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

American Water Works Association

The Authoritative Resource on Safe Water®

AWWA Standard

Hypochlorites

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Committee Personnel

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

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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*).

* 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

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

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

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

or

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

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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(Revision of ANSI/AWWA B300-04)

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.