ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

ALUMINUM

CAS # 7429-90-5

Division of Toxicology and Environmental Medicine ToxFAQs™ September 2006

This fact sheet answers the most frequently asked health questions (FAQs) about aluminum. For more information, call the ATSDR Information Center at 1-888-422-8737. 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 with other elements) has been found in at least 606 of the 1,678 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, 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.
- ❑ It can dissolve in lakes, streams, and rivers depending on the quality of the water.
- ❑ 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.
- ❑ Eating small amounts of aluminum in 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?

Exposure to aluminum is usually not harmful, but exposure to high levels can be. 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 show that people exposed to high levels of aluminum may develop Alzheimers disease, but other studies have not

found this to be true. We do not know for certain whether aluminum causes Alzheimers disease. People may get skin rashes from the aluminum compounds in some underarm antiperspirants.

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. We do not know if aluminum will cause birth defects in people. Birth defects have not been seen in animals. Large amounts of aluminum have been shown to be harmful to unborn and developing animals because it can cause delays in skeletal and neurological development. It does not appear that children are more sensitive to aluminum than adults.

There does not appear to be any difference between children and adults in terms of how much aluminum will enter the body, where aluminum can be found in the body, and how fast aluminum will leave the body. Aluminum from the mother can enter her unborn baby through the placenta. Aluminum is found in breast milk, but only a small amount of this aluminum will enter the infants 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've 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. Tests to measure aluminum levels in the body are not usually available at a doctors office because they require special equipment.

Has the federal government made recommendations to protect human health?

The EPA has recommended a Secondary Maximum Contaminant Level (SMCL) of 0.050.2 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 Safety and Health Administration (OSHA) has determined that the amount of aluminum in dusts that workers breathe should not be more than 15 milligrams per cubic meter (mg/m^3) of air.

The Food and Drug Administration (FDA) has determined that aluminum cooking utensils, aluminum foil, antiperspirants, antacids, and other aluminum products are generally safe.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2006. Toxicological Profile for Aluminum (Draft for Public Comment). Atlanta, GA: U.S. Department of Public 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 Environmental Medicine, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-800-232-4636, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html. 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.

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ToxFAQ™ 47k
ToxFAQ™ en Español 30k
Public Health Statement 126k
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ToxFAQs™
ToxFAQs™ en Español
Public Health Statements

February 2001

ToxFAQs™ for Manganese

(Manganeso)

CAS# 7439-96-5

This fact sheet answers the most frequently asked health questions about manganese. For more information, you may call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important 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: Manganese is a trace element and eating a small amount from food or water is needed to stay healthy. Exposure to excess levels of manganese may occur from breathing air, particularly where manganese is used in manufacturing, and from drinking water and eating food. At high levels, it can cause damage to the brain, liver, kidneys, and the developing fetus. This chemical has been found in at least 603 of 1,467 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is manganese?

Manganese is a naturally occurring metal that is found in many types of rocks. Pure manganese is silver-colored, but does not occur naturally. It combines with other substances such as oxygen, sulfur, or chlorine. Manganese can also be combined with carbon to make organic manganese compounds. Common organic manganese compounds include pesticides, such as maneb or mancozeb, and methylcyclopentadienyl manganese tricarbonyl (MMT), a fuel additive in some gasolines.

Manganese is an essential trace element and is necessary for good health. Manganese can be found in several food items, including grains and cereals, and is found in high amounts in other foods, such as tea.

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What happens to manganese when it enters the environment?

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- Manganese can enter the air from iron, steel, and power plants, coke ovens, and from dust from mining operations.
- It can enter the water and soil from natural deposits, disposal of wastes, or deposits from airborne sources.
- Manganese exists naturally in rivers, lakes, and underground water.
- Plants in the water can take up some of the manganese from water and concentrate it.

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How might I be exposed to manganese?

- Everyone is exposed to small amounts of manganese in air, water, and food.
- Individuals who work in occupations that mine or use manganese are likely to be exposed to excess levels in their work environment.
- People who improperly use pesticides such as maneb and mancozeb, may be exposed to excess levels.

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How can manganese affect my health?

Some individuals exposed to very high levels of manganese for long periods of time in their work developed mental and emotional disturbances and slow and clumsy body movements. This combination of symptoms is a disease called "manganism." Workers usually do not develop symptoms of manganism unless they have been exposed to manganese for many months or years. Manganism occurs because too much manganese injures a part of the brain that helps control body movements.

Exposure to high levels of airborne manganese, such as in a manganese foundry or battery plant, can affect motor skills such as holding one's hand steady, performing fast hand movements, and maintaining balance. Exposure to high levels of the metal may also cause respiratory problems and sexual dysfunction.

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How likely is manganese to cause cancer?

There are no human cancer data available for manganese. Exposure to high levels of manganese in food resulted in a slightly increased incidence of pancreatic tumors in male rats and thyroid tumors in male and female mice.

The EPA has determined that manganese is not classifiable as to human carcinogenicity.

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How does manganese affect children?

Daily intake of small amounts of manganese is needed for growth and good health in children. Manganese is constantly present in the mother and is available to the developing fetus during pregnancy. Manganese is also transferred from a nursing mother to

her infant in breast milk at levels that are appropriate for proper development.

Children, as well as adults, who lose the ability to remove excess manganese from their bodies develop nervous system problems. Because at certain ages children take in more than adults, there is concern that children may be more susceptible to the toxic effects of excess manganese.

Animal studies indicate that exposure to high levels of manganese can cause birth defects in the unborn. There is no information on whether mothers exposed to excess levels of manganese can transfer the excess to their developing fetus during pregnancy or to their nursing infant in breast milk.

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How can families reduce the risk of exposure to manganese?

In most situations, there is no need to reduce one's exposure to manganese because it is an essential nutrient for good health.

Excess levels of manganese may be present in soils, especially at or near hazardous waste sites. Therefore, it is important to discourage hand-to-mouth activity in young children, especially near hazardous waste sites or in areas that may have increased manganese levels in the soil.

Manganese is also present in pesticides that may be used around the home. These pesticides should be used in a manner consistent with manufacturer's instructions.

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Is there a medical test to show whether I've been exposed to manganese?

Tests are available that show levels of manganese in different body fluids. Measurements of manganese in blood, urine, feces, and scalp hair can be used to determine exposure to excess levels of manganese by testing whether levels of the metal in your body tissues are greater than normal. However, these tests cannot predict how the levels in your tissues will affect your health. Your doctor can take samples and send them to a testing laboratory.

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Has the federal government made recommendations to protect human health?

The EPA has set a non-enforceable guideline for the level of manganese in drinking water at 0.05 milligrams per liter (0.05 mg/L).

The Occupational Safety and Health Administration (OSHA) has set a limit of 5 milligrams manganese per cubic meter (5 mg/m^3)

of workplace air for the average amount of manganese during an 8-hour workday, 40-hour workweek.

The National Research Council has recommended safe and adequate daily intake levels for manganese that range from 0.3 to 1 mg/day for children up to 1 year, 1 to 2 mg/day for children up to age 10, and 2 to 5 mg/day for children 10 and older.

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References

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological Profile for manganese. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

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Where can I get more information?

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.

For more information, contact:

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE, Mailstop F-32
Atlanta, GA 30333
Phone: 1-888-42-ATSDR (1-888-422-8737)
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ToxFAQs™
ToxFAQs™ en Español
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September 2003

ToxFAQs™ for Selenium

(Selenio)

CAS# 7782-49-2

This fact sheet answers the most frequently asked health questions about selenium. For more information, you may call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important 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: People may be exposed to low levels of selenium daily through food and water. Selenium is a trace mineral needed in small amounts for good health, but exposure to much higher levels can result in neurological effects and brittle hair and deformed nails. Occupational inhalation exposure to selenium vapors may cause dizziness, fatigue, irritation of mucous membranes, and respiratory effects. This substance has been found in at least 508 of the 1,636 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is selenium?

Selenium is a naturally occurring mineral element that is distributed widely in nature in most rocks and soils. In its pure form, it exists as metallic gray to black hexagonal crystals, but in nature it is usually combined with sulfide or with silver, copper, lead, and nickel minerals. Most processed selenium is used in the electronics industry, but it is also used: as a nutritional supplement; in the glass industry; as a component of pigments in plastics, paints, enamels, inks, and rubber; in the preparation of pharmaceuticals; as a nutritional feed additive for poultry and livestock; in pesticide formulations; in rubber production; as an ingredient in antidandruff shampoos; and as a constituent of fungicides. Radioactive selenium is used in diagnostic medicine.

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What happens to selenium when it enters the environment?

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- Selenium occurs naturally in the environment and can be released by both natural and manufacturing processes.
- Selenium dust can enter the air from burning coal and oil. This selenium dust will eventually settle over the land and water.
- It also enters water from rocks and soil, and from agricultural and industrial waste. Some selenium compounds will dissolve in water, and some will settle to the bottom as particles.
- Insoluble forms of selenium will remain in soil, but soluble forms are very mobile and may enter surface water from soils.
- Selenium may accumulate up the food chain.

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How might I be exposed to selenium?

- The general population is exposed to very low levels of selenium in air, food, and water. The majority of the daily intake comes from food.
- People working in or living near industries where selenium is produced, processed, or converted into commercial products may be exposed to higher levels of selenium in the air.
- People living in the vicinity of hazardous waste sites or coal burning plants may also be exposed to higher levels of selenium.

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How can selenium affect my health?

Selenium has both beneficial and harmful effects. Low doses of selenium are needed to maintain good health. However, exposure to high levels can cause adverse health effects. Short-term oral exposure to high concentrations of selenium may cause nausea, vomiting, and diarrhea. Chronic oral exposure to high concentrations of selenium compounds can produce a disease called selenosis. The major signs of selenosis are hair loss, nail brittleness, and neurological abnormalities (such as numbness and other odd sensations in the extremities).

Brief exposures to high levels of elemental selenium or selenium dioxide in air can result in respiratory tract irritation, bronchitis, difficulty breathing, and stomach pains. Longer-term exposure to either of these air-borne forms can cause respiratory irritation, bronchial spasms, and coughing. Levels of these forms of selenium that would be necessary to produce such effects are normally not seen outside of the workplace.

Animal studies have shown that very high amounts of selenium can affect sperm production and the female reproductive cycle. We do not know if similar effects would occur in humans.

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How likely is selenium to cause cancer?

Studies of laboratory animals and people show that most selenium compounds probably do not cause cancer. In fact, studies in humans suggest that lower-than-normal selenium levels in the diet might increase the risk of cancer.

The International Agency for Research on Cancer (IARC) has determined that selenium and selenium compounds are not classifiable as to their carcinogenicity to humans.

The EPA has determined that one specific form of selenium, selenium sulfide, is a probable human carcinogen. Selenium sulfide is not present in foods and is a very different chemical from the organic and inorganic selenium compounds found in foods and in the environment.

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How can selenium affect children?

It is likely that the health effects seen in children exposed to selenium will be similar to the effects seen in adults. However, one study found that children may be less susceptible to the health effects of selenium than adults.

Selenium compounds have not been shown to cause birth defects in humans or in other mammals.

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How can families reduce the risk of exposure to selenium?

- Certain dietary supplements and shampoos contain selenium; these should be used according to the manufacturer's directions.
- Children living near waste sites that contain selenium or coal burning plants should be encouraged to wash their hands before eating and to avoid putting their unwashed hands in their mouths.

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Is there a medical test to show whether I've been exposed to selenium?

Low levels of selenium are normally found in body tissues and urine. Blood and urine tests for selenium are most useful for people who have recently been exposed to high levels. Toenail clippings can be used to determine longer term exposure. These tests are not usually available at your doctor's office, but your doctor can send the samples to a laboratory that can perform the tests. None of these tests, however, can predict whether you will experience any health effects.

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Has the federal government made recommendations to

protect human health?
The EPA restricts the amount of selenium allowed in public water supplies to 50 parts total selenium per billion parts of water (50 ppb).

The Occupational Safety and Health Administration (OSHA) sets a limit of 0.2 mg selenium/m^3 of workroom air for an 8-hour work shift..

ATSDR and the EPA have determined that 5 micrograms of selenium per kilogram of body weight taken daily would not be expected to cause any adverse health effects over a lifetime of such intake.

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References
Agency for Toxic Substances and Disease Registry (ATSDR). 2003. Toxicological Profile for selenium. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.
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Where can I get more information?
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U.S. Environmental Protection Agency

Ground Water & Drinking Water

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Consumer Factsheet on: NITRATES/NITRITES

List of Contaminants

As part of the Drinking Water and Health pages, this fact sheet is part of a larger publication:
National Primary Drinking Water Regulations

This is a factsheet about a chemical that may be found in some public or private drinking water supplies. It may cause health problems if found in amounts greater than the health standard set by the United States Environmental Protection Agency (EPA).

What are Nitrates/Nitrites and how are they used?

Nitrates and nitrites are nitrogen-oxygen chemical units which combines with various organic and inorganic compounds. Once taken into the body, nitrates are converted into nitrites. The greatest use of nitrates is as a fertilizer.

Why are Nitrates/Nitrites being regulated?

In 1974, Congress passed the Safe Drinking Water Act. This law requires EPA to determine safe levels of chemicals in drinking water which do or may cause health problems. These non-enforceable levels, based solely on possible health risks and exposure, are called Maximum Contaminant Level Goals.

The MCLG for nitrates has been set at 10 parts per million (ppm), and for nitrites at 1 ppm, because EPA believes this level of protection would not cause any of the potential health problems described below.

Based on this MCLG, EPA has set an enforceable standard called a Maximum Contaminant Level (MCL). MCLs are set as close to the MCLGs as possible, considering the ability of public water systems to detect and remove contaminants using suitable treatment technologies.

The MCL for nitrates has been set at 10 ppm, and for nitrites at 1 ppm, because EPA believes, given present technology and resources, this is the lowest level to which water systems can reasonably be required to remove this contaminant should it occur in drinking water.

These drinking water standards and the regulations for ensuring these standards are met, are called National Primary Drinking Water Regulations. All public water supplies must abide by these regulations.

What are the health effects?

Short-term: Excessive levels of nitrate in drinking water have caused serious illness and sometimes death. The serious illness in infants is due to the conversion of nitrate to nitrite by the body, which can interfere with the oxygen-carrying capacity of the childs blood. This can be an acute condition in which health deteriorates rapidly over a period of days. Symptoms include shortness of breath and blueness of the skin.

Long-term: Nitrates and nitrites have the potential to cause the following effects from a lifetime exposure at levels above the MCL: diuresis, increased starchy deposits and hemorrhaging of the spleen.

How much Nitrates/Nitrites are produced and released to the environment?

Most nitrogenous materials in natural waters tend to be converted to nitrate, so all sources of combined nitrogen, particularly organic nitrogen and ammonia, should be considered as potential nitrate sources. Primary sources of organic nitrates include human sewage and livestock manure, especially from feedlots.

The primary inorganic nitrates which may contaminate drinking water are potassium nitrate and ammonium nitrate both of which are widely used as fertilizers.

According to the Toxics Release Inventory, releases to water and land totaled over 112 million pounds from 1991 through 1993. The largest releases of inorganic nitrates occurred in Georgia and California.

What happens to Nitrates/Nitrites when they are released to the environment?

Since they are very soluble and do not bind to soils, nitrates have a high potential to migrate to ground water. Because they do not evaporate, nitrates/nitrites are likely to remain in water until consumed by plants or other organisms.

How will Nitrates/Nitrites be detected in and removed from my drinking water?

The regulation for nitrates/nitrites became effective in 1992. Between 1993 and 1995, EPA required your water supplier to collect water samples at least once a year and analyze tem to find out if nitrates/nitrites are present above 50 percent of their MCLs. If it is present above this level, the system must continue to monitor this contaminant every 3 months.

If contaminant levels are found to be consistently above their MCLs, your water supplier must take steps to reduce the amount of nitrates/nitrites so that they are consistently below that level. The following treatment methods have been approved by EPA for removing nitrates/nitrites: Ion exchange, Reverse Osmosis, Electrodialysis.

How will I know if Nitrates/Nitrites are in my drinking water?

If the levels of nitrates/nitrites exceed their MCLs, the system must notify the public via newspapers, radio, TV and other means. Additional actions, such as providing

alternative drinking water supplies, may be required to prevent serious risks to public health.

Drinking Water Standards (ppm): MCLG MCL

Nitrate:	**10**	**10**
Nitrite:	**1**	**1**

Nitrate and Nitrite Releases to Water and Land: 1991 to 1993 (in pounds)

	Water	**Land**
TOTALS	**59,014,378**	**53,134,805**

Top Fifteen States*		
GA	12,114,253	12,028,585
CA	0	21,840,999
AL	3,463,097	6,014,674
LA	8,778,237	2,250
MO	6,985,890	206,181
MS	6,952,387	0
KS	5,140,000	877,095
VA	5,091,764 0	
NV	0	4,977,482
FL	1,056,560	1,835,736
AR	1,206,610	1,058,294
MD	1,802,219	138,819
IA	1,500,340	132,042
OK	1,436,348	14,199
UT	0	1,045,400

Major Industries*		
Nitrogenous fertilizer	41,584,611	8,607,376
Misc. Ind. inorganics	4,113,312	29,676,919
Misc. Metal ores	0	5,764,976
Misc. Ind. organics	5,091,764	0
Fertilizer mixing	480,000	4,554,916
Explosives	850,921	1,297,590
Paper mills	1,727,061	0
Pulp mills	1,321,500	3,350
Canned foods	0	1,056,794
Phosphate fertilizers	1,000,000	0

* State/Industry totals only include facilities with releases greater than 10,000 lbs.

Learn more about your drinking water!

EPA strongly encourages people to learn more about their drinking water, and to support local efforts to protect and upgrade the supply of safe drinking water. Your water bill or telephone books government listings are a good starting point.

Your local water supplier can give you a list of the chemicals they test for in your water, as well as how your water is treated.

Your state Department of Health/Environment is also a valuable source of information.

For help in locating these agencies or for information on drinking water in general, call: EPAs Safe Drinking Water Hotline: (800) 426-4791.

For additional information on the uses and releases of chemicals in your state, contact the: Community Right-to-Know Hotline: (800) 424-9346.

Last updated on Wednesday, October 25th, 2006
URL: http:///C%3A/Documents%2520and%2520Settings/david.mayerson/My%2520Documents/HMC/2006%2520sampling/Fact%2520sheet/EPA%2520Ground%2520Water%2520%2526%2520Drinking%2520Water%2520%2520breadcrumb%2520%2520Consumer%2520Factsheet%2520on%2520NITRATES-NITRITES.htm

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Secondary Drinking Water Regulations: Guidance for Nuisance Chemicals

EPA 810/K-92-001
July 1992

What are Secondary Standards?

The U.S. Environmental Protection Agency (EPA) has established National Primary Drinking Water Regulations that set mandatory water quality standards for drinking water contaminants. These are enforceable standards called "maximum contaminant levels" or "MCLs", which are established to protect the public against consumption of drinking water contaminants that present a risk to human health. An MCL is the maximum allowable amount of a contaminant in drinking water which is delivered to the consumer .

In addition, EPA has established National Secondary Drinking Water Regulations that set non-mandatory water quality standards for 15 contaminants. EPA does not enforce these "secondary maximum contaminant levels" or "SMCLs." They are established only as guidelines to assist public water systems in managing their drinking water for aesthetic considerations, such as taste, color and odor. These contaminants are not considered to present a risk to human health at the SMCL.

Why Set Secondary Standards?

Since these contaminants are not health threatening at the SMCL, and public water systems only need test for them on a *voluntary* basis, then why it is necessary to set secondary standards?

EPA believes that if these contaminants are present in your water at levels above these standards, the contaminants may cause the water to appear cloudy or colored, or to taste or smell bad. This may cause a great number of people to stop using water from their public water system even though the water is actually safe to drink.

Secondary standards are set to give public water systems some guidance on removing these chemicals to levels that are below what most people will find to be noticeable.

What problems are caused by THESE contaminants?

There are a wide variety of problems related to secondary contaminants. These problems can be grouped into three categories: *Aesthetic effects* -- undesirable tastes or odors; *Cosmetic effects* -- effects which do not damage the body but are still undesirable; and *Technical effects* -- damage to water equipment or reduced effectiveness of treatment for other contaminants. The secondary MCLs related to each of these effects are given in Table 1.

Aesthetic Effects

Odor and Taste are useful indicators of water quality even though odor-free water is not necessarily safe to drink. Odor is also an indicator of the effectiveness of different kinds of treatment. However, present methods of measuring taste and odor are still fairly subjective and the task of identifying an unacceptable level for each chemical in different waters requires more study. Also, some contaminant odors are noticeable even when present in extremely small amounts. It is usually very expensive and often impossible to identify, much less remove, the odor-producing substance.

- *Standards related to odor and taste:* Chloride, Copper, Foaming Agents, Iron, Manganese pH, Sulfate, Threshold Odor Number (TON), Total Dissolved Solids, Zinc.

Color may be indicative of dissolved organic material, inadequate treatment, high disinfectant demand and the potential for the production of excess amounts of disinfectant by-products. Inorganic contaminants such as metals are also common causes of color. In general, the point of consumer complaint is variable over a range from 5 to 30 color units, though most people find color objectionable over 15 color units. Rapid changes in color levels may provoke more citizen complaints than a relatively high, constant color level.

- *Standards related to color:* Aluminum, Color, Copper, Foaming Agents, Iron, Manganese, Total Dissolved Solids.

Foaming is usually caused by detergents and similar substances when water has been agitated or aerated as in many faucets. An off-taste described as oily, fishy, or perfume-like is commonly associated with foaming. However, these tastes and odors may be due to the breakdown of waste products rather than the detergents themselves.

- *Standards related to foaming:* Foaming Agents.

Cosmetic Effects

Skin discoloration is a cosmetic effect related to silver ingestion. This effect, called argyria, does not impair body function, and has never been found to be caused by drinking water in the United States. A standard has been set, however, because silver is used as an antibacterial agent in many home water treatment devices, and so presents a potential problem which deserves attention.

- *Standard related to this effect:* Silver.

Tooth discoloration and/or pitting is caused by excess fluoride exposures during the formative period prior to eruption of the teeth in children. The secondary standard of 2.0 mg/L is intended as a guideline for an upper boundary level in areas which have high levels of *naturally occurring* fluoride. It is *not* intended as a substitute for the lower concentrations (0.7 to 1.2 mg/L) which have been recommended for systems which *add* fluoride to their water. The level of the SMCL was set based upon a balancing of the beneficial effects of protection from tooth decay and the undesirable effects of excessive exposures leading to discoloration.

- *Standard related to this effect:* Fluoride.

Technical Effects

Corrosivity, and *staining* related to corrosion, not only affect the aesthetic quality of water, but may also have significant economic implications. Other effects of corrosive water, such as the corrosion of iron and copper, may stain household fixtures, and impart objectionable metallic taste and red or blue-green color to the water supply as well. Corrosion of distribution system pipes can reduce water flow.

- *Standards related to corrosion and staining:* Chloride, Copper, Corrosivity, Iron, Manganese, pH, Total Dissolved Solids, Zinc.

Scaling and *sedimentation* are other processes which have economic impacts. Scale is a mineral deposit which builds up on the insides of hot water pipes, boilers, and heat exchangers, restricting or even blocking water flow. Sediments are loose deposits in the distribution system or home plumbing.

- *Standards related to scale and sediments:* Iron, pH, Total Dissolved Solids, Aluminum.

Table I. Secondary Maximum Contaminant Levels

Contaminant	Secondary MCL	Noticeable Effects above the Secondary MCL
Aluminum	0.05 to 0.2 mg/L*	colored water
Chloride	250 mg/L	salty taste

Color	15 color units	visible tint
Copper	1.0 mg/L	metallic taste; blue-green staining
Corrosivity	Non-corrosive	metallic taste; corroded pipes/ fixtures staining
Fluoride	2.0 mg/L	tooth discoloration
Foaming agents	0.5 mg/L	frothy, cloudy; bitter taste; odor
Iron	0.3 mg/L	rusty color; sediment; metallic taste; reddish or orange staining
Manganese	0.05 mg/L	black to brown color; black staining; bitter metallic taste
Odor	3 TON (threshold odor number)	"rotten-egg", musty or chemical smell
pH	6.5 - 8.5	*low pH:* bitter metallic taste; corrosion *high pH:* slippery feel; soda taste; deposits
Silver	0.1 mg/L	skin discoloration; graying of the white part of the eye
Sulfate	250 mg/L	salty taste
Total Dissolved Solids (TDS)	500 mg/L	hardness; deposits; colored water; staining; salty taste
Zinc	5 mg/L	metallic taste
** mg/L is milligrams of substance per liter of water*		

How can these Problems be Corrected?

Although state health agencies and public water systems often decide to monitor and treat their supplies for secondary contaminants, federal regulations do not require them to do this. Where secondary contaminants are a problem, the types of removal technologies discussed below are corrective actions which the water supplier can take. They are usually effective depending upon the overall nature of the water supply.

Corrosion control is perhaps the single most cost-effective method a system can use to treat for iron, copper and zinc due to the significant benefits in (1) reduction of contaminants at the consumer's tap, (2) cost savings due to extending the useful life of water mains and service lines, (3) energy savings from transporting water more easily through smoother, uncorroded pipes, and (4) reduced water losses through leaking or broken mains or other plumbing. This treatment is used to control the acidity, alkalinity or other water qualities which affect pipes and equipment used to transport water. By controlling these factors, the public water system can reduce the leaching of metals such as copper, iron, and zinc from pipes or fixtures, as well as the color and taste associated with these contaminants. It should be noted that corrosion control is not used to remove metals from contaminated source waters.

Conventional treatments will remove a variety of secondary contaminants. *Coagulation/ flocculation* and *filtration* removes metals like iron, manganese and zinc. *Aeration* removes odors, iron and manganese. *Granular activated carbon* will remove most of the contaminants which cause odors, color, and foaming.

Non-conventional treatments like *distillation, reverse osmosis* and *electrodialysis* are effective for removal of chloride, nitrates, total dissolved solids and other inorganic substances. However, these are fairly expensive technologies and may be impractical for smaller systems.

Non-treatment options include blending water from the principal source with uncontaminated water from an alternative source.

What Can You Do?

If you are concerned about the presence of secondary contaminants in your drinking water supply,

here are a few suggestions:

- **FIRST, identify your local public water system**. If you pay a water bill, the name, address, and telephone number of your supplier should be on the bill. If you do not pay a water bill, then contact your landlord, building manager, or the local health department -- they should know.
- **SECOND, contact your local public water system.** Inquire about your supplier's monitoring for secondary contaminants. Ask for the list of secondary contaminants which are being monitored in your water supply. Does the water being delivered to the public meet these SMCLs? If you have not yet received notice from your supplier, ask how you can get a copy of the monitoring results.
- **THIRD, if you receive a public notice from your local public water system** regarding other drinking water standards -- READ IT CAREFULLY -- and follow any instructions closely. If you have questions or concerns, contact the person from the water system who is indicated in the notice. If that person is unavailable, contact either the state drinking water program or your local health department.
- **FOURTH, contact your state drinking water program** if your water supplier is unable to provide the information you need. Ask if your water supplier is consistently in compliance with both primary and secondary drinking water regulations. Request a copy of monitoring results that were submitted to the State by your supplier. Your state drinking water program is usually located in the state capital (or another major city), and is often part of the department of health or environmental regulation. Consult the blue "government pages" of your local phone book for the proper address and phone number, or call the Safe Drinking Water Hotline.
- **FIFTH, support rate increases for your local water supplier,** where necessary, to upgrade your supplier's treatment facilities to meet drinking water standards.
- **FINALLY, if you have a private well** and you think that the well may be near a source of contamination or may have been contaminated -- HAVE YOUR WATER TESTED by a certified laboratory. A list of certified labs is available from your state's laboratory certification officer. A list of the certification officers can be obtained from the Safe Drinking Water Hotline.

For More Information

For more information on secondary contaminants, write or call the EPA. Ask for a list of the primary and secondary contaminants, about monitoring requirements for these, and for a list of the health advisories available for these contaminants.

or call the Safe Drinking Water Hotline
at 1-800-426-4791

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

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September 1999

ToxFAQs™ for Uranium

(Uranio)

CAS# 7440-61-1

This fact sheet answers the most frequently asked health questions about uranium. For more information, you may call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important 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: Uranium is a naturally occurring chemical substance that is mildly radioactive. Everyone is exposed to low amounts of uranium through food, air, and water. Exposure to high levels of uranium can cause kidney disease. It is not known to cause cancer, but can decay into other radioactive materials that may. Uranium above natural levels has been found in at least 54 of the 1,517 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is uranium?

Uranium is a common naturally occurring and radioactive substance. It is a normal part of rocks, soil, air, and water, and it occurs in nature in the form of minerals - but never as a metal. Uranium metal is silver-colored with a gray surface and is nearly as strong as steel. Natural uranium is a mixture of three types or isotopes called U-234 (^{234}U), U-235 (^{235}U), and U-238 (^{238}U). All three are the same chemical, but they have different radioactive properties.

Typical concentrations in soil are a few parts per million (ppm). Some rocks contain high enough mineral concentrations of uranium to be mined. The rocks are taken to a chemical plant where the uranium is taken out and made into uranium chemicals or metal. The remaining sand is called mill tailings. Tailings are rich in the chemicals and radioactive materials that were not removed, such as radium and thorium.

MHMIs
Interaction Profiles
Priority List of Hazardous Substances
Division of Toxicology

One of the radioactive properties of uranium is half-life, or the time it takes for half of the isotope to give off its radiation and change into another substance. The half-lives are very long (around 200,000 years for ^{234}U, 700 million years for ^{235}U, and 5 billion years for ^{238}U. This is why uranium still exists in nature and has not all decayed away.

The isotope ^{235}U is useful as a fuel in power plants and weapons. To make fuel, natural uranium is separated into two portions. The fuel portion has more ^{235}U than normal and is called enriched uranium. The leftover portion with less ^{235}U than normal is called depleted uranium, or DU. Natural, depleted, and enriched uranium are chemically identical. DU is the least radioactive and enriched uranium the most.

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What happens to uranium when it enters the environment?

- Uranium is already naturally present throughout the environment. Human activities, wind, streams, and volcanoes can move the uranium around and change the levels that you are exposed to.
- Uranium is found in soil where it may stay for billions of years.
- It exists as dust in the air and the dust settles onto surface water, soil, and plants.
- Uranium enters water by dissolving soil, eroding soil and rocks, or in releases from processing plants. Larger particles settle into the bottom of lakes, rivers, and ponds and join uranium that is there naturally.
- Some plants may absorb uranium or it may stick to the root surface.

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How might I be exposed to uranium?

- Breathing air or drinking water in a place that has higher than background levels of uranium.
- Eating food grown in areas with higher than background levels of uranium.
- Working in factories that process uranium or with phosphate fertilizers, or living near any type of mine.
- Living near a coal-fired power plant.

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How can uranium affect my health?

All uranium mixtures (natural, depleted, and enriched) have the same chemical effect on your body. Large amounts of uranium can react with the tissues in your body and damage your kidneys. The radiation damage from exposure to high levels of natural or depleted uranium are not known to cause cancer (see next section).

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How likely is uranium to cause cancer?

Humans and animals exposed to high levels of uranium did not have higher cancer rates. The Committee on the Biological Effects of Ionizing Radiation (BEIR IV) reported that eating food or drinking water that has normal amounts of uranium will most likely not cause cancer.

Uranium can decay into other radioactive substances, such as radium, which can cause cancer if you are exposed to enough of them for a long enough period of time. Studies have reported lung and other cancers in uranium miners; however, the miners also smoked and were exposed to other substances that cause cancer, such as radon and silica dust.

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How does uranium affect children?

Like adults, children are exposed to small amounts of uranium in air, food, and drinking water. If children were exposed to very large amounts of uranium, it is possible that they might have kidney damage like that seen in adults. We do not know whether children differ from adults in their susceptibility to the health effects of uranium exposure.

It is not known if exposure to uranium can affect the developing human fetus. In laboratory animals, high doses of uranium in drinking water resulted in birth defects and an increase in fetal deaths. Measurements of uranium have not been made in pregnant women, so we do not know if uranium can cross the placenta and enter the fetus. In an experiment with pregnant animals, only a small amount of the injected uranium reached the fetus.

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How can families reduce the risk of exposure to uranium?

If your doctor finds that you have been exposed to significant amounts of uranium, ask whether your children might also be exposed. Your doctor might need to ask your state health department to investigate.

It is possible that higher-than-normal levels of uranium may be in the soil at a hazardous waste site. If you live near such a hazardous waste site, you should prevent your children from eating dirt and make sure that they wash their hands frequently and before eating. You should also wash fruits and vegetables grown in that soil well, and consider discarding the outside portion of root vegetables.

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Is there a medical test to show whether I've been exposed to uranium?

Uranium is in your normal diet, so there will always be some level

of uranium in all parts of your body. Uranium is normally measured in a sample of urine collected and sent to a laboratory. Blood, feces, and tissue samples are rarely used. Because most uranium leaves the body within a few days, higher than normal amounts in your urine shows whether you have been exposed to larger-than-normal amounts within the last week or so. Some highly sensitive radiation methods can measure uranium levels for a long time after you take in a large amount. Also, some radiation equipment can tell if uranium is on your skin.

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Has the federal government made recommendations to protect human health?

The EPA requires that spills or accidental releases of uranium waste into the environment containing 0.1 curies or more of radioactivity must be reported to the EPA.

The EPA is currently working to develop an appropriate drinking water limit for uranium based on a broad range of human and animal health studies.

The Occupational Safety and Health Administration has set occupational exposure limits for uranium in breathing air over an 8-hour workday, 40-hour workweek. The limits are 0.05 milligrams per cubic meter (0.05 mg/m^3) for soluble uranium dust and 0.25 mg/m^3 for insoluble uranium dust.

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References

Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological Profile for uranium. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

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Where can I get more information?

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.

For more information, contact:

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE, Mailstop F-32
Atlanta, GA 30333
Phone: 1-888-42-ATSDR (1-888-422-8737)
FAX: (770)-488-4178
Email: ATSDRIC@cdc.gov

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U.S. Environmental Protection Agency

Ground Water & Drinking Water

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Drinking Water For Kids!

Sulfate in Drinking Water

Background

Sulfate is a substance that occurs naturally in drinking water. Health concerns regarding sulfate in drinking water have been raised because of reports that diarrhea may be associated with the ingestion of water containing high levels of sulfate. Of particular concern are groups within the general population that may be at greater risk from the laxative effects of sulfate when they experience an abrupt change from drinking water with low sulfate concentrations to drinking water with high sulfate concentrations.

Sulfate in drinking water currently has a secondary maximum contaminant level (SMCL) of 250 milligrams per liter (mg/L), based on aesthetic effects (i.e., taste and odor). This regulation is not a Federally enforceable standard, but is provided as a guideline for States and public water systems. EPA estimates that about 3% of the public drinking water systems in the country may have sulfate levels of 250 mg/L or greater.

The Safe Drinking Water Act (SDWA), as amended in 1996, directs the U.S. Environmental Protection Agency (EPA) and the Centers for Disease Control and Prevention (CDC) to jointly conduct a study to establish a reliable dose-response relationship for the adverse human health effects from exposure to sulfate in drinking water, including the health effects that may be experienced by sensitive subpopulations (infants and travelers). SDWA specifies that the study be based on the best available peer-reviewed science and supporting studies, conducted in consultation with interested States, and completed in February 1999.

EPA/CDC Study

EPA and CDC completed a study, "Health Effects from Exposure to High Levels of Sulfate in Drinking Water Study" ("Sulfate Study") in January, 1999. The overall purpose of this study was to examine the association between consumption of tap water containing high levels of sulfate and reports of osmotic diarrhea in susceptible populations (infants and transients). Specifically, CDC researchers designed field investigations of infants naturally exposed to high levels of sulfate in the drinking water provided by public water systems and an experimental trial of exposure in adults.

As a supplement to the Sulfate Study and literature review, CDC, in coordination with EPA, convened an expert workshop ("Sulfate Workshop"), open to the public, in Atlanta, Georgia on September 28, 1998. The expert scientists reviewed the available literature and the Sulfate Study results, and provided their opinions in response to a series of questions about the health effects from exposure to sulfate in drinking water.

EPA announced the availability of the Sulfate Study report and the Sulfate Workshop summary in the Federal Register.

Next Steps

Sulfate is one of the 50 chemical and 10 microbiological contaminants/contaminant groups included on the Drinking Water Contaminant Candidate List published on March 2, 1998 (63 FR 10273). SDWA, section 1412 (b)(12)(B)(ii), directs EPA to include sulfate among the five or more contaminants for which the Agency will determine by August, 2001, whether or not to regulate.

EPA will be further evaluating the two documents, analyzing all public comments on the documents, reviewing all comments on its previously proposed National Primary Drinking Water Regulation for sulfate (December 20, 1994; 59 FR 65578) and reviewing any other pertinent information that could have a bearing on its decision of whether or not to regulate sulfate as a NPDWR. In so doing, EPA will be evaluating whether or not the statutory tests provided at Section 1412(b)(1)(A) of SDWA for proceeding with such regulation are met:

- "....the contaminant may have an adverse effect on the health of persons;
- the contaminant is known to occur or there is a substantial likelihood that the contaminant will occur in public water systems with a frequency and at levels of public health concern; and
- in the sole judgment of the Administrator, regulation of such contaminant presents a meaningful opportunity for health risk reduction for persons served by public water systems."

In making this determination, EPA will review, in addition to the dose-response data and information described in the Federal Register notice a host of applicable risk management factors, including, but not limited to: occurrence data on concentrations of sulfate in public water systems; information relative to treatment technologies (particularly, technologies applicable to small public water systems); availability and costs of analytical methods for sulfate; and overall costs and benefits attributable to any likely rule.

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U.S. Environmental Protection Agency

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