

American Water Works Association

ANSI/AWWA B453-01

(Revision of ANSI/AWWA B453-96)



AWWA STANDARD
FOR
POLYACRYLAMIDE



Effective date: January 1, 2002.

First edition approved by AWWA Board of Directors July 30, 1954.

This edition approved June 17, 2001.

Approved by American National Standards Institute October 20, 2001.

AMERICAN WATER WORKS ASSOCIATION

6666 West Quincy Avenue, Denver, Colorado 80235

www.awwa.org

Copyright © 2001 American Water Works Association, All Rights Reserved

AWWA Standard

This document is an American Water Works Association (AWWA) standard. It is not a specification. AWWA standards describe minimum requirements and do not contain all of the engineering and administrative information normally contained in specifications. The AWWA standards usually contain options that must be evaluated by the user of the standard. Until each optional feature is specified by the user, the product or service is not fully defined. AWWA publication of a standard does not constitute endorsement of any product or product type, nor does AWWA test, certify, or approve any product. The use of AWWA standards is entirely voluntary. AWWA standards are intended to represent a consensus of the water supply industry that the product described will provide satisfactory service. When AWWA revises or withdraws this standard, an official notice of action will be placed on the first page of the classified advertising section of *Journal AWWA*. The action becomes effective on the first day of the month following the month of *Journal AWWA* publication of the official notice.

American National Standard

An American National Standard implies a consensus of those substantially concerned with its scope and provisions. An American National Standard is intended as a guide to aid the manufacturer, the consumer, and the general public. The existence of an American National Standard does not in any respect preclude anyone, whether that person has approved the standard or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standard. American National Standards are subject to periodic review, and users are cautioned to obtain the latest editions. Producers of goods made in conformity with an American National Standard are encouraged to state on their own responsibility in advertising and promotional materials or on tags or labels that the goods are produced in conformity with particular American National Standards.

CAUTION NOTICE: The American National Standards Institute (ANSI) approval date on the front cover of this standard indicates completion of the ANSI approval process. This American National Standard may be revised or withdrawn at any time. ANSI procedures require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of publication. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute, 25 W. 43rd St., Fourth Floor, New York, NY 10036; (212) 642-4900.

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording, or any information or retrieval system, except in the form of brief excerpts or quotations for review purposes, without the written permission of the publisher.

Copyright © 2001 by American Water Works Association
Printed in USA

Committee Personnel

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

Francis J. Mangravite, *Chair*

Consumer Members

T.A. Barber Jr., Coca-Cola Co., Atlanta, Ga.	(AWWA)
O.J. Dzydzora, East Stroudsburg, Pa.	(AWWA)
D.W. Fredericksen, Upper Mohawk Valley Regional Water Board, Utica, N.Y.	(AWWA)
Sun Liang, Metropolitan Water District of Southern California, Los Angeles, Calif.	(AWWA)
S.R. Lohman, Denver Water, Denver, Colo.	(AWWA)
J.I. McKergow, Municipality of Metro Toronto, Toronto, Ont.	(AWWA)
J.C. Routt, Kentucky–American Water Co., Lexington, Ky.	(AWWA)

General Interest Members

H.R. Hall,* City of Corpus Christi, Corpus Christi, Texas	(AWWA)
S.S. Hazan, NSF International, Ann Arbor, Mich.	(AWWA)
F.L. Hinker, Consulting Engineer, Santa Rosa, N.M.	(AWWA)
R.D. Letterman, Syracuse University, Syracuse, N.Y.	(AWWA)
F.J. Mangravite, Public Works Management Co., Morris Plains, N.J.	(AWWA)
J.H. Wilber,* Standards Program Manager, AWWA, Denver, Colo.	(AWWA)

Producer Members

F.W. Barvenik, CYTEC Industries, Stamford, Conn.	(AWWA)
B.S. Johnson, Nalco Chemical Company, Naperville, Ill.	(AWWA)
S.R. Kurowsky, Vulcan Performance Chemicals, Columbus, Ga.	(AWWA)
W.D. Laraway,† MPL Services Inc., Long Valley, N.J.	(AWWA)
C.B. Lind, General Chemical Corporation, Parsippany, N.J.	(AWWA)
C.C. Pintner, Ciba Specialty Chemicals, West Memphis, Ariz.	(AWWA)

*Liaison, nonvoting

†Alternate

This page intentionally blank.

Contents

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

SEC.	PAGE	SEC.	PAGE
Foreword		4.2	Qualifications..... 3
I	Introduction..... vii	4.3	Physical Requirements..... 4
I.A	Background..... vii	4.4	Chemical Requirements 4
I.B	History viii	4.5	Impurities..... 5
I.C	Acceptance ix	4.6	Inert Substances..... 6
II	Special Issues x	5	Verification
II.A	Safety x	5.1	General..... 6
II.B	Spill Control xi	5.2	Sampling 6
III	Use of This Standard..... xi	5.3	Visual Inspection 7
III.A	Development of a Purchase Specification xi	5.4	Test Procedures 8
III.B	Modification to Standard..... xv	5.5	Solution Preparation 14
IV	Major Revisions..... xv	5.6	Product Performance..... 18
V	Comments..... xvi	5.7	Residual Acrylamide Monomer 20
		5.8	Rejection 21
Standard		6	Delivery
1	General	6.1	Markings 21
1.1	Scope 1	6.2	Packaging and Shipping 22
1.2	Purpose 1	6.3	Affidavit of Compliance..... 22
1.3	Application..... 1	Table	
2	References 2	1	Typical Concentrations and Ranges for Determining Brookfield Viscosity..... 5
3	Definitions 2		
4	Requirements		
4.1	Description 3		

This page intentionally blank.

Foreword

This foreword is for information only and is not a part of AWWA B453.

I. Introduction.

I.A. *Background.* Chemical clarification methods have been used to improve the quality of drinking water supplies since the late 1880s. In 1967, the first completely synthetic organic polyelectrolyte was accepted by the US Public Health Service for use in treatment of potable water. The responsibility for accepting additives for drinking water treatment was subsequently assumed by the US Environmental Protection Agency (USEPA) and administered by their Office of Drinking Water as an advisory program. USEPA's acceptance was by the specific name of the suppliers' product and not by generic type. Polyacrylamide (CAS* No. 9003-05-8) is one of several types of synthetic organic polyelectrolytes that were accepted for use in potable water treatment under this program, which was discontinued in 1990.

Polyacrylamides (PAMs) belong to a family of synthetic organic polyelectrolytes (also called polymers or flocculants) used in water treatment to improve the performance of some unit operations in the treatment process, most often by increasing the extent or rate of liquid–solids separation. PAMs may have an anionic, nonionic, or cationic charge and will always have a high relative molecular weight. Because of this high molecular weight, they are manufactured for the potable water supply service in three distinctly different product forms: powders, emulsions, and solutions. The solution form is the least frequently used because of its high viscosity and lower polymer content. An aqueous dispersion form may be available in the future.

The important concepts to remember regarding PAMs include the following:

1. PAMs differ from polyDADMAC polymers (ANSI/AWWA Standard B451) and epichlorohydrin-DMA polymers (ANSI/AWWA Standard B452) in their use, handling, storage, and solution preparation.
2. PAMs are not one polymer, but a family of polymers that differ in product form, charge type, charge density, molecular weight, and other properties.

*Chemical Abstracts Service, 2540 Olentangy River Rd., P.O. Box 3012, Columbus, OH 43210.

3. The nomenclature used to describe the four forms in which PAMs are supplied is

- a. powders (also called flake, dry, granular, or bead)
- b. emulsions (also called liquids, dispersions, or inverse emulsions)
- c. solutions (also called liquids, aqueous solutions, or viscous solutions)
- d. aqueous dispersions (also called oil-free emulsion, water dispersion, brine dispersion)

4. The physical properties of a PAM cannot usually be used to judge product performance. Only through laboratory testing, pilot plant studies, or full plant trials can product efficacy be discerned.

5. PAMs may or may not contain inactive ingredients, such as hydrocarbon solvents, surfactants, and salts, depending on the product form, manufacturing method, and formulation. The typical primary components of each form can be described generically as follows:

a. Powders (PAM, moisture [water]; may contain inert inorganic salts or inert organic compounds).

b. Emulsions (PAM, hydrocarbon oil, water, surfactants). The amount of hydrocarbon oil is typically, but not limited to, 20 percent to 50 percent by weight of the emulsion.

c. Solution (usually a dilute, viscous, aqueous solution of powder or emulsion form PAM. Refer to the aforementioned primary components).

d. Aqueous dispersions (PAM, water, salts) in which the PAM is suspended in aqueous solution of inorganic salts. Aqueous dispersion PAMs are currently used for wastewater treatment and may be introduced in the future for potable water supply treatment subject to appropriate approvals. These products contain no hydrocarbon oil or surfactants.

The user should consult the material safety data sheet (MSDS) for product composition information regarding any specific PAM product.

6. The storage, dissolution, and feeding of PAMs may require specific procedures, considerations, and equipment that are unique for each product form (powders, emulsions, and solutions).

I.B. History. Authorization for development of this standard was given by the AWWA Standards Council. The standard was developed by the AWWA Standards Committee on Polyelectrolytes and this first edition was approved by the AWWA

Board of Directors on Feb. 4, 1996. This subsequent action was approved by the Board of Directors on June 17, 2001.

I.C. *Acceptance.*^{*} In May 1985, the US Environmental Protection Agency (USEPA) entered into a cooperative agreement with a consortium led by NSF International (NSI) to develop voluntary third-party consensus standards and a certification program for all direct and indirect drinking water additives. Other members of the original consortium included the American Water Works Association Research Foundation (AWWARF) 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:

1. An advisory program formerly administered by USEPA, Office of Drinking Water, discontinued on Apr. 7, 1990.
2. Specific policies of the state or local agency.
3. Two standards developed under the direction of NSF ANSI/NSF[‡] 60, Drinking Water Treatment Chemicals—Health Effects, and ANSI/NSF 61, Drinking Water System Components—Health Effects.
4. Other references, including AWWA standards, *Food Chemicals Code*, *Water Chemicals Codex*,^{**} and other standards considered appropriate by the state or local agency.

Various certification organizations may be involved in certifying products in accordance with ANSI/NSF 60. Individual states or local agencies have authority to

^{*}See Sec. 4.5.2, which gives the USEPA Treatment Technique requirements for residual acrylamide monomer in polyacrylamide polymers.

[†]Persons in Canada, Mexico, and non-North American countries should contact the appropriate authority having jurisdiction.

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

[§]NSF International, 789 N. Dixboro Rd., Ann Arbor, MI 48105.

^{**}Both publications available from National Academy of Sciences, 2101 Constitution Ave. N.W., Washington, DC 20418.

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 ANSI/NSF 60 does not stipulate a Single Product Allowable Concentration (SPAC) of a contaminant for substances not regulated by a USEPA final maximum contaminant level (MCL). The SPACs 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.

AWWA B453-01 addresses additives requirements in Sec. 4.5 of the standard. The transfer of contaminants from chemicals to processed water or the residual solids is becoming a problem of greater concern. The language in Sec. 4.5.4 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 ANSI/NSF Standard 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 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 all 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. *Safety.* PAMs are not considered to be as toxic as some household products nor are they considered to be primary skin or eye irritants as defined by the Consumer Product Safety Commission (US Federal Hazardous Substances Act). Good housekeeping procedures and personal cleanliness are recommended when handling polyacrylamides. The products may contain trace amounts of acrylamide monomer, which has been shown to be toxic. The MCL of 0.05 percent is lower than that which would require labeling under the OSHA Hazard Communication Standard.

Safety glasses should be worn when handling emulsion or solution forms of PAM and, although not required, when handling the powder form. Appropriate first-aid practices should be followed in all cases of exposure. In case of eye contact, flush with plenty of water for at least 15 min and call a physician. Emulsion form PAMs contain hydrocarbon solvents whose vapors can cause nausea, headaches, and other

symptoms. Consult the MSDS for the specific product for safety procedures before handling any PAM product.

II.B. *Spill Control.* Dispose of PAMs according to local, state and provincial, and federal regulations. Solutions of PAMs make floors and other surfaces extremely slippery. A dike should be formed around the spill area to contain as much spilled material as possible and the contained material should be shoveled, scooped, or pumped, as appropriate, into suitable disposal containers. Any remaining material should be adsorbed on vermiculite or other suitable adsorbing material and placed in a sealed metal container for disposal. The spill area should be thoroughly washed with water only after all possible polymer has been scooped up, absorbed, or wiped up. Use of warm water is beneficial.

III. Use of This Standard. AWWA has no responsibility for the suitability or compatibility of the provisions of this standard to any intended application by any user. Accordingly, each user of this standard is responsible for determining that the standard's provisions are suitable for and compatible with that user's intended application.

III.A. *Development of a Purchase Specification.* This AWWA standard can be used to prepare a purchase specification but is not itself a specification because it cannot address requirements unique to the purchaser's specific situation, nor does it establish business relationships or set additive requirements (MCL or maximum use dosage). In addition, this PAM standard does not establish physical and chemical property specifications for any one PAM product for two reasons: (1) PAMs are a broad family of products differing widely in properties and product form, and (2) physical and chemical properties of PAMs do not always relate to their performance as a flocculant in specific applications.

Sec. III.A.1 through Sec. III.A.6 detail requirements that the user may consider when developing a PAM product purchase specification.

III.A.1. General Product Requirements.

III.A.1.1. Additive Requirements (Sec. I.C). The following requirements should be met for additives:

1. Certification under the earlier USEPA advisory program or the current ANSI/NSF Standard 60.
2. Compliance with USEPA Phase II Rule National Primary Drinking Water Regulations acrylamide monomer treatment technique requirements (40 CFR 141.111).

3. Approval by or certification that meets any applicable state or local requirements.

4. Whether the recommended compliance with ANSI/NSF Standard 60, Drinking Water Treatment Chemicals—Health Effects, is to be required. If this certification is to be required, the purchaser's specifications shall read, "This material *shall* be certified as suitable for contact with or treatment of drinking water by an accredited certification organization in accordance with ANSI/NSF Standard 60, Drinking Water Treatment Chemicals—Health Effects."

III.A.1.2. Residual Acrylamide Monomer (Sec. I.C, Sec. 4.5.2, Sec. 5.7). The acrylamide monomer content of each shipment and lot of PAM shall be no greater than 0.05 percent by weight of the active polymer content based on a dose level of 1 mg/L active PAM polymer (or equivalent). Upon request, the supplier shall provide an estimate of the residual acrylamide monomer content. This estimate shall be based on the maximum concentration of residual acrylamide monomer and shall be reported as less than or equal to that concentration.

NOTE: It may not be possible for the supplier to routinely provide the precise value of the residual acrylamide monomer of each PAM shipment. Such measurements are conducted on each manufactured batch, which may then be continuously added to bulk storage tanks from which shipments are continuously extracted.

III.A.1.3. Impurities (Sec. 4.5).

III.A.2. User Specific Requirements.

1. Description of application.
2. Estimated annual purchase requirements (lb [kg]).
3. Typical order size (number of containers and lb [kg]).
4. Packaging (superbag, bag, fiber drum, pails, drum and drum size, returnable semibulk containers, nonreturnable semibulk containers, bulk by truck, bulk by rail) (Sec. 6.2).
5. Marking (Sec. 6.1).
6. Shipping (Sec. 6.2).
7. Delivery requirements (truck with a lift gate; length and coupling size of hoses needed for bulk delivery; transfer pump; allowed times of delivery; limitations on truck size or weight; sampling protocol; other).
8. Order lead time (number of working days between order placement and delivery necessary if typical lead times are insufficient).
9. Affidavit of compliance (Sec. 6.3).