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American Water Works Association

The Authoritative Resource on Safe Water®

AWWA Standard

Liquid Polyaluminum Chloride

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The AWWA Standards Committee on Iron Salts, Aluminum Salts, and Related Coagulant Aids, 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 a part of ANSI/AWWA B408.*

I. Introduction.

I.A. *Background.* This standard covers a variety of products based on the chemistry of aluminum salt solutions, where polyaluminum oligomers become the predominant and defining form of the aluminum cation. The characteristics of the corresponding anion in these oligomer products, although more commonly entirely chloride, may be instead sulfate or even some ratio of these two anions in combination. There are, additionally, formulations of these products wherein a polymer (organic polyelectrolyte) is blended in with inorganic oligomers to provide enhancements of specific functionalities.

This standard will focus on polyaluminum chloride (PACl) products—as they are the predominant presentation of this chemistry—commercially available as liquids in the United States and Canada. This standard covers liquid PACl for use in municipal and industrial water supplies. As a note, certain parts of this standard may be used wholly, or in part, to aid the user and producer to define and measure a specific related product chemistry being offered, though only as is appropriate and mutually agreed on beforehand by both the purchaser and supplier/manufacturer. Given these conditions, it may be necessary for the purchaser to acquire and utilize additional or different information and methodologies from that offered in this standard to allow the proper management of products in this group.

Some inorganic coagulants are mixed with polymers to produce blends.†

Polyaluminum chloride is a misnomer, however, because these products contain a mixture of polymers (actually aggregates of oligomers) of aluminum chloride hydroxide (Chemical Abstract Service [CAS] No. 1327-41-9) with the empirical formula $Al_n(OH)_mCl_{(3n-m)}$ for $0 < m < 3n$. At least the following five CAS numbers, 1327-41-9, 10284-64-7, 14215-15-7, 39290-78-3, and 12042-91-0, have been used for various types of PACl. *Basicity* (hydroxyl number) refers to the average number of hydroxide ions per aluminum atom in the PACl molecules or m/n. In some PACl products, an anion other

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

† Characterization of Inorganic Coagulant/Polymer Blends Using Refractive Index and Specific Gravity Measurements. 2004. Polyelectrolytes Standards Committee Report, B.S. Johnson, Chair. *J. AWWA* 96:170.

than chloride, such as sulfate, may also be present, but this anion should be present in much lower concentrations than the chloride ion if the product is being sold as PACl.

The basicity of PACl products can range from 0 to 2.5, though the basicity should not be 0 if the product is being sold as PACl. The basicity is converted to "percent basicity" using the following formula:

$$\text{percent basicity} = \frac{(\text{OH/Al}) \times 100}{3}$$

Where:

Al and OH are expressed as moles/liter

The values for percent basicity of liquid PACl products can range from about 10 to 83.3. The basicity of the product does not necessarily relate directly to product performance, so the highest basicity may not give the best performance in a particular application.

Polyaluminum chloride products contain varying amounts of PACl, the concentration of which is conventionally expressed as "percent by weight as Al" or "percent as Al." The range of PACl content in PACl products is about 2.5 to 13 percent as aluminum (5 to 25 percent as Al_2O_3).

Polyaluminum chloride can be commercially manufactured from a number of aluminum-containing raw materials, including aluminum metal, alumina trihydrate, aluminum chloride, aluminum sulfate, and combinations of these. The products can contain by-product salts, such as sodium/calcium/magnesium chloride or sulfate, depending on the manufacturing process. The presence of these salts is not harmful to product performance or to those handling the product. Recognizing that the purity of PACl can vary with the manufacturing process, the purchaser should ask the supplier for information concerning potential impurities.

This standard provides methods for analysis of active PACl expressed in percent as aluminum (or Al_2O_3), percent basicity, turbidity, and specific gravity.

I.B. *History.* In 1988, the AWWA Standards Committee on Iron Salts, Aluminum Salts, and Related Coagulant Aids organized a subcommittee to prepare a standard for PACl products. The first draft of the standard was reviewed in 1989, and the final draft was approved in 1992. The first edition of ANSI/AWWA B408, Standard for Liquid Polyaluminum Chloride, was approved by the AWWA Board of Directors on Jan. 31, 1993. The second edition was approved on June 21, 1998. The third edition was approved on June 19, 2003. This edition was approved June 20, 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 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 B408 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

* Persons outside the United States should contact the appropriate authority having jurisdiction.
† NSF International, 789 N. Dixboro Road, Ann Arbor, MI 48105.

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.

II. Special Issues.

II.A. *Storage and Handling Precautions.* Liquid PACl is a clear to slightly hazy solution that is acidic and corrosive to common metals. Suitable materials for construction of storage and handling facilities include synthetic rubber-lined steel, corrosion-resistant fiberglass-reinforced plastics (FRP), ceramics, tetrafluoroethylene polymer (PTFE), polyvinylidene fluoride (PVDF), polyethylene, polypropylene, and polyvinyl chloride (PVC). Steel (stainless and mild), aluminum, nickel, copper, or brass are *not* suitable. The supplier should be contacted for recommendations on appropriate materials of construction for the storage, handling, and packaging of any specific product.

Contact with PACl products may cause burns or irritation to the eyes or skin. Protective clothing, such as rubber gloves, boots, pants, and jackets, and eye protection, such as goggles or face masks, are recommended.

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 B408, Liquid Polyaluminum Chloride, of latest revision.
2. Details of other federal, state or provincial, and local requirements (Sec. 4.1).
3. Percent active PACl expressed as percent Al or as percent Al_2O_3.
4. Whether compliance with NSF/ANSI 60, Drinking Water Treatment Chemicals—Health Effects, is required.
5. 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. 5.3 through 5.7, 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 the shipment.
6. Method of shipping, packaging, and container size (Sec. 6.2).

7. Whether alternative security measures have been adopted to replace or augment the security measures set out in Sec. 6.2.2 and 6.2.3.

8. An affidavit of compliance or certified analysis, 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 to the standard in this edition include the following:

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

2. Inclusion of a requirement for tamper-evident packaging (Sec. 6.2.2 and 6.2.3).

3. Additional information on the types of products covered in this standard (I.A).

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 at 303.795.7603, write to the group at 6666 West Quincy Avenue, Denver, CO 80235-3098, or e-mail the group at standards@awwa.org.

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AWWA Standard

Liquid Polyaluminum Chloride

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard describes polyaluminum chloride (PACl) in aqueous (liquid) form for use in the treatment of potable water, wastewater, and reuse or reclaimed water.

Sec. 1.2 Purpose

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

Sec. 1.3 Application

This standard can be referenced in specifications for purchasing and receiving liquid PACl and can be used as a guide for testing the physical and chemical properties of liquid PACl samples. The stipulations of this standard apply when this document has been referenced and then only to liquid PACl used in the treatment of potable water, wastewater, and reuse or reclaimed water.