American Water Works Association

The Authoritative Resource on Safe Water®

ANSI/AWWA B300-10
(Revision of ANSI/AWWA B300-04)

AWWA Standard

Hypochlorites

AWWA STANDARD Since 1881

Approved American National Standard ANSI

Effective date: April 1, 2010.
First edition approved by AWWA Board of Directors June 2, 1953.
This edition approved Jan. 17, 2010.
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AWWA Standard

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American Water Works Association

B300a-11
Addendum to
ANSI/AWWA B300-10
Standard
for

Hypochlorites

Approved by AWWA Board of Directors Jan. 23, 2011.
Approved by American National Standards Institute April 11, 2011.

APPENDIX A

Recommendations for the Handling and Storage of Hypochlorite Solutions*

This appendix is for information only and is not a part of ANSI/AWWA B300.

Several key factors have been identified that impact the formation of perchlorate, bromate, and other contaminants in hypochlorite solutions. The major factors impacting perchlorate formation parallel those that also affect the decomposition of hypochlorite: temperature, ionic strength, concentration, and pH. By using the information gathered in the study referenced below and by applying the "Predictive Model" to hypothetical liquid hypochlorite storage scenarios, several quantitative and qualitative recommendations can be made:

1. *Dilute stored hypochlorite solutions upon delivery.* The decomposition of hypochlorite and subsequent formation of chlorate and perchlorate is dependent upon hypochlorite concentration and ionic strength. Higher ionic strength and hypochlorite concentration will drive the reaction towards a greater production of

* Hypochlorite—An Assessment of Factors That Influence the Formation of Perchlorate and Other Contaminants. 2009. Water Research Foundation, Denver, Colo.

chlorate and perchlorate while also increasing the rate of decomposition of hypochlorite. By diluting a 2M hypochlorite solution by a factor of 2, the rate of perchlorate formation decreases by a factor of 7 because of the combination of concentration and ionic strength effects. A fourfold dilution of a hypochlorite solution will decrease the rate of formation by a factor of 36. A tenfold dilution of a hypochlorite solution will decrease the rate of perchlorate formation by a factor of 270.

2. *Store the hypochlorite solutions at lower temperatures.* Higher temperatures speed up the chemical decomposition of hypochlorite and the subsequent formation of chlorate and perchlorate. Every 5°C (9°F) reduction in storage temperature will reduce the rate of perchlorate formation by a factor of approximately 2. To minimize temperature increases, the product should be stored out of direct sunlight.

3. *Control the pH of stored hypochlorite solutions at pH 11–13 even after dilution.* Storage of concentrated hypochlorite solutions at pH values lower than 11 is not recommended because of rapid decomposition of hypochlorite ion/hypochlorous acid and the consequent formation of chlorate, even though this reduces the amount of perchlorate formed. When the pH is higher than 13, perchlorate formation is enhanced because of the ionic strength effect. As such, utilities should continue to insist that manufacturer specifications include pH control in the range of 11–13. Given the typical pH range of on-site generation (OSG) hypochlorite (pH 9–10), such solutions should be used as soon as possible after manufacture and should not be stored for more than 1–2 days.

4. *Control the removal of transition metal ions by purchasing filtered hypochlorite solutions and by using low-metal ion concentration feedwater for the OSG systems and dilution water.* The presence of transition metal ions results in an increased degradation rate of hypochlorite. While this degradation is concomitant with reduced perchlorate formation, the free available chlorine concentration is also reduced, forcing a utility to use a higher volume of a hypochlorite solution, which results in higher mass loading of contaminants such as perchlorate, chlorate, and bromate.

5. *Use fresh hypochlorite solutions when possible.* Hypochlorites will naturally decompose to produce oxygen, chlorate, and perchlorate. Less storage time will minimize the formation of these contaminants in the hypochlorite solution. Rotate stock and minimize the quantity of aged product in storage tanks prior to the delivery of new product. A fresh hypochlorite solution will also contain a higher concentration of hypochlorite, thereby reducing the amount of solution required to obtain the target chlorine residual. Again, higher hypochlorite concentration in

a fresh hypochlorite solution will correspond to lower concentrations of contaminants dosed.

6. *For utilities using OSG hypochlorite, use a low-bromide salt to minimize the amount of bromide present in the brine.* Bromate formation will occur rapidly in hypochlorite solutions in the presence of bromide. By controlling the amount of bromide in the salt and source water used for on-site generation, bromate formation can be minimized.

Committee Personnel

The AWWA Standards Committee on Disinfectants, which reviewed and approved this standard, had the following personnel at the time of approval:

Clifford L. McLain, *Chair*

General Interest Members

D.J. Gates, Citrus Heights, Calif.	(AWWA)
G. Giasson, Pawtucket Water Supply Board, Pawtucket, R.I.	(AWWA)
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J. Sloan, American Chemistry Council, Arlington, Va.	(AWWA)

User Members

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* Liaison, nonvoting
† Alternate

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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 part of ANSI/AWWA B300-10.

I. Introduction.

I.A. *Background.* *Hypochlorites* is used as an all-inclusive term for chlorinated lime, calcium hypochlorite, and sodium hypochlorite. A concise description of each chemical follows.

Chlorinated lime: 25 percent to 37 percent available chlorine. Other common names for chlorinated lime are bleaching powder and chloride of lime. Because it is an unstable material and is subject to deterioration from heat and moisture, it is not usually fed dry but as a 2 percent solution. Excess insolubles present in this solution must be separated by decantation before use. Storage in a cool, dry area, for no more than nine months, is advisable. Chlorinated lime is available in 100-lb (45.4-kg), 300-lb (136-kg), and 800-lb (363-kg) drums. Approximately 0.25 lb/gal (30 g/L) of water will produce a solution of approximately 1 percent available chlorine.

Calcium hypochlorite: 65 percent to 70 percent available chlorine. This material is unstable but more stable than the grade with 35 percent available chlorine. It is best fed as a solution. Its theoretical solubility is approximately 22 g/100 mL of water (18 percent) at room temperature; however, its practical solubility use is closer to 3 percent. Decantation is advisable before use because of the excess insolubles present. Storage in a cool, dry area is advisable, but storage periods should not exceed one year. Calcium hypochlorite can lose 3 percent to 10 percent available chlorine in one year. It is available in 3-lb to 5-lb (1.4-kg to 2.3-kg) cans, 2-lb to 9-lb (0.9-kg to 4.1-kg) plastic containers, and 100-lb (45.4-kg) steel drums and in granular powder, granule, and tablet form. Solubility tests that determine both rate and percentage should be conducted with particular emphasis on testing the tablets. Approximately ⅛ lb/gal (15 g/L) of calcium hypochlorite to water produces a solution of approximately 1 percent available chlorine.

Sodium hypochlorite: 12 percent to 20 percent available chlorine. Other common names for sodium hypochlorite are bleach, liquor, chlorine water, and Javelle water. Sodium hypochlorite will undergo some decomposition over time. There are numerous parameters that affect the rate of decomposition (see The Chlorine Institute* Pamphlet 96, *Sodium Hypochlorite Manual*).

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* The Chlorine Institute Inc., 1300 Wilson Blvd., Arlington, VA 22209.

Sodium hypochlorite is miscible in any proportion with water. It should be stored in a dark area where the temperature does not exceed 80°F (30°C). A 12 percent to 20 percent solution is still liquid at 0°F (–17.8°C) but is a slush at –20°F (–28.9°C). It is available in 5-gal and 13-gal (19-L and 49-L) carboys (glass or polyethylene), 30-gal (113.6-L) drums, and in approximately 5,000-gal (18,926-L) tank trucks. The available chlorine content is as indicated in Table F.1.

I.B. *History.* The original AWWA Standard for Hypochlorites, prepared for the AWWA Water Purification Division, was approved by the Executive Committee of the Water Purification Division and by the Water Works Practice Committee and received approval by the AWWA Board of Directors on June 2, 1953. It was designated ANSI/AWWA B300 53T.

The initial document was reaffirmed without revision on June 17, 1955, and the designation was changed from ANSI/AWWA B300 53T to ANSI/AWWA B300 55. Subsequent revisions were adopted on June 5, 1964, Jan. 26, 1975, June 15, 1980, and June 14, 1987. This standard was revised by the AWWA Standards Committee on Disinfectants, and ANSI/AWWA B300-99 was approved by the AWWA Board of Directors on June 20, 1999. A subsequent revision was adopted on June 13, 2004. This edition was approved on Jan. 17, 2010.

I.C. *Acceptance.* In May 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

Table F.1 Chlorine available in sodium hypochlorite

gpl Available Chlorine	Trade % Available Chlorine	Chlorine Equivalent *lb/gal*	Chlorine Equivalent *kg/L*	Gallons to Obtain 1 lb Chlorine	Liters to Obtain 1 kg Chlorine
200	20.0	1.630	0.200	0.610	5.000
160	16.0	1.333	0.160	0.752	6.250
150	15.0	1.200	0.150	0.800	6.667
120	12.0	1.000	0.120	1.000	8.333
50	5.0	0.417	0.050	2.400	20.000
10	1.0	0.083	0.010	12.000	100.000

Sample Calculation:

12 trade percent available chlorine = 120 grams per liter (gpl) available chlorine
120 gpl × 3.785 L/gal × 2.205 lb/1,000 g = 1 lb/gal available chlorine

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 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, and NSF/ANSI 61, Drinking Water System Components—Health Effects.

Various certification organizations may be involved in certifying products in accordance with NSF/ANSI 60. Individual states or local agencies have authority to accept or accredit certification organizations within their jurisdiction. Accreditation of certification organizations may vary from jurisdiction to jurisdiction.

Annex A, "Toxicology Review and Evaluation Procedures," to NSF/ANSI 60 does not stipulate a maximum allowable level (MAL) of a contaminant for substances not regulated by a USEPA final maximum contaminant level (MCL). The MALs of an unspecified list of "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 B300 addresses additives requirements in Sec. 4.4 of the standard. The transfer of contaminants from chemicals to processed water or the residual solids is becoming a problem of great concern. The language in Sec. 4.4.2 is a recommendation only for direct additives used in the treatment of potable water to be certified by an accredited certification organization in accordance with NSF/ANSI 60, Drinking Water Treatment Chemicals—Health Effects. However, users of the standard may opt to make this certification a requirement for the product. Users of this standard should also consult the appropriate state or local agency having jurisdiction in order to

1. Determine additives requirements, including applicable standards.

2. Determine the status of certifications by parties offering to certify products for contact with, or treatment of, drinking water.

3. Determine current information on product certification.

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* Persons outside the United States should contact the appropriate authority having jurisdiction.

† NSF International, 789 N. Dixboro Road, Ann Arbor, MI 48105.

‡ American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.

II. Special Issues.

II.A. *Storage and Handling Precautions.* Light, heat, organic matter, and certain heavy metal cations, such as copper, nickel, and cobalt, accelerate the decomposition of hypochlorites. Dampness appreciably decreases the life of metal containers in which the powdered forms are shipped. Hypochlorites should be stored in a cool, dry place, preferably in the dark or out of direct sunlight. They are very active chemically and should be stored in a manner that prevents any possible contact with other materials that are flammable, such as oil, grease, glycerine, or printed matter. When removing hypochlorite from a drum, never use a scoop or vessel that is contaminated with organic matter.

All hypochlorite solutions are corrosive to some degree and will affect the skin and eyes on contact. Any affected areas should be washed with copious amounts of water. Personnel are advised to use caution and to wear protective clothing (i.e., gloves, apron, goggles, and a suitable vapor mask) when handling the solutions. Personnel should refer to the manufacturer's material safety data sheets (MSDS) for recommendations regarding personal protective equipment.

Because chlorine gas can be released, never acidify a hypochlorite solution.

Hypochlorite solutions can add chlorate/chlorite ions to the potable water. There is some concern about the health effects of chlorate/chlorite. Utilities using these products are advised to analyze for the chlorate/chlorite ion in their water supply.

Perchlorate is another possible contaminant in hypochlorites.

II.B. *Strength of Solutions.* There are several common ways that the concentration of sodium hypochlorite may be expressed. These are listed below with explanations.

1. Available chlorine. The term *available chlorine* came into usage as a means of comparing oxidizers in different applications.

Because chlorine was among the first widely used oxidizers, it became the standard against which other oxidizers were measured. As shown in the following equations, sodium hypochlorite is capable of oxidizing the same amount of iodide ion as the chlorine (Cl_2) that it takes to manufacture the sodium hypochlorite.

$$NaOCl + 2KI + 2HAc \rightarrow I_2 + NaCl + 2KAc + H_2O$$

This may be compared with the reaction of chlorine with potassium iodide:

$$Cl_2 + 2KI \rightarrow I_2 + 2KCl$$

One molecule of hypochlorite ion has the equivalent oxidizing power of two atoms (1 molecule) of chlorine. Therefore, sodium hypochlorite behaves as if all of the chlorine consumed in making it is *available* for oxidizing purposes, even though half of that chlorine is in the chloride form.

Available chlorine refers to the amount of chlorine equivalent to hypochlorite in terms of oxidizing power. It is a measure of strength and bleaching power and, in one or another of its related units of measurement, denotes the concentration of the bleach solution.

2. Grams per liter (gpl) available chlorine. The weight of available chlorine in grams contained in one liter of sodium hypochlorite solution.

3. Trade percent available chlorine. Commonly used to denote the strength of commercial sodium hypochlorite solutions, it is similar to grams per liter, except that the unit of volume is 100 milliliters instead of one liter. Its value is therefore one tenth of the grams per liter.

$$\text{trade percent available chlorine} = \frac{\text{gpl available chlorine}}{10} \qquad \text{(Eq 1)}$$

4. Weight percent available chlorine. Dividing trade percent by the specific gravity of the sodium hypochlorite solution gives weight percent or percent available chlorine by weight.

$$\text{wt \% available chlorine} = \frac{\text{gpl available chlorine}}{10 \times (\text{specific gravity of solution})} \qquad \text{(Eq 2)}$$

$$\text{wt \% available chlorine} = \frac{\text{trade percent available chlorine}}{(\text{specific gravity of solution})} \qquad \text{(Eq 3)}$$

II.C. *Sodium Hypochlorite.* To facilitate a variety of calculations and operations in different chemical processes, it is often important to know the concentration of the actual chemical species, NaOCl, in sodium hypochlorite solutions. In addition, *weight percent sodium hypochlorite* must be displayed on US Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)–registered pesticide products.

Weight percent of sodium hypochlorite is defined as the weight of sodium hypochlorite per 100 parts weight of bleach solution. It can be calculated by converting weight percent of available chlorine into its equivalent as sodium hypochlorite; that is, multiplying by the ratio of their respective molecular weights as shown below:

$$\frac{\text{molecular wt NaOCl}}{\text{molecular wt Cl}_2} = \frac{74.44}{70.91} = 1.05 \qquad \text{(Eq 4)}$$

$$\text{wt \% NaOCl} = (\text{wt \% available Cl}_2) \times \frac{\text{molecular wt NaOCl}}{\text{molecular wt Cl}_2} \qquad \text{(Eq 5)}$$

or

$$\text{wt \% NaOCl} = \text{wt \% available chlorine} \times 1.05 \qquad \text{(Eq 6)}$$

$$\text{wt \% NaOCl} = \frac{\text{gpl available chlorine}}{10 \times (\text{specific gravity})} \times 1.05 \qquad \text{(Eq 7)}$$

$$= \text{wt \% available chlorine} \times 1.05$$

or

$$\text{wt \% NaOCl} = \frac{\text{trade \% available chlorine}}{(\text{specific gravity})} \times 1.05 \qquad \text{(Eq 8)}$$

Generally, sodium hypochlorite solutions are produced at strengths up to 20 percent by weight sodium hypochlorite. As strength increases, stability generally decreases. Frequently, manufacturers provide a range of strengths depending on customer requirements. Bleach solutions with a strength of less than 7.0 weight percent sodium hypochlorite are typically used in household bleach applications.

II.D. *Bromate in Sodium Hypochlorite.* Stage 1 of the Disinfectants and Disinfection By-Products Rule requires potable water plants to meet a bromate MCL of 10 ppb in their effluent. Water plants that use ozone in their treatment process are required to test monthly for bromate. Water plants that do not use ozone but use sodium hypochlorite solutions do not need to test for bromate but are required to use sodium hypochlorite solutions that are certified under NSF/ANSI 60.

Sodium hypochlorite solutions certified to meet NSF/ANSI 60 will allow water plants to meet the bromate MCL. Each facility must make certain that the sodium hypochlorite they purchase is certified for their maximum anticipated dosage. Certification to NSF/ANSI 60 may be accomplished at a lower Maximum Use Level (MUL) than the standard MUL of 10 ppm (as chlorine). In some cases, a product could be certified to a MUL as low as 2.0 ppm (as chlorine). If a water plant does not expect to exceed this value, such a product is suitable for that site.

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 B300, Standard for Hypochlorites, of latest revision.

2. Quantity required.

3. Whether compliance with NSF/ANSI 60, Drinking Water Treatment Chemicals—Health Effects, is required.

4. Details of other federal, state or provincial, and local requirements (Sec. 4.1).

5. Type and grade of material wanted or required (Sec. 4.2 and 4.3).

6. 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, demonstrates 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 the shipment.

7. Whether alternative security measures have been adopted to replace or augment the security measures set out in Sec. 6.2.5 and 6.2.6.

8. Form of shipment—bulk or package, and the type and size of container (Sec. 6.2).

9. Affidavit of compliance, if required (Sec. 6.3).

III.B. *Modification to Standard.* Any modification to 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 edition include the following:

1. Inclusion of a requirement for compliance with the Safe Drinking Water Act and other fed-eral regulations (Sec. 4.1).

2. Inclusion of a requirement for tamper-evident packaging (Sec. 6.2.5 and 6.2.6).

3. Additional clarification of the distinction between trade percent and weight percent in the Foreword (II.B and II.C).

V. Comments. If you have any comments or questions about this standard, please call the AWWA Volunteer and Technical Support Group at 303.794.7711, FAX 303.795.7603, write to the group 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

Hypochlorites

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard describes chlorinated lime, calcium hypochlorite, and sodium hypochlorite for use in water, wastewater, and reclaimed water treatment.

Sec. 1.2 Purpose

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

Sec. 1.3 Application

This standard can be referenced in specifications for purchasing and receiving hypochlorites and can be used as a guide for testing the physical and chemical properties of hypochlorite samples. The stipulations of this standard apply when this document has been referenced and then only to hypochlorites used in water supply service, wastewater treatment, and reclaimed water treatment applications.

SECTION 2: REFERENCES

This standard references the following documents. In their latest edition, 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.

NSF*/ANSI† 60—Drinking Water Treatment Chemicals—Health Effects.

Standard Methods for the Examination of Water and Wastewater (latest edition). APHA,‡ AWWA, WEF.§

SECTION 3: DEFINITIONS

The following definitions shall apply in this standard:

1. *Manufacturer:* The party that manufactures, fabricates, or produces materials or products.

2. *Purchaser:* The person, company, or organization that purchases any materials or work to be performed.

3. *Supplier:* The party that supplies materials or services. A supplier may or may not be the manufacturer.

4. *Day:* A day is defined as a 24-hr period.

5. *Potable water:* Water that is safe and satisfactory for drinking and cooking.

6. *Reclaimed water:* Wastewater that is safe and satisfactory for drinking and cooking.

7. *Tamper-evident packaging:* Packaging having one or more indicators or barriers to entry which, if breached or missing, can reasonably be expected to provide visible evidence to the purchaser that tampering has occurred. The tamper-evident features of the packaging shall be designed to and shall remain intact when handled in a reasonable manner during manufacture, storage, shipment, and delivery to the purchaser. Properly constructed, labeled, and closed sheet-iron drums and plastic containers constitute two forms of tamper-evident packaging.

8. *Wastewater:* A combination of the liquid and water-carried waste from residences, commercial buildings, industrial plants, and institutions, together with any groundwater, surface water, and stormwater that may be present.

* NSF International, 789 N. Dixboro Rd., Ann Arbor, MI 48105.

† American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.

‡ American Public Health Association, 800 I Street NW, Washington, DC 20001.

§ Water Environment Federation, 601 Wythe Street, Alexandria, VA 22314.

SECTION 4: REQUIREMENTS

Sec. 4.1 Materials

Materials shall comply with the requirements of the Safe Drinking Water Act and other federal regulations for potable water, wastewater systems, and reclaimed water as applicable.

Sec. 4.2 Physical Requirements

4.2.1 *Chlorinated lime.* Chlorinated lime (bleaching powder, chloride of lime) is a fine, yellowish-white, hygroscopic powder of about 38 lb/ft^3–53 lb/ft^3 (0.61 g/cc–0.85 g/cc)* bulk density, containing from 25 percent to 37 percent available chlorine by weight. It is manufactured by the action of chlorine on selected slaked lime. The material contains some free lime. The exact formula is a matter of controversy. One of the more generally accepted formulas is $CaO{\cdot}2CaOCl_2{\cdot}3H_2O$.

4.2.1.1 Chlorinated lime shall be substantially free of lumps. It shall not contain any dirt or foreign material.

4.2.2 *Calcium hypochlorite.* Calcium hypochlorite [$Ca(OCl)_2$] is a white or yellowish-white granular powder, granule, or tablet containing from 65 percent to 70 percent available chlorine by weight. The bulk density of the granular powder is about 32 lb/ft^3–50 lb/ft^3 (0.51 g/cc–0.8 g/cc), and the bulk density of the granules is approximately 68 lb/ft^3–80 lb/ft^3 (1.1 g/cc–1.3 g/cc). It may be manufactured by adding chlorine to a milk of lime slurry, which may be prepared by mixing hydrated lime with water or by slaking quicklime with water.

4.2.2.1 Calcium hypochlorite granular powder or granules shall be substantially free of lumps. Not more than 10 percent of the powder shall pass a 100 mesh screen. It shall not contain any dirt or other foreign material.

4.2.2.2 Calcium hypochlorite tablets shall be uniform in shape. The weight of the tablets shall not vary by more than 5 percent from the average value stated on the label. Not more than 2 percent of the tablets shall be broken.

4.2.3 *Sodium hypochlorite.* Sodium hypochlorite solution (NaOCl) is a clear, light-yellow liquid containing up to 200-g/L available chlorine (20 trade percent). Passing chlorine into a caustic soda solution or into a caustic soda–soda ash mix is one method of manufacture.

* Metric conversions given in this standard are direct conversions of US customary units and are not those specified in International Organization for Standardization (ISO) standards

Another method of manufacture is the use of an electrochemical generator. This manufacturing method utilizes a sodium chloride feed to an electrochemical cell where the salt is converted to sodium hypochlorite using electricity.

4.2.3.1 Sodium hypochlorite solution shall be a clear liquid containing not more than 0.15 percent insoluble matter by weight.

Sec. 4.3 Chemical Requirements

4.3.1 *Chlorinated lime.* Chlorinated lime shall contain not less than 25 percent available chlorine by weight.

4.3.2 *Calcium hypochlorite.* Calcium hypochlorite shall contain not less than 65 percent available chlorine by weight when shipped.

4.3.3 *Sodium hypochlorite.* Sodium hypochlorite shall contain not less than 100 g/L available chlorine (10 trade percent; see Sec. II.B.3 in the foreword).

4.3.3.1 The total free alkali (expressed as NaOH) in sodium hypochlorite shall not exceed 1.5 percent by weight.

Sec. 4.4 Impurities*

4.4.1 *General.* The hypochlorites supplied according to this standard shall contain no soluble material or organic substances in quantities capable of producing deleterious or injurious effects on the health of those consuming water that has been treated properly with the hypochlorites.

4.4.2 *Product certifications.* Hypochlorites are direct additives used in the treatment of potable water and wastewater. This material should be certified as suitable for contact with or treatment of drinking water by an accredited certification organization in accordance with NSF/ANSI 60, Drinking Water Treatment Chemicals—Health Effects. Evaluation shall be accomplished in accordance with requirements that are no less restrictive than those listed in NSF/ANSI 60. Certification shall be performed by a certification organization accredited by the American National Standards Institute.

All hypochlorites used in water disinfection are required to be registered with USEPA under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).†

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* See Sec. I.C of the foreword.

† Government packaging and marking references reflect US requirements. Users of ANSI/AWWA B300 outside the United States should verify applicable local, provincial, and national regulatory requirements. Because of frequent changes in these regulations, all parties should remain informed of possible revisions. Provisions of the purchaser's documents should not preclude compliance with applicable regulations.

SECTION 5: VERIFICATION

Sec. 5.1 Sampling

5.1.1 *Sampling point.* Samples shall be taken at the point of destination.

5.1.2 *Sampling procedures.*

5.1.2.1 Not less than 5 percent of the packages or containers shall be sampled. No sample shall be taken from a broken package or container.

5.1.2.2 The powdered and granule forms of hypochlorite shall be sampled by means of a sampling tube that is at least ¾ in. (20 mm) in diameter. Tablets shall be selected at random from each container sampled.

5.1.2.3 The total gross sample of the solid forms of hypochlorite, weighing at least 16 lb (7.3 kg), shall be mixed thoroughly and divided to provide three 1-lb (0.45-kg) samples. The samples shall be sealed in airtight, moisture-proof glass containers. Each sample shall be labeled for identification, and the label shall be dated and signed by the sampler. This should be done rapidly and carefully to avoid loss of chlorine.

5.1.2.4 Sodium hypochlorite shall be mixed thoroughly by rolling containers or by other suitable means before sampling. The gross sample, collected in a clean earthenware or glass container, shall contain at least 10 qt (9.5 L). The gross sample shall be mixed thoroughly and three 1-pint (0.47-L) samples provided. These shall be sealed in airtight, moisture-proof glass or plastic containers. Each sample container shall be labeled to identify it, and the label shall be dated and signed by the sampler.

5.1.3 *Sample handling.*

5.1.3.1 The samples of chlorinated lime and calcium hypochlorite shall be divided carefully and rapidly to approximately 100 g. After thorough mixing, the 100-g sample shall be stored in an airtight glass container and shall be kept in a dark, cool, dry place. The container shall be kept closed to avoid loss of available chlorine, except when portions of it are being weighed.

5.1.3.2 Sodium hypochlorite solution shall be mixed thoroughly before withdrawing a portion for analysis. The moisture-proof glass or plastic sample bottle shall be stored in a dark, cool, dry place and kept perfectly sealed after the sample is withdrawn.

5.1.3.3 The laboratory examination of the sample shall be completed within five days after receipt of the shipment.

5.1.3.4 Samples shall be stored for at least 30 days from the date of receipt of a shipment before disposal.

Sec. 5.2 Test Procedures

5.2.1 *Testing for available chlorine in chlorinated lime and calcium hypochlorite.*

5.2.1.1 Reagents.

1. Crystalline potassium iodide (iodate-free).
2. 0.1*N* sodium thiosulfate.
3. Glacial acetic acid.
4. Starch indicator solution.

5.2.1.2 Procedure.

1. Place 5 g of chlorinated lime or calcium hypochlorite into a nonmetallic mortar, moisten with distilled water, and grind into a fine paste. Transfer to a 1-L flask. Rinse the mortar with distilled water and add to 1-L flask. Make up to 1 L with distilled water and mix.

2. Measure 25 mL of the solution from the l-L flask into a 250-mL Erlenmeyer flask, add approximately 1 g of crystalline potassium iodide, and make acid with approximately 4 mL of glacial acetic acid. Titrate* with 0.1*N* sodium thiosulfate until the yellow color of the iodine is nearly destroyed. Add approximately 1 mL of soluble starch solution and continue to titrate until the blue (blackish-blue) color disappears entirely.

5.2.1.3 Calculation.

$$\text{sodium thiosulfate, in milliliters} \times \text{normality} \times \frac{40 \times 0.03545 \times 100}{\text{grams of sample}} \qquad \text{(Eq 1)}$$

$$= \text{percent available chlorine by weight}$$

(That is, milliliters of sodium thiosulfate × normality × 28.37 = percentage available chlorine by weight when a 5-g sample is analyzed.)

5.2.2 *Testing for available chlorine in sodium hypochlorite.*

5.2.2.1 Reagents.

1. Crystalline potassium iodide (iodate-free).
2. 0.1*N* sodium thiosulfate.†
3. Glacial acetic acid.
4. Starch indicator solution.

* Moist samples of hypochlorite partially decompose in storage and result in the formation of chlorite. In acetic acid medium, ClO_2 reacts with I^- very slowly to release iodine. Therefore, if chlorite is present in the sample, a sharp end point in iodometric titration may not be attained.

† Nominal; see *Standard Methods for the Examination of Water and Wastewater* (APHA, AWWA, WEF; latest edition), 4500-Cl B, for comparable standardization.

5.2.2.2 Procedure.

1. Measure accurately 20 mL of the sample, transfer it to a 1-L volumetric flask, and make up to volume with distilled water.

2. Measure 25 mL of the solution from the 1-L flask into a 250-mL Erlenmeyer flask; add approximately 1 g of crystalline potassium iodide; and make acid with approximately 4 mL of glacial acetic acid. Titrate* with 0.1*N* sodium thiosulfate until the yellow color of the iodine is nearly destroyed. Add about 1 mL of soluble starch solution and continue to titrate until the blue (blackish-blue) color disappears entirely.

5.2.2.3 Calculations. When volumes of sample and aliquot, as stated in Sec. 5.2.2.2, are used:

$$\text{sodium thiosulfate, in milliliters} \times \text{normality} \times \frac{40 \times 50 \times 0.03545}{10} \qquad \text{(Eq 2)}$$

$$= \text{volume or trade, percent}$$

or

$$\text{sodium thiosulfate, in milliliters} \times \text{normality} \times 7.092 = \text{volume or trade percent}$$

5.2.3 *Testing for free alkali in sodium hypochlorite.*

5.2.3.1 Reagents.

1. 0.1*N* hydrochloric acid.
2. Hydrogen peroxide solution, 3 percent.
3. Methyl orange indicator.

5.2.3.2 Procedure.

1. Weigh accurately 10 g of sodium hypochlorite into a tall-form, 200-mL, heat-resistant glass beaker and add hydrogen peroxide until the action ceases. Record the exact amount of H_2O_2 addition. Boil for 2 min and then cool.

2. Titrate with 0.1*N* hydrochloric acid, using methyl orange as an indicator.

3. Measure the same amount of hydrogen peroxide solution into a beaker as was added to the sample in Sec. 5.2.3.2(1). Next, titrate with 0.1*N* hydrochloric acid using methyl orange indicator. Subtract this amount from the titration method in Sec. 5.2.3.2(2).

5.2.3.3 Calculation.

$$\frac{\text{net mL HCl} \times \text{normality} \times 0.04\ 100}{10 \text{ grams (weight of sample)}} = \text{net mL HCl} \times \text{normality} \times 0.4 \qquad \text{(Eq 3)}$$

$$= \text{percentage free alkali, as NaOH}$$

* Moist samples of hypochlorite partially decompose in storage and result in the formation of chlorite. In acetic acid medium, ClO2 reacts with I^- very slowly to release iodine. Therefore, if chlorite is present in the sample, a sharp end point in iodometric titration may not be attained.

5.2.4 *Testing for insoluble matter in sodium hypochlorite.*

5.2.4.1 Procedure. Pour approximately 100 mL of the sodium hypochlorite solution into a tared 400-mL beaker placed on a laboratory platform balance and weigh to the nearest 0.1 g. Add 100 mL of distilled water and mix thoroughly. Filter through a tared Gooch crucible. Wash the beaker and crucible with distilled water. Dry the crucible to a constant weight at 212°F–221°F (100°C–105°C).

5.2.4.2 Calculation.

$$\frac{\text{grams of residue}}{\text{grams of sample}} \times 100 = \%\ \text{insoluble matter} \qquad \text{(Eq 4)}$$

Sec. 5.3 Notice of Nonconformance

If the hypochlorite delivered to the purchaser does not meet the chemical, physical, safety, or security requirements of this standard, the purchaser shall provide a notice of nonconformance to the supplier within 10 days after receipt of the shipment at the point of destination. The results of the purchaser's test shall prevail, unless the supplier notifies the purchaser within five days after receipt of the notice of complaint that a retest is desired. On receipt of the request for a retest, the purchaser shall forward to the supplier one of the sealed samples taken in accordance with Sec. 5.1. If the results obtained by the supplier on retesting do not agree with the test results obtained by the purchaser, the other sealed sample shall be forwarded, unopened, to a referee laboratory agreed on by both parties for analysis. The results of the referee's analysis shall be accepted as final.

The supplier shall provide to the purchaser an adjustment that is agreed on between the supplier and the purchaser reflecting the diminished quality of the product.

SECTION 6: DELIVERY

Sec. 6.1 Marking*

6.1.1 *Required.* Hypochlorites are oxidizing materials generally used by water utilities as a disinfectant. Hypochlorites used for disinfection shall be registered, labeled, and marked as prescribed by FIFRA. Labels should serve as a

* Government packaging and marking references reflect US requirements. Users of ANSI/AWWA B300 outside the United States should verify applicable local, provincial, and national regulatory requirements. Because of frequent changes in these regulations, all parties should remain informed of possible revisions. Provisions of the purchaser's documents should not preclude compliance with applicable regulations.

warning that the material is a strong oxidizing agent and that contact with heat, acids, or organic or combustible materials could cause fire. Shipments shall also bear warning labels as specified by US Department of Transportation regulations. Each package shall bear a legible statement identifying the active ingredient and content, the net weight of the contents, the name of the manufacturer or distributor, the lot number, and the brand name, if any, and other markings as required by applicable laws and regulations. Each package must bear a USEPA registration number as well as the USEPA establishment number indicating where the product was manufactured or last repackaged. For calcium hypochlorite tablets, each label shall also show either the weight of each tablet or the number of tablets per unit weight.

6.1.2 *Optional.* Each package may also bear the statement "Guaranteed by (name of manufacturer) to meet ANSI/AWWA B300, Standard for Hypochlorites, for (type of hypochlorite contained in the package)" provided that the requirements of this standard are met.

Sec. 6.2 Packaging and Shipping

Packaging and shipping of all hypochlorites shall conform to the current federal, state or provincial, and local regulations.

6.2.1 *Chlorinated lime.* Chlorinated lime may be shipped in 100-lb or 300-lb (45-kg or 136-g) sheet-iron drums. The containers should be tight enough so that the material will not sift through cracks or openings but should not be airtight. Sealing compound shall not be used at the seams of metal drums.

NOTE: High pressure may develop in an airtight drum should rapid decomposition of the chlorinated lime occur.

6.2.2 *Calcium hypochlorite.* Calcium hypochlorite may be shipped in approved corrosion resistant containers or in metal drums. Sealing compound shall not be used at the seams of the metal drums.

6.2.3 *Sodium hypochlorite.* Sodium hypochlorite solutions may be shipped in glass carboys; in approved plastic containers; or in suitably lined, thoroughly clean tank trucks of approximately 5,000-gal (18,926-L) capacity.

6.2.4 *Net weight.* The net weight or net volume of packaged or containerized material shall not deviate from the recorded weight or volume by more than an absolute value of 2.5 percent. If exception is taken to the weight or volume of the material received, acceptance or rejection shall be based on the weight or volume of not less than 10 percent of the packages or containers received, selected at random from the shipment.

6.2.5 *Security requirements for nonbulk shipments.* Packaged product shall be stored, shipped, and delivered in tamper-evident packaging as defined in Section 3, item 6, or an alternative method or methods may be agreed on by the manufacturer and purchaser that provide a reasonable assurance of protection against tampering.

6.2.6 *Security requirements for bulk shipments.* Bulk quantities of product shall be secured by employing one of the following security measures (or a combination of measures):

6.2.6.1 Seals. Bulk quantities of product may be sealed with a uniquely numbered tamper-evident seal(s). The seal numbers shall be recorded and disclosed on shipping documents such as the Bill of Lading. Seals shall be inspected upon receipt of product by the purchaser, and evidence of tampering or removal should be reported to the carrier and supplier.

6.2.6.2 Chain of custody. A continuous chain of custody may be maintained between the manufacturer and the purchaser during storage and shipment if so specified by the purchaser.

6.2.6.3 Alternative method. An alternative method or methods may be agreed on by the manufacturer and purchaser that provide reasonable assurance of protection against tampering.

Sec. 6.3 Affidavit of Compliance

The purchaser may require an affidavit from the manufacturer or supplier attesting that the hypochlorite provided according to the purchaser's order complies with all applicable requirements of this standard.

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