



# National Primary Drinking Water Regulations

## Barium

### CHEMICAL/ PHYSICAL PROPERTIES

CAS NUMBER: 7440-39-3 (metal)

COLOR/ FORM/ODOR: Barium is a lustrous, machinable metal which exists in nature only in combined form.

SOIL SORPTION COEFFICIENT: K<sub>oc</sub> N/A; high mobility

BIOCONCENTRATION FACTOR: BCFs of 7-100 for marine animals, 1000 for marine plants, 2-20 for some crops.

COMMON ORES: sulfate- Barite; carbonate- Witherite

### SOLUBILITIES (WATER):

carbonate-	22 mg/L at 18 deg C
chloride-	310 g/L at 0 deg C
chromate-	3.4 mg/L at 16 deg C
cyanide	800 g/L at 14 deg C
hydroxide-	sol. in dil. acid
nitrate-	87 g/L at 20 deg C
permanganate-	625 g/L at 11 deg C
peroxide-	sol. in dil. acid
sulfate-	2.2 mg/L at 18 deg C

### DRINKING WATER STANDARDS

MCLG: 2 mg/l

MCL: 2 mg/l

HAL(child): none

### HEALTH EFFECTS SUMMARY

**Acute:** EPA has found barium to potentially cause gastrointestinal disturbances and muscular weakness resulting from acute exposures at levels above the MCL.

No Health Advisories have been established for short-term exposures.

**Chronic:** Barium has the potential to cause hypertension resulting from long-term exposures at levels above the MCL.

**Cancer:** There is no evidence that barium has the potential to cause cancer from lifetime exposures in drinking water.

### USAGE PATTERNS

The largest end use of barium metal is as a "getter" to remove the last traces of gases from vacuum and television picture tubes. It is also used to improve performance of lead alloy grids of acid batteries; as a component of grey and ductile irons; in the manufacture of steel, copper and other metals; as a loader for paper, soap, rubber and linoleum.

Barium peroxide is used as a bleach, in dyes, fireworks and tracer-bullets, in igniter and welding materials, and in manufacture of hydrogen peroxide and oxygen. The permanganate is used as a dry cell depolarizer and in disinfectants.

Barium nitrate is used in fireworks, ceramic glazes, electronics, tracer bullets, detonators, and neon sign lights. Barium cyanide is used in electroplating and metallurgy. Barium chlorate is used in fireworks, explosives, matches, and as a mordant in dyeing.

Barium carbonate is used as follows: 45 percent as ingredient in glass, 25 percent in brick and clay products, 7 percent as a raw material for barium ferrites, 4 percent in photographic paper coatings, 19 percent other.

### TOXIC RELEASE INVENTORY -

#### RELEASES TO WATER AND LAND: 1987 TO 1993

	Water	Land
TOTALS (in pounds)	928,448	57,063,031
<b>Top Ten States *</b>		
AZ	0	14,595,520
UT	1,500	13,423,164
VA	0	9,218,901
NM	0	5,233,790
IL	34,000	3,977,817
TN	0	2,586,906
AL	31,041	1,638,988
PA	15,582	1,216,362
TX	167,864	599,565
NJ	20,905	705,666

#### Major Industries\*

Copper smelting	1,500	31,958,310
Car parts, accessories	1,743	9,456,667
Industrial organics	132,511	4,106,827
Inorganic pigments	5,261	3,672,451
Gray, ductile iron	0	1,556,681
Steelworks, furnaces	256,582	679,999
Electrometallurgy	1,599	633,876
Paper mills	64,770	527,330

\* Water/Land totals only include facilities with releases greater than a certain amount - usually 1000 to 10,000 lbs.

Barium hydroxide is used in lubricating oils and greases and as a component of detergents in motor oils. It is also used in plastics stabilizers, papermaking additives, sealing compounds, vulcanization accelerators, pigment dispersants and self-extinguishing polyurethane foams and to protect limestone objects from deterioration.

Barium chloride is used in pigments, glass, dyeing, leather tanning, chlorine and sodium hydroxide manufacture and in water softening. Barium-based dyes are widely used in inks, paints, cosmetics and drugs.

Over 65% of barite produced was used as a weighting agent in oil and gas well drilling fluids, with a 50 percent decrease in demand for barite in 1986 due primarily to a severe downturn in oil and gas well drilling activity prompted by soft world oil prices. Barium sulfate is also used in photographic papers, pigments and as a filler for rubber & resins.

#### RELEASE PATTERNS

Barium metal does not occur in nature. The most common ores are the sulfate, barite, found in AK, AR, CA, GA, KY, MO, NV, TN, and the carbonate, witherite, found in AR, CA, GA, KY, MO, NV. Barite was produced at 38 mines in the seven states in 1973, with Nevada supplying 50% of the tonnage. Missouri ranked second.

Barium is released to water and soil in the discharge and disposal of drilling wastes, from the smelting of copper, and the manufacture of motor vehicle parts and accessories.

Barium is emitted into the atmosphere mainly by the industrial processes involved in the mining, refining, and production of barium and barium-based chemicals, and as a result of combustion of coal and oil.

From 1987 to 1993, according to the Toxics Release Inventory barium compound releases to land and water totalled over 57 million lbs., of which about 99 percent was to land. These releases were primarily from copper smelting industries which use barium as a deoxidizer. The largest releases occurred in Arizona and Utah. The largest direct releases to water occurred in Texas.

Barium is found in waste streams from a large number of manufacturing plants in quantities that seldom exceed the normal levels found in soil. Background levels for soil range from 100-3000 ppm barium. Occurs naturally in almost all (99.4%) surface waters examined, in concentration of 2 to 340 ug/l, with an average of 43 ug/l. The drainage basins with low mean concentration of barium (15 ug/l) occur in the western Great Lakes, & the highest mean concentration of 90 ug/l is in the southwestern drainage basins of the lower Mississippi Valley. In stream water & most groundwater, only traces of the element are present.

There are limited survey data on the occurrence of

barium in drinking water. Most supplies contain less than 200 ug/l of barium. The average concentration of barium in USA drinking water is 28.6 ug/l (1977 data). The drinking water of many communities in Illinois, Kentucky, Pennsylvania, & New Mexico contains concentrations of barium that may be 10 times higher than the drinking water standard. The source of these supplies is usually well water. Currently 60 ground water supplies and 1 surface water supply exceeds 1000 ug/l.

#### ENVIRONMENTAL FATE

In water, the more toxic soluble barium salts are likely to precipitate out as the less toxic insoluble sulfate or carbonate. Barium is not very mobile in most soil systems. Adsorption of barium was measured in a sandy soil and a sandy loam soil at levels closely corresponding to those to be expected for field conditions. In general, sludge solutions appeared to increase the mobility of elements in a soil. This is due to a combination of complexation by dissolved organic compounds, high background concentration and high ionic strengths of the soil solution.

Marine animals concentrate the element 7-100 times, and marine plants 1000 times from seawater. Soybeans and tomatoes also accumulate soil barium 2-20 times.

#### OTHER REGULATORY INFORMATION

##### MONITORING:

###### - FOR GROUND WATER SOURCES:

INITIAL FREQUENCY- 1 sample once every 3 years

REPEAT FREQUENCY- If no detections for 3 rounds, once every 9 years

###### - FOR SURFACE WATER SOURCES:

INITIAL FREQUENCY- 1 sample annually

REPEAT FREQUENCY- If no detections for 3 rounds, once every 9 years

- TRIGGERS - If detect at > 2 mg/L, sample quarterly.

##### ANALYSIS:

REFERENCE SOURCE	METHOD NUMBERS
EPA 600/4-79-020	208.1; 208.2
NTIS PB 91-231498	200.7
Standard Methods	3111D; 3113B

##### TREATMENT:

###### BEST AVAILABLE TECHNOLOGIES

Ion Exchange, Reverse Osmosis, Lime Softening, Electrodialysis

##### FOR ADDITIONAL INFORMATION:

- ◆ EPA can provide further regulatory and other general information:
- EPA Safe Drinking Water Hotline - 800/426-4791
- ◆ Other sources of toxicological and environmental fate data include:
- Toxic Substance Control Act Information Line - 202/554-1404
- Toxics Release Inventory, National Library of Medicine - 301/496-6531
- Agency for Toxic Substances and Disease Registry - 404/639-6000