United States Environmental Protection Agency

Office of Water
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Fact Sheet: Draft Aquatic Life Ambient Water Quality Criteria for Aluminum in Freshwaters

Summary

EPA published a draft update of aluminum aquatic life ambient water quality criteria for freshwaters under Section 304(a)(1) of the Clean Water Act to reflect the latest scientific knowledge. EPA will accept public comment on the draft criteria for 60 days upon publication of the Federal Register notice. Once final, the criteria will serve as recommendations to states and tribes by defining the concentration of aluminum in water that will protect against harmful effects to aquatic life.

Background

EPA first published criteria for aluminum in 1988 to protect aquatic life from harmful effects of aluminum toxicity in freshwaters. Aluminum can inhibit an aquatic organism's ability to regulate salt concentrations and clog fish gills, potentially resulting in death or affecting growth and reproduction. EPA is updating the aluminum criteria to better reflect the latest science. Unfortunately, there are not enough data to support the development of estuarine/marine criteria at this time.

Unlike the fixed acute and chronic values found in the 1988 document, this draft document provides users the flexibility to develop site-specific criteria based on a site's water chemistry using the *Aluminum Criteria Calculator V.1.0.xlsx* or by using the lookup tables provided in the criteria appendix. Studies have shown that three water chemistry parameters, pH, dissolved organic carbon (DOC), and hardness, can affect the toxicity of aluminum by affecting the bioavailability of aluminum in the water to aquatic species.

What is Aluminum and How Does it Enter the Water?

Aluminum is found in most soils and rocks and is the third most abundant element and the most common metal in the earth's crust. Aluminum can enter the water via natural processes, like weathering of rocks. Aluminum is also released to water by mining, industrial processes using aluminum, and waste water treated with alum, an aluminum compound.

How does Aluminum Affect Aquatic Life?

Aluminum is considered a non-essential metal because fish and other aquatic life don't need it to function. Elevated levels of aluminum can affect some species ability to regulate ions, like salts, and inhibit respiratory functions, like breathing. Aluminum can accumulate on the surface of a fish's gill, leading to respiratory dysfunction, and possibly death. Aquatic plants are generally less sensitive to aluminum than fish and other aquatic life.

What is a Water Quality Parameter and Why is it Important?

Bioavailability is the measure whether a substance in the environment is available to enter living organisms, like fish. The bioavailability of aluminum is dependent on the chemical properties of water, otherwise known as water quality parameters. The more bioavailable the aluminum is, the more likely it is to cause a toxic effect. The water quality parameters that have the greatest impact on aluminum's bioavailability are pH, DOC, and hardness.

- pH: a low pH generally makes it easier for aluminum to be dissolved, and therefore more bioavailable. At higher pH, aluminum speciation changes make it more bioavailable.

- DOC: higher dissolved organic carbon reduces the bioavailability of aluminum because it binds to form aluminum complexes.
- Hardness: higher hardness values mean there are more ions present that compete with aluminum. This makes aluminum less bioavailable.

What is the Recommended Level of Aluminum in Freshwater for the Protection of Aquatic Life?

The recommended level of aluminum in freshwater depends on a site's water quality parameters. Unlike the fixed values found in the 1988 criteria document, these criteria use a Multiple Linear Regression (MLR) model to normalize the data, and the criteria are based on a site's pH, DOC, and hardness. See Table 1 for a comparison of existing and draft criteria values.

For freshwater criteria, users can put their site's water quality parameters into the *Aluminum Criteria Calculator V.1.0.xlsx* or use the lookup tables in the document's appendix. The resulting acute criterion would have an appropriate level of protection if the one-hour average concentration is not exceeded more than once every three years on average. If the four-day average concentration is not exceeded more than once every three years on average, the chronic criterion is protective.

Where can I find more information?

For more information please visit EPA's website at www.epa.gov/wqc/aquatic-life-criteria-aluminum or contact Diana Eignor at Eignor.Diana@epa.gov.

Table 1: 2017 Draft Aluminum Aquatic Life Criteria Compared to Current 1988 Criteria[a]

Version	**Freshwater Acute** (1 day, total aluminum)	**Freshwater Chronic** (4-day, total aluminum)
2017 Draft AWQC Criteria (MLR normalized to pH = 7, hardness = 100 mg/L, DOC = 1 mg/L)	1,400 µg/L	390 µg/L
1988 AWQC Criteria (pH 6.5 – 9.0, across all hardness and DOC ranges)	750 µg/L	87 µg/L

[a] Values are recommended not to be exceeded more than once every three years on average.
Note: Values will be different under differing water chemistry conditions as identified in this document.

Aluminum- ToxFAQs™

CAS # 7429-90-5

This fact sheet answers the most frequently asked health questions (FAQs) about aluminum. For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Everyone is exposed to low levels of aluminum from food, air, water, and soil. Exposure to high levels of aluminum may result in respiratory and neurological problems. Aluminum (in compounds combined with other elements) has been found in at least 596 of the 1,699 National Priority List (NPL) sites identified by the Environmental Protection Agency (EPA).

What is aluminum?

Aluminum is the most abundant metal in the earth's crust. It is always found combined with other elements such as oxygen, silicon, and fluorine. Aluminum as the metal is obtained from aluminum-containing minerals. Small amounts of aluminum can be found dissolved in water.

Aluminum metal is light in weight and silvery-white in appearance. Aluminum is used for beverage cans, pots and pans, airplanes, siding and roofing, and foil. Aluminum is often mixed with small amounts of other metals to form aluminum alloys, which are stronger and harder.

Aluminum compounds have many different uses, for example, as alums in water-treatment and alumina in abrasives and furnace linings. They are also found in consumer products such as antacids, astringents, buffered aspirin, food additives, cosmetics, and antiperspirants.

What happens to aluminum when it enters the environment?

- Aluminum cannot be destroyed in the environment, it can only change its form.
- In the air, aluminum binds to small particles, which can stay suspended for many days.
- Under most conditions, a small amount of aluminum will dissolve in lakes, streams, and rivers.
- It can be taken up by some plants from soil.
- Aluminum is not accumulated to a significant extent in most plants or animals.

How might I be exposed to aluminum?

- Virtually all food, water, air, and soil contain some aluminum.
- The average adult in the U.S. eats about 7–9 milligrams (mg) aluminum per day in their food.
- Breathing higher levels of aluminum dust in workplace air.
- Living in areas where the air is dusty, where aluminum is mined or processed into aluminum metal, near certain hazardous waste sites, or where aluminum is naturally high.
- Eating substances containing high levels of aluminum (such as antacids) especially when eating or drinking citrus products at the same time.
- Children and adults may be exposed to small amounts of aluminum from vaccinations.
- Very little enters your body from aluminum cooking utensils.

How can aluminum affect my health?

Only very small amounts of aluminum that you may inhale, ingest, or have skin contact with will enter the bloodstream.

Exposure to aluminum is usually not harmful, but exposure to high levels can affect your health. Workers who breathe large amounts of aluminum dusts can have lung problems, such as coughing or abnormal chest X-rays. Some workers who breathe aluminum dusts or aluminum fumes have decreased performance in some tests that measure functions of the nervous system.

Some people with kidney disease store a lot of aluminum in their bodies and sometimes develop bone or brain diseases which may be caused by the excess aluminum. Some studies

CAS # 7429-90-5

show that people exposed to high levels of aluminum may develop Alzheimer's disease, but other studies have not found this to be true. We do not know for certain whether aluminum causes Alzheimer's disease.

Studies in animals show that the nervous system is a sensitive target of aluminum toxicity. Obvious signs of damage were not seen in animals after high oral doses of aluminum. However, the animals did not perform as well in tests that measured the strength of their grip or how much they moved around.

We do not know if aluminum will affect reproduction in people. Aluminum does not appear to affect fertility in animals.

How likely is aluminum to cause cancer?

The Department of Health and Human Services (DHHS) and the EPA have not evaluated the carcinogenic potential of aluminum in humans. Aluminum has not been shown to cause cancer in animals.

How can aluminum affect children?

Children with kidney problems who were given aluminum in their medical treatments developed bone diseases. It does not appear that children are more sensitive to aluminum than adults.

We do not know if aluminum will cause birth defects in people. Birth defects have not been seen in animals. Aluminum in large amounts has been shown to be harmful to unborn and developing animals because it can cause delays in skeletal and neurological development.

Aluminum is found in breast milk, but only a small amount of this aluminum will enter the infant's body through breastfeeding.

How can families reduce the risks of exposure to aluminum?

- Since aluminum is so common and widespread in the environment, families cannot avoid exposure to aluminum.
- Avoid taking large quantities of aluminum-containing antacids and buffered aspirin and take these medications as directed.
- Make sure all medications have child-proof caps so children will not accidentally eat them.

Is there a medical test to determine whether I have been exposed to aluminum?

All people have small amounts of aluminum in their bodies. Aluminum can be measured in blood, bones, feces, or urine. Urine and blood aluminum measurements can tell you whether you have been exposed to larger-than-normal amounts of aluminum. Measuring bone aluminum can also indicate exposure to high levels, but this requires a bone biopsy.

Has the federal government made recommendations to protect human health?

The EPA has recommended a Secondary Maximum Contaminant Level (SMCL) of 0.05–0.2 milligrams per liter (mg/L) for aluminum in drinking water. The SMCL is not based on levels that will affect humans or animals. It is based on taste, smell, or color.

The Occupational Health and Safety Administration (OSHA) has limited workers' exposure to aluminum in dusts to 15 milligrams per cubic meter (mg/m^3) (total dust) and 5 mg/m^3 (respirable fraction) of air for an 8-hour workday, 40-hour workweek.

The Food and Drug Administration (FDA) has determined that aluminum used as food additives and medicinals such as antacids are generally safe.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2008. Toxicological Profile for Aluminum. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636

ToxFAQs™ Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.