Return to Main Menu Return to List of Standards Return to History of Standards

ANSI/AWWA B605-18
(Revision of ANSI/AWWA B605-13)

American Water Works Association

Dedicated to the World's Most Important Resource®

AWWA Standard

Reactivation of Granular Activated Carbon

Effective date: June 1, 2018.
First edition approved by AWWA Board of Directors Jan. 14, 1999.
This edition approved Jan. 20, 2018.
Approved by American National Standards Institute Dec. 19, 2017.

American Water Works Association STANDARD Since 1881

Approved American National Standard ANSI

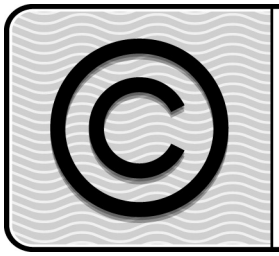
AWWA Standard

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. This standard does not supersede or take precedence over or displace any applicable law, regulation, or code of any governmental authority. AWWA standards are intended to represent a consensus of the water industry that the product described will provide satisfactory service. When AWWA revises or withdraws this standard, an official notice of action will be placed in the Official Notice section of *Journal - American Water Works Association*. 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 ANSI approval. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036; (212) 642-4900, or emailing info@ansi.org.



This AWWA content is the product of thousands of hours of work by your fellow water professionals. Revenue from the sales of this AWWA material supports ongoing product development. Unauthorized distribution, either electronic or photocopied, is illegal and hinders AWWA's mission to support the water community.

ISBN-13, print: 978-1-62576-291-7

eISBN-13, electronic: 978-1-61300-472-2

DOI:http://dx.doi.org/10.12999/AWWA.B605.18

Committee Personnel

The AWWA Standards Committee on Activated Carbon, Powdered and Granular, which developed this standard, had the following personnel at the time of approval:

David W. Mazyck, *Chair*

General Interest Members

W.B. Dowbiggin, CDM Smith, Raleigh, N.C.
A. Fisher, UL LLC, Northbrook, Ill.
D.J. Hartman, Consultant, Cincinnati, Ohio
E. Kelley, Environmental Partners Group, Woburn, Mass.
D.R.U. Knappe, North Carolina State University, Raleigh, N.C.
R. Loftis, Engineering Performance Solutions, Jacksonville, Fla.
D.W. Mazyck, University of Florida, Gainesville, Fla.
T.J. McCandless,* Standards Engineer Liaison, AWWA, Denver, Colo.
R.P. Neyland, Tata & Howard, Marlborough, Mass.
R. Rodriguez†, University of Florida, Gainesville, Fla.
T.F. Speth, USEPA, Cincinnati, Ohio
I.H. Suffet, UCLA, Los Angeles, Calif.
R.S. Summers, University of Colorado at Boulder, Boulder, Colo.
M.A. Waer, Consultant, Phoenix, Ariz.

Producer Members

T.M. Byrne, Ingevity Corporation, North Charleston, S.C.
R. Clackum, Cabot Norit Americas, Marshall, Texas
J.A. Dye, Atlas Carbon LLC, Gillette, Wyo.
W.P. Freeman, Jacobi Carbons Inc., Columbus, Ohio
D.M. Jordan, Evoqua Water Technologies, San Francisco, Calif.
R. Krishnan, Commix LLC, Lansdale, Pa.
M.S. Potok, Donau Carbons/Standards Purification, Dunnellon, Fla.
R.J. Potwora, Carbon Resources, LLC, Oceanside, Calif.
K. Ryan, Calgon Carbon Corporation, Moon Township, Pa.

* Liaison, nonvoting
† Alternate

User Members

L.A. Gilmore, The Coca-Cola Company, Atlanta, Ga.
T. Hayes, City of Phoenix, Water Services Department, Phoenix, Ariz.
A.K. Kramer, Northern Kentucky Water District, Erlanger, Ky.
M. Meyer, Greater Cincinnati Water Works, Cincinnati, Ohio
B.E. Perron, Salem-Beverly Water Supply Board, Beverly, Mass.
J.V. Roccaro, Suffolk County Water Authority, Oakdale, N.Y.
J. Spitzer-London, New Jersey American Water, Farmingdale, N.J.
D.E. Tungate, Rivanna Water and Sewer Authority, Charlottesville, Va.

Contents

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

Foreword

This Foreword is for information only and is not a part of ANSI/AWWA B605.*

I. Introduction.

I.A. *Background*. A number of municipal water utilities employ granular activated carbon (GAC) to remove organic impurities from potable water sources.

These impurities include compounds imparting taste and odors, algal toxins, synthetic organic compounds, endocrine disruptors, pharmaceutically active compounds, and disinfection byproduct precursors. As GAC service time increases, GAC's capacity to adsorb impurities decreases. When the GAC filter no longer produces water of the desired quality, a potable water utility faces the decision either to replace the GAC with virgin (new) carbon or to reactivate the used GAC and use it again. This standard offers guidelines for reactivation and is intended to provide criteria for use by the potable water utilities that use granular activated carbon and to the suppliers who provide a thermal reactivation service.

I.B. *History*. The AWWA Standards Council authorized the development of this standard in 1993. The standard was developed by the AWWA Reactivation of Granular Activated Carbon Subcommittee, and the first edition was approved by the AWWA Board of Directors Jan. 14, 1999. Subsequent editions were approved on Feb. 15, 2007, and Jan. 20, 2013. This edition was approved on Jan. 20, 2018.

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 Water Research Foundation (formerly AwwaRF) and the Conference of State Health and Environmental Managers (COSHEM). The American Water Works Association 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

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

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

1. Specific policies of the state or local agency.

2. 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.

3. Other references, including AWWA standards, *Food Chemicals Codex, 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 NSF/ANSI 61. 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 61 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 B605 does not address additives requirements. 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. *General.* A description of virgin GAC and its production is provided in ANSI/AWWA B604, Granular Activated Carbon.

GAC is used to remove a broad spectrum of impurities from water. At some point in the service life of a GAC, the GAC adsorption capacity decreases to the point that the GAC no longer produces the desired effluent water quality. At this time, the GAC is characterized as *spent*, and it must be replaced. The spent GAC can be disposed of and replaced with virgin GAC, or the spent GAC can be reactivated and reinstalled for additional use.

* NSF International, 789 North Dixboro Road, Ann Arbor, MI 48105.

† Both publications available from National Academy of Sciences, 500 Fifth Street, NW, Washington, DC 20001.

During reactivation, GAC is typically exposed to the following conditions: drying, desorption/devolatization, pyrolysis, and oxidation. The reactivation process requires high-temperature conditions. Reactivation is a form of regeneration. Regeneration can also include low-temperature processes that may not be as effective as reactivation.

Varying conditions within a water treatment plant, such as process upsets, length of GAC service, or widely fluctuating influent water quality, will affect how efficiently a specific spent GAC may be reactivated. Because of this, characterizing a representative sample of the spent GAC and determining its reactivation characteristics (possibly by laboratory reactivation testing) are the most reliable means for projecting how the GAC will behave in a commercial reactivation system.

For generic classification purposes, lightly loaded GACs are those that have been subjected to low loadings of organics (e.g., contaminants, total organic carbon [TOC]) and inorganics (e.g., calcium, oxidized iron, manganese). At the other extreme are highly loaded GACs that have experienced high loadings of organics and inorganics. The relationship between loading and reactivation will vary by GAC type and water quality, but in general, lightly loaded GACs will recover a higher percentage of adsorptive capacity than heavily loaded GACs. Metals can accumulate even in lightly loaded GAC and remain present at detectable concentrations after reactivation.

Some loss of GAC will occur during reactivation. Causes for this loss include transportation and handling and reactivation losses. Therefore, makeup GAC is added to the reactivated GAC to bring the total GAC volume back to the original level. The makeup GAC should be virgin GAC or other reactivated GAC from the same potable water facility, exclusively. Use of virgin GAC as makeup avoids the potential liability of introducing leachable inorganic material from reactivated GAC from sources other than the purchaser's own water. However, commingling of municipal-grade reactivated carbon may be done with the purchaser's approval and regulatory approval, as required.

II.B. *Source of Supply and Services*. GAC and carbon reactivation services should be obtained from sources regularly used to produce and supply these materials and services for water utilities.

II.C. *GAC Size Distribution*. The reactivated GAC should possess a particle size distribution, effective size, and uniformity coefficient comparable to the virgin product to ensure proper physical filtration performance and adsorption behavior. The makeup GAC can be either virgin or reactivated GAC. Because the makeup GAC can contribute significantly to the overall GAC volume, the acceptability of placing the entire makeup GAC shipment in a filter should be determined by considering the impact and effect of the makeup GAC on the particle size distribution, effective size,

and uniformity coefficient. More information on the definition and significance of GAC size distribution is provided in ANSI/AWWA B604.

II.D. *Adsorptive Capacity*. To accurately assess the effectiveness of reactivated GAC, test work should be completed using water from the particular plant in question. If the GAC sees significant variations in the water quality, every effort should be made to test each type of water quality, ensuring (or understanding) the effectiveness of the GAC in treating the varying water qualities. Evaluating the removal of a specific challenge compound, such as geosmin or 2-methylisoborneol, may be included in the test work. It is strongly recommended that users of reactivated GAC follow this approach, as it will reflect the actual conditions under which the GAC will be used.

Various surrogate tests have been developed that give an indication of a GAC's performance under specific conditions. The tests use a specific adsorbate at a high concentration to reduce the amount of time required to run the test. These tests are of limited versatility and are not necessarily indicative of a GAC's performance for a given application. Examples of these tests are the iodine number, tannin value, and acetoxime adsorption tests. Iodine number is indicative of the total surface area of a carbon. As stated in ASTM* D4607, iodine number is the relative indicator of porosity in activated carbon. It does not necessarily provide a measure of the carbon's ability to adsorb another species. Also, it must be realized that any relationship between surface area and iodine number cannot be generalized. This relationship varies with changes in carbon raw material, processing conditions, and pore volume distribution. Acetoxime number is used as an index of GAC's ability to remove some low-molecular-weight organic compounds, such as volatile organic chemicals from groundwater. The acetoxime test's applicability for evaluating GAC for use in surface water applications has not been demonstrated. The same can be said for acetoxime number as for iodine number; the number cannot be generalized and should be reviewed and/or tested for each individual application. This value may not be applicable for every drinking water system. Tannin value is used as an index of a carbon's ability to remove high-molecular-weight impurities, such as natural organic matter. The test method for iodine number can be found in ASTM D4607. Information on tannin value and acetoxime adsorption tests may be found in Appendix B to ANSI/AWWA B604 for those purchasers who want to include these requirements in their documents. Please note that the use of these surrogates may not appropriately model adsorption of actual water contaminants,

* ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428.

and, therefore, it is highly encouraged that GAC users follow the Water Research Foundation's* *Standardized Protocol for the Evaluation of GAC* (Summers et al. 1992).

II.E. *Caution in Handling and Storage*. Wet GAC will readily adsorb oxygen from the air, creating an acute oxygen depletion hazard in confined areas. Appropriate safety measures for oxygen-deficient atmospheres should be strictly adhered to when entering enclosed or partially enclosed areas containing GAC. In storing dry, reactivated GAC, users should take precautions to avoid direct contact with strong oxidizing agents such as chlorine, hypochlorite, potassium permanganate, ozone, chlorite, and peroxide. Contact with these agents can produce significant exothermic reactions or the rapid production of gaseous decomposition products. GAC can ignite or explode if it is overpressurized.

Mixing of GAC with hydrocarbons (oils, gasoline, diesel fuel, grease, paint thinners, etc.) may cause spontaneous combustion. Therefore, GAC must be kept separate from hydrocarbon storage or spills.

GAC dusts are classified as "nuisance particulates," and the applicable threshold limit values should be followed.

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 B605, Reactivation of Granular Activated Carbon, of latest revision.

2. Whether compliance with NSF/ANSI 61, Drinking Water System Components—Health Effects, is required.

3. Any chain-of-custody requirements and documentation needed to track spent GAC from point of origin, through transportation, reactivation, storage, and return to the purchaser (water utility).

4. Quantity of spent GAC to be reactivated. Reactivated GAC, including makeup GAC, intended for immediate placement in an adsorption bed is typically purchased by the volume that remains following in-place backwashing and draining, per ANSI/AWWA B604.

5. Details of other federal, state or provincial, and local requirements (Sec. 4.1.1).

6. Required moisture content (Sec. 4.1.2).

* Water Research Foundation, 6666 West Quincy Avenue, Denver, CO 80235.

7. Required particle size distribution (Sec. 4.1.4).

8. Required effective size (Sec. 4.1.5).

9. Required uniformity coefficient (Sec. 4.1.6).

10. Additional adsorptive capacity tests (Sec. 4.2.2).

11. Information on the spent GAC and water treatment facility physical characteristics provided by the purchaser (Sec. 4.3.2).

12. Handling and transport requirements (Sec. 4.4).

13. If an environmental audit of facility is required (Sec. 4.5.2).

14. Reference sample, authorizing for shipment, and basis of acceptance (Sec. 5.3.1, 5.3.2, and 5.3.5).

15. Provisions for failing to reactivate GAC to required conditions (Sec. 5.3.6).

16. If shipment is to be in bulk, the type of railcar or truck/trailer (Sec. 6.2.4); the type of bulk bag (Sec. 6.2); and whether the bulk shipments are to be accompanied by weight certificates by certified weighers (Sec. 6.2.5).

17. Whether an affidavit of compliance is 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 revisions made to the standard in this edition include the following:

1. Options to include various quality control requirements in the purchase documents including:

2. Amount of metals that can leach from the reactivated GAC at initial startup.

3. Documentation from GAC reactivator that verifies the origin of the spent GAC used, provides spent GAC characterization attributes (Sec. 4.3.3), and ensures trucking/handling/storage requirements have been met.

4. Documentation from GAC transporters that certifies all requirements have been met.

5. Requirements for the reactivation facility relative to documentation of GAC origin, custom segregation, and chain of custody.

6. Required MCL or other chemical parameters.

7. Provide purchaser with a quality assurance/quality control plan that describes the methodology used.

8. Testing of defined physical and chemical parameters and performance characteristics.

9. Basis for Rejection section (Sec. 5.3.6) replaces Notice of Nonconformance.

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

ANSI/AWWA B605-18
(Revision of ANSI/AWWA B605-13)

American Water Works Association

Dedicated to the World's Most Important Resource®

AWWA Standard

Reactivation of Granular Activated Carbon

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard describes the procurement of granular activated carbon (GAC) reactivation services and the use of reactivated GAC for potable water, wastewater, and reclaimed water treatment. This standard does not cover the design of activated carbon handling facilities, reactivation facilities, or adsorption processes. Background information on GAC reactivation can be found in references listed in the Bibliography to this standard (Appendix A).

Sec. 1.2 Purpose

The purpose of this standard is to provide guidelines for use in preparing purchase documents for the procurement of GAC reactivation services where GAC is used as an adsorptive medium for treatment in potable water, wastewater, and reclaimed water systems.

Sec. 1.3 Application

This standard can be referenced in purchase documents for the reactivation of GAC. The stipulations of this standard apply when this document has been referenced and then only to the reactivation of GAC.