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Standard Terminology Used for Microfiltration, Ultrafiltration, Nanofiltration, and Reverse Osmosis Membrane Processes[1]

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1. Scope

1.1 This terminology covers the use of microfiltration, ultrafiltration, nanofiltration, and reverse osmosis for membrane separation processes.

1.2 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1129 Terminology Relating to Water

D2035 Practice for Coagulation-Flocculation Jar Test of Water

D3739 Practice for Calculation and Adjustment of the Langelier Saturation Index for Reverse Osmosis

D4582 Practice for Calculation and Adjustment of the Stiff and Davis Stability Index for Reverse Osmosis (Withdrawn 2019)[3]

3. Summary

3.1 This terminology is common to membrane separation processes but independent of the source of manufacture.

4. Significance and Use

4.1 The need to understand the relationships found in membrane unit processes for water treatment increases with the continuing demand for these separation systems. Defining the terms common to microfiltration, ultrafiltration, nanofiltration, and reverse osmosis processes assist the manufacturer, consultant, and end-user in eliminating inter-process terminology confusion. This standard expands the definitions found in Terminology D1129.

5. Terminology

5.1 *Definitions:*

absolute filter rating, *n*—particle size above which 100 % of particles that are trapped on or within the filter medium.

absorption, *n*—the release for desorption holding of a substance within a solid by cohesive or capillary forces.

accumulator, *n*—a pulsation dampener installed on the suction and/or discharge lines of pumps, generally plunger type, to minimize pressure surges and provide uniformity of flow.

accuracy, *n*—the closeness of agreement between an observed value and an accepted reference value. Where an accepted reference value is not available, accuracy is a description of a measure of the degree of conformity of a value generated by a specific procedure to the assumed or accepted true value, including both precision and bias.

acidity, *n*—the quantitative capacity of aqueous media to react with hydroxyl ions.

activated carbon, *n*—granulated or powdered activated carbon used to remove tastes, odor, chlorine, chloramines, and some organics from water. A family of carbonaceous substances manufactured by processes that develop adsorptive properties.

adsorption, *n*—the holding of a substance onto the surface of a solid by chemical surface forces, without forming new chemical bonds.

aerobic bacteria, *n*—bacteria that require oxygen for growth. See **bacteria, aerobes**.

aggregate, *n*—granular material such as sand, gravel, crushed stone.

aggressive water, *n*—water having a high tendency to corrode pipes and other equipment. Usually seen as having a negative Langelier Index value.

[1] This terminology is under the jurisdiction of ASTM Committee D19 on Water and is the direct responsibility of Subcommittee D19.08 on Membranes and Ion Exchange Materials.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

air header, *n*—the pipe running within a cassette that distributes the air to the individual modules or aerators.

air scour, *n*—distributing air over the entire area at the bottom of a filter media flowing upward or immersed membrane to improve the effectiveness of filtration or backwashing or to permit the use of lower backwash water flow rate, or both.

air stripping, *v*—removal of volatile substances from a water solution by passing a gas through the solution.

algae, *n*—a major group of lower plants, generally aquatic, photosynthetic of extremely varied morphology and physiology, mono cellular plants with chlorophyll often masked by a brown or red pigment.

alkalinity, *n*—the quantitative capacity of aqueous media to react with hydrogen ions. "M" alkalinity is that which will react with acid as the pH of the sample is reduced to the methylorange endpoint of about 4.5. "P" alkalinity is that which reacts with acid as the pH of the sample is reduced to the phenolphthalein end point of 8.3. "M" is the total alkalinity which is the sum of hydroxide, carbonate, and bicarbonate contents, "P" includes all the hydroxyl and half the carbonate content.

alum, *n*—aluminum sulfate, $AL_2(SO_4)_3XH_2O$ (X = 14–18), a coagulant.

ambient temperature, *n*—the temperature of the surroundings, generally assumed to be 20–25°C.

amorphous, *n*—non crystalline, devoid of regular cohesive structure.

amphoteric, *adj*—capable of acting as an acid or a base.

anaerobic bacteria, *n*—bacteria that do not use oxygen. Oxygen is toxic to them. See **bacteria, anaerobes**.

angstrom (A), *n*—a unit of length equaling 10^{-10} m, 10^{-4} μm, 10^{-8} cm, and 3.937×10^{-9} in. The symbol is Å, A, or A.U.

anion, *n*—negatively charged ion.

anion exchange material, *n*—a material capable of the reversible exchange of negatively charged ions.

anion exchange membrane, *n*—membrane containing fixed cationic charges and mobile anions that can be exchanged with other anions present in an external fluid in contact with the membrane.

anionic polyelectrolyte, *n*—usually acrylamide or acrylamide and acrylic copolymers, negatively charged, used for coagulation/flocculation. See **polyelectrolyte**.

anisotropic membrane, *n*—a non-uniform structure in cross-section; typically the support substructure has pores much larger than the barrier layer. See **asymmetric membranes**.

anode, *n*—positive electrode.

anthracite, *n*—a granular hard coal used as a filtration media, commonly used as the coarser layer in dual and multimedia filters.

antifoulant, *n*—see **antiscalant**.

antiscalant, *n*—a compound added to a water which inhibits the precipitation of sparingly soluble inorganic salts.

anti-telescoping device, *n*—a plastic or metal device attached to the ends of a spiral wound cartridge to prevent movement of the cartridge leaves in the feed flow direction, due to high feed flows.

AOC, *n*—assimilable organic carbon.

aquifer, *n*—a water-bearing geological formation that provides a ground water reservoir.

aramid, *n*—a fully aromatic polyamide.

array, *n*—the overall arrangement of pressure vessels in a crossflow membrane system, including the groupings of vessels in parallel and in series.

asymmetric membrane, *n*—membrane which has a change in pore structure. See **anisotropic membranes**.

ATD, *n*—see **anti-telescoping device**.

atomic weight, *n*—the relative mass of an atom based on a scale in which a specific carbon atom (carbon 12) is assigned a mass value of 12.

ATP, *n*—adenosine triphosphate.

autopsy, *n*—the dissection of a membrane module or element to investigate causes of unsatisfactory performance.

availability, *n*—the on-stream time or rated operating capacity of a water treatment system.

a-value, *n*—membrane water permeability coefficient. The coefficient is defined as the amount of water produced per unit area of membrane per unit of net driving pressure (NDP); units of measurement are $m^3/hr/m^2/kPa$.

AWWA, *n*—American Water Works Association.

AWWARF, *n*—American Water Works Association Research Foundation.

backflush, *n*—temporary reversal of the permeate or retentate flow.

backpulse, *n*—pumping treated water with or without added chemicals in the reversed direction from the lumen to the feed side of the membrane (inside-out).

backwash, *n*—reversing the flow of water with/without air either across or through a medium or membrane. Designed to remove the collected foreign material from the bed or membranes.

bacteria, *n*—any of a class of microscopic single-celled organisms reproducing by fission or by spores. Characterized by round, rod-like, spiral, or filamentous bodies, often aggregated into colonies or mobile by means of flagella. Widely dispersed in soil, water, organic matter, and the bodies of plants and animals. Either autotrophic (self-sustaining, self-generative), saprophytic (derives nutrition

from non-living organic material already present in the environment), or parasitic (deriving nutrition from another living organism). Often symbiotic (advantageous) in man, but sometimes pathogenic.

bactericide, *n*—agent capable of killing bacteria.

bacteriostat, *n*—substance that prevents bacterial growth and metabolism but does not necessarily kill them.

baffle, *n*—a deflector plate in a vessel that disperses the inlet fluid.

bank, *n*—a grouping of pressure vessels in parallel, with common feed- and concentrate-stream manifolds; equivalent to **stage**.

bar, *n*—unit of pressure; 14.50 lbs/in.^{2}, 1.020 kg/cm^2, 0.987 atm, 0.1 MPa.

BAT, *n*—best available technology.

battery limit, *n*—the boundary limits that physically defines a plant or process; inside the boundary are all the equipment and reactions associated with the defined plant or process

baume scale, °Be, *n*—a measure of the density of a solution relative to water.

$$^{\circ}BE = 145 - \frac{145}{\text{specific gravity*}}$$

United States for densities greater than unity.

$$^{\circ}BE = \frac{140}{\text{specific gravity*}} - 130$$

For densities less than unity.
*at 60°F

bed depth, *n*—the depth of the filter medium or ion exchange resin in a vessel.

bed expansion, *n*—the depth increase of filter medium or ion exchange resin that occurs during backwashing.

beta (value), *n*—a design parameter indicating the ratio of the ion concentrations at the membrane surface to the concentration in the bulk stream for spiral wound RO/NF.

binders, *n*—in reference to cartridge filters, chemicals used to hold, or 'bind,' short fibers together in a filter.

binding, *n*—in surface filtration, a build-up of particulates on the filter, restricting fluid flow through the filter at normal pressures.

biocide, *n*—a substance that kills all living organisms.

biological deposits, *n*—the debris left by organisms as a result of their life processes.

biomass, *n*—any material which is or was a living organism or excreted from a micro-organism.

bioremediation, *n*—the biological degradation treatment of waste sludge and soils to breakdown organic and hydrocarbons.

biostat, *n*—a substance that inhibits biological growth.

bipolar membrane, *n*—synthetic membrane containing two oppositely charged ion-exchange layers that are in contact with each other.

block, *n*—a grouping of devices in a single unit having common control. See **array, bank, train**.

BOD (biochemical oxygen demand), *n*—the amount of dissolved oxygen utilized by natural agencies in water in stabilizing organic matter at specified test conditions.

body feed, *n*—the continuous addition of filter medium (for example, diatomaceous earth) to sustain the efficacy of the filter.

BOO, *n*—build, own, operate.

BOOT, *n*—build, own, operate, and transfer.

boundary layer, *n*—a thin layer at the membrane surface where water velocities are significantly less than those in the bulk flow.

brackish water, *n*—water with an approximate concentration of total dissolved solids ranging from 500 to 10 000 mg/L. See **high brackish water, potable water, sea water**.

breakpoint chlorination, *n*—the point at which the water chlorine demand is satisfied and any further chlorine is the chlorine residual, the "free" chlorine species.

break tank, *n*—a storage device used for hydraulic isolation and surge protection.

brine, *n*—the concentrate (reject) stream from a crossflow membrane device performing desalination. Portion of the feed stream which does not pass through the membrane.

brine (concentrate) seal, *n*—a rubber lip seal on the outside of a spiral wound cartridge which prevents feed by-pass between the cartridge and the inside pressure vessel wall.

brine seal carrier, *n*—see **ATD**.

brine system staging, *n*—a process in which the concentrate, under pressure, of a group of membrane devices is fed directly to another set of membrane devices to improve the efficiency of the water separation.

bubble point, *n*—pressure differential at which bubbles first appear on one surface of an immersed porous membrane as gas pressure is applied to the other side.

bubble point pressure, *n*—the pressure differential necessary to displace a liquid held by surface tension forces from the largest equivalent capillaries in a membrane filter.

bubble point test, *n*—a nondestructive membrane filter test used to assess filter integrity and proper installation.

buffer, *n*—a substance in solution that accepts hydrogen or hydroxyl ions added to the solution minimizing a change in pH.