NSF/ANSI 60. As noted above, most states and provinces/territories require that direct additives be certified to NSF/ANSI 60. A user of this standard should consult with the state, province/territory, or local agency having jurisdiction for certification requirements, but the user may require certification even in the absence of such a requirement by the agency having jurisdiction.

II. Special Issues.

II.A. *Storage and Handling Precautions.* Sodium fluoride chemicals must be stored in a clean, dry location that is well ventilated. Sodium fluoride has a tendency to compact or cake when exposed to moisture, when bags are stacked too high, or during long periods of storage. Bags of sodium fluoride should be stored on pallets in stacks not more than six bags high.

Sodium fluoride is hazardous if swallowed or inhaled in large amounts. Ingestion of 4 to 5 g of fluoride ion (F^-) per 150 lb (69 kg) body weight may be fatal. The inhalation of sodium fluoride dust should be avoided. Protective safety gear should be worn when handling sodium fluoride. The following protective clothing and equipment should be the minimum available:

1. A National Institute for Occupational Safety and Health/Mine Safety Health Administration (NIOSH/MSHA) approved, high-efficiency dust respirator (chemical mask) with a soft rubber face-to-mask seal and replaceable cartridges.*
2. Gauntlet neoprene gloves (12-in. [300-mm] minimum glove length).
3. Heavy-duty neoprene aprons.
4. Splash-proof goggles.

Spills should be cleaned up immediately. Personnel should wash thoroughly after handling fluoride chemicals. For additional safety aspects, refer to material safety data sheets (MSDS) available from the chemical supplier or manufacturer.

* NIOSH/MSHA approval is given to various masks. Each brand is evaluated by NIOSH/MSHA for the proposed use and conditions. Available from the National Institute of Occupational Safety and Health, 4676 Columbia Parkway, Cincinnati, OH 45226; or Mine Safety Health Administration, 4015 Wilson Boulevard, Arlington, VA 22203.

II.B. *Upflow-Type Saturator Operations.* The only fluoride product suitable for use in a saturator is sodium fluoride.

1. Sodium fluoride will dissolve to saturation within a 5-min contact period with water having hardness content of less than 50–75 mg/L as $CaCO_3$ (3.0–4.5 gr per gal) if a flow restrictor with a maximum flow of 2 gal per min is installed. Waters with a total hardness of greater than 50–75 mg/L as $CaCO_3$ should be softened to reduce the hardness.

2. The pressure of the incoming makeup water should be reduced to a range of 20–80 psi during the fill cycle. A small water meter must be provided on the make-up water line for the saturator so that calculations can be made to confirm that the proper amounts of fluoride solution are being fed. This meter should be read daily and the results recorded.

3. The sodium fluoride bed should be maintained at a sufficient depth and the water should be limited to a rise rate that provides a minimum of 5 min contact before it emerges out of the bed into the saturator bulk saturated solution. The minimum depth of the fluoride bed upon solution erosion should be 12 in. to maintain a sufficient bed depth to provide sufficient contact through the bed to achieve a saturated flow. The maximum bed depth should be 18–24 in. to avoid compaction and flow constrictions through the bed. Marking the outside of the translucent thermoplastic saturator tank with fill and refill markings and turning on the inside saturator lamp momentarily will help the operator maintain the proper depth. The fluoride should be replenished in the bed on a daily basis. A larger volume saturator should be considered if high usage rate erodes the bed depth within a few hours and frequent additions of sodium fluoride are necessary.

4. Fresh sodium fluoride should be added to the bed in a uniform pattern and not added only at one side of the saturator. After the fresh sodium fluoride is added, a 5-ft long ¾ in. diameter PVC schedule 80 pipe-stick with a glued-on cap, pole, or paddle implement should be used to gently stir the bed contents to a uniform character and height.

5. Allow the saturator solution to settle (for a couple of minutes) so that excessive colloidal solids and particles are not suspended when pumping is resumed. If possible, adding the sodium fluoride when the water source is off line is preferable.

6. It is natural that some quantity of colloidal solids and particles may be suspended in the saturated solution and will be drawn into the feed tube. To prevent plugging and operational problems in the system, a filter or strainer should be included on the suction end of the feed tube to the pump. This filter or strainer should be

checked and cleaned regularly to prevent air-binding. Using dual-pump pickup strainers on saturator top cover will reduce the maintenance downtime spent on cleaning the strainers.

7. Since the sodium fluoride salts will continue to dissolve, the insoluble fraction of the product will accumulate in the bed. Experience has found that as much as 2 percent of the product can be anticipated to become residual cinders and other insolubles that need to be cleaned out periodically. With a recommended minimum bed depth of 12 in. prior to routine additive replenishment, there should not be more than 3 in. of cinders and other insolubles or there may be difficulty in maintaining sufficient bed depth to ensure saturation of the flow. This results in an approximate cycle of standard 55-gal saturator cleanout according to the following schedule (may vary by season):

- One 50-lb bag or less added per week requires an annual cleanout cycle to allow for annual inspection of installation.
- Two 50-lb bags added per week require an annual cleanout cycle to allow for annual inspection of installation.
- Four 50-lb bags added per week require a 6-month cleanout cycle.
- One 50-lb bag added per day requires a 4-month cleanout cycle.
- Two 50-lb bags added per day require a 2-month cleanout cycle.

8. Many facilities have found that using a 12-in. minimum bed depth, presuming potentially 3 in. of residual cinders and other insolubles at the end of the cleanout cycle, with a full bed depth of 18 in. provides desirable operating result without bed compaction. If higher demand rates are experienced, or if a saturator can achieve satisfactory operation with up to a 24-in. deep bed, consideration may be made to not let the saturator deplete to less than 18 in., and then a 6-in. residual cinders and other insolubles accumulation may be tolerated. If that is practiced, the facilities that add more than one bag a day may be able to operate with a deeper bed and double the suggested periods between cleanout.

9. Some facilities have a larger capacity than the standard 55-gal saturator. Those larger units should have a cleanout cycle based on an interval equal to a ratio of the larger tank to a 55-gal tank. For example, a 110-gal saturator tank can operate for 4 months with up to two 50-lb bags added per day.

10. When cleaning out the saturator, it is recommended that the operator terminate replenishing the sodium fluoride bed for between 1 to 5 days to allow further depletion of the sodium fluoride. Each day, the operator should use a paddle or a stick to keep the bed mixed and uniform. It is possible the optimal fluoridation level may not

be reached as the solution drops below saturated concentration if there is insufficient sodium fluoride in the exhausted bed. When sufficient depletion has occurred, but not exceeding 5 days' duration or if the bed is depleted to 9-in. in depth, the remainder can be presumed to be a mixture of silica, carbonates, and sodium fluoride. The operator of the landfill can then determine if this is satisfactory for disposal in a landfill or if secure disposal in containment for potentially hazardous material will need to be considered following state regulations.

III. Use of This Standard. It is the responsibility of the user of an AWWA standard to determine that the products described in that standard are suitable for use in the particular application being considered.

III.A. *Purchaser Options and Alternatives.* The following information should be provided by the purchaser.

1. Standard used—that is, ANSI/AWWA B701, Sodium Fluoride, of latest revision.
2. Whether compliance with NSF/ANSI 60, Drinking Water Treatment Chemicals—Health Effects, is required.
3. Quantity required.
4. Additional impurity limits if required. If additional impurity limits are required by the purchaser, the purchaser must state the test procedures to be used to determine compliance with the limits (Sec. I.C and Sec. 4.3.4).
5. Details of other federal, state or provincial, and local requirements (Section 4).
6. Physical form desired—coarse crystalline—and required mesh sizes (Sec. 4.1).
7. Whether the purchaser will reject product from containers or packaging with missing or damaged seals. The purchaser may reject product from bulk containers or packages with missing or damaged seals unless the purchaser's tests of representative samples, conducted in accordance with Sec. 5.2, demonstrate that the product meets the standard. Failure to meet the standard or the absence of, or irregularities in, seals may be sufficient cause to reject a shipment.
8. Form of shipment—bulk or package (type and size) (Sec. 6.2).
9. Whether alternative security measures have been adopted to replace or augment the security measures set out in Sec. 6.2.4 and 6.2.5.
10. Affidavit of compliance or certified analyses, or both, if required (Sec. 6.3).

III.B. *Modification to Standard.* Any modification of the provisions, definitions, or terminology in this standard must be provided by the purchaser.

IV. Major Revisions. Major changes made to the standard in this revision include the following:

1. Inclusion of a section on Upflow-Type Saturator Operations (foreword II.B.).
2. Inclusion of a requirement for compliance with the Safe Drinking Water Act and other federal regulations (Section 4).
3. Inclusion of a requirement for tamper-evident packaging (Sec. 6.2.4 and 6.2.5).
4. Inclusion of provisional stirred/settled turbidity test procedures (appendix B).

V. Comments. If you have any comments or questions about this standard, please call AWWA Engineering and Technical Services at 303.794.7711, FAX at 303.795.7603, write to the department at 6666 West Quincy Avenue, Denver, CO 80235-3098, or e-mail at standards@awwa.org.

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American Water Works Association

AWWA Standard

Sodium Fluoride

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard describes sodium fluoride (NaF), coarse crystalline grade, for use in the treatment of potable water.

Sec. 1.2 Purpose

The purpose of this standard is to provide the minimum requirements for sodium fluoride, including physical, chemical, sampling, packaging, shipping, and testing requirements.

Sec. 1.3 Application

This standard can be referenced in documents for purchasing and receiving sodium fluoride and can be used as a guide for testing the physical and chemical properties of sodium fluoride samples. The stipulations of this standard apply when this document has been referenced and then only to sodium fluoride used in the treatment of potable water.

SECTION 2: REFERENCES

This standard references the following documents. In their latest editions, they form a part of this standard to the extent specified within the standard. In any case of conflict, the requirements of this standard shall prevail.