**SIDS INITIAL ASSESSMENT PROFILE**

<table>
<thead>
<tr>
<th>CAS No.</th>
<th>513-77-9</th>
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<tbody>
<tr>
<td>Chemical Name</td>
<td>Barium carbonate</td>
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<tr>
<td>Structural Formula</td>
<td><img src="image" alt="Structural Formula" /></td>
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**SUMMARY CONCLUSIONS OF THE SIAR**

**Human Health**

The toxicity of barium compounds depends on their solubility. Barium carbonate is less soluble than barium chloride. Since the toxicity of barium salts is mainly depending on the $\text{Ba}^{2+}$ ion, barium carbonate is less toxic than barium chloride. So in nearly all sections the studies of barium chloride are used as surrogate to estimate the toxicity of barium carbonate. Distribution studies in rats showed barium, as chloride or carbonate, to be rapidly absorbed and distributed. 24 Hours after gastric intubation of barium chloride to rats, tissue concentrations ranked in the order of heart $>$ eye $>$ skeletal muscle $>$ kidney $>$ blood $>$ liver, indicating retention in some tissues. Following intra-muscular injection of barium carbonate to rats, barium carbonate left the injection site very rapidly but resided in the bones with a biological half-life of 460 days.

Barium is not an essential element in human tissues. The metabolism of barium in mammals has been shown to be similar to calcium and strontium (all group II metals). The principal physiological activity of barium is stimulation of all types of muscles, irrespective of their innervations. The average daily human intake of barium is about 1.3 mg (0.65 - 1.7 mg). The human adult body contains 22 mg of barium of which 66 % is present in bones and estimated to have a half-life of 50 days. Excretion of barium is both fecal and urinary. Within 24 hours, 20 % of an ingested dose appears in feces and 5 - 7 % is excreted via the urine. Injection of a soluble barium salt results in increased urinary excretion compared to an ingested dose, but fecal excretion is still greater. Within 21 days, 90 % of the dose is excreted in a 1:9 ratio of urine vs. feces. Barium is found in newborn babies at concentrations higher than in adults; it crosses the lactational and placental barriers.

The acute oral LD$_{50}$ of barium chloride in rats is 419 (males) and 408 (females) mg/kg bw. Ninety percent of deaths occurred within 5 hours of administration, and hemorrhagic areas in the stomach and inflammation of the intestines were observed in the primary necropsy. A second single dose study was conducted at three dose levels of 30, 100 and 300 mg/kg bw. At 300 mg/kg, 8 of 10 males and 7 of 10 females died within 24 hours, and the effects on body, liver and kidney weights after a single dose of 300 mg/kg bw appeared to be related to barium chloride. The same symptoms of the small and large intestines observed in the previous study (to determine the median lethal dose) were also seen at the high dose in both sexes. There were no chemical-related changes at doses of up to 100 mg/kg bw. Studies in dogs with infused barium chloride demonstrated the toxicity of barium ion, which is relevant to barium carbonate. The data showed that barium caused a reduction in plasma potassium, resulting in hypokalaemia and that barium also caused hypertension. There were no reliable animal acute toxicity studies by dermal and inhalation routes available.

The barium carbonate poisoning in humans initially stimulates striated, cardiac and smooth muscles and depresses serum potassium, which is forced intracellularly. Subsequent muscle weakness may result from a direct depolarizing effect and neuromuscular blockade. Symptoms are vomiting, severe abdominal pain, diarrhea, slow irregular pulse, muscle paralysis, dilated pupils, increasing somnolence, and cardiac arrest.

No reliable skin/eye irritation and skin sensitization studies were available.
In repeated dose toxicity studies, barium chloride dihydrate was given to F334/N rats and B6C3F1 mice in drinking water for 13 weeks at concentrations of 0, 125, 500, 1,000, 2,000 and 4,000 ppm. The NOAEL value was estimated to be approximately 2,000 ppm, corresponding to an average daily dose of 110 and 115 mg Ba/kg bw to male and female rats, respectively, and 205 and 200 mg Ba/kg bw to male and female mice, respectively. This was based on mortality, decreased final mean body weights and mean body weight gains, decreased water consumption and renal toxicity. A similar study was conducted in the same species with the same concentrations of barium chloride dihydrate in drinking water for 92 days. The NOAEL of this study was 2,000 ppm (rats: 61 – 81 mg Ba/kg bw/day, mice: 165 – 166 mg Ba/kg bw/day) in the drinking water (based on depressed body weight gains and chemically related lesions in the kidney and lymphoid tissue for both species).

There are no in vitro or in vivo genotoxicity studies and no carcinogenicity studies of barium carbonate available. However, a number of in vitro genotoxicity studies of barium chloride dihydrate were conducted. Barium chloride dihydrate showed negative results in a bacterial reverse mutation test with Salmonella typhimurium strains (TA 97, TA98, TA100, TA1535 and TA1537) with and without S9 at concentrations of up to 10,000 µg/plate. In contrast, barium chloride dihydrate at concentrations of 250 µg/ml and above induced gene mutation at L5178Y mouse lymphoma cells in the presence of S9 mix while mutagenic activity was not observed without S9 mix. In vitro tests for sister chromatid exchange and chromosome aberration in Chinese hamster ovary (CHO) cells showed that barium chloride dihydrate did not induce chromosome changes up to the concentration of 3,000 µg/mL with or without S9 mix. No in vivo genotoxicity data was available. In conclusion, all except one in vitro genotoxicity studies were negative. The mouse lymphoma test gave an equivocal result only in the presence of an S9 activation system.

Concerning the carcinogenic potential, there was no evidence of carcinogenic activity of barium chloride dihydrate in drinking water to either sex of rats or mice that received up to 2,500 ppm for 2 years, corresponding to an average daily dose of 60 and 75 mg Ba/kg bw to male and female rats, respectively, and 160 and 200 mg Ba/kg bw to male and female mice, respectively.

Concerning the effect of Barium on reproduction and fetal development, the NOAEL for barium chloride dihydrate on fertility and developmental toxicity was 4,000 ppm for rats (the average dose was 201.5 mg Ba/kg bw/day for males and 179.5 mg Ba/kg bw/day for females) and 2,000 ppm for mice (the average dose was 206 mg Ba/kg bw/day for males and 199.8 mg Ba/kg bw/day for females). There were no treatment-related effects on pregnancy rates, pup survivals, pup weights, external abnormalities in both species except rats receiving 4,000 ppm exhibited marginal reduction in pup weights. No effect of barium chloride dihydrate could be detected on epididymal sperm counts, sperm motility, sperm morphology, testis or epididymal weight or vaginal cytology in either species up to 4,000 ppm in rats and 2,000 ppm in mice.

Environment

Barium carbonate is an odorless white inorganic solid. It occurs in nature as the mineral witherite. It is soluble in water at 24 mg/L at 25 °C, soluble in acids (except sulfuric acid) and in ethanol. It has a density of 4.3 g/cm³ at 20 °C and negligible vapor pressure.

There is no evidence that barium carbonate undergoes environmental biotransformation other than dissolving to a divalent cation. Photodegradation and biodegradation are not relevant transformation processes. Under natural conditions barium will form compounds in the +2 oxidation state. Environmental fate modelling cannot be performed with the available data. Soil adsorption of barium was studied in a sandy soil and a sandy loam soil. Sludge solutions appeared to increase the mobility of elements in soil. Barium adsorption in algae increased proportionally with decreasing barium concentration in the medium. Bioconcentration of barium in fish was studied. BCF value for Lepomis macrochirus in male carcass was 74.4 (ug/g wet weight of bluegill tissue)/(ug/mL unfiltered water) so barium has a low potential for bioaccumulation.

In an acute toxicity test with barium carbonate on Gambusia affinis, a 96 hour TLm of >10,000 mg/L was determined. For Daphnia magna; a 48 hour EC₅₀ of 32 mg/L was determined with barium. Barium was phytotoxic to the common duckweed, the 96 hour IC₅₀ varying from approximately 100 mg/L to > 400 mg/L barium, the variability dependent upon site-specific water quality and in particular, the sulfate concentration. Chronic toxicity to aquatic organisms was studied. In a static renewal test using rainbow trout embryos and larvae, 4 day LC₁₀ and LC₁ values of 9.5 and 2.8 mg/L were determined for barium (salt not specified). 30 day
LC₅₀ values of *Orconectes limosus* and *Austropotamobius pallipes pallipes* (crayfish) for barium chloride were 59 mg/L and 39 mg/L, respectively. 21 days LC₅₀ value of *Daphnia magna* for barium chloride was 13.5 mg/L.

**Exposure**

Barium is the 16\textsuperscript{th} most abundant non-gaseous element of the Earth’s crust, constituting approximately 0.04 %. The two most prevalent naturally occurring barium ores are barite (barium sulfate) and witherite (barium carbonate).

In 2001, 542,000 tonnes of barium carbonate were produced globally. In Korea the estimated production volume of barium carbonate was 26 626, 10 681, and 16 452 tonnes/year in 2002, 2003, and 2004, respectively.

Barium carbonate has a wide variety of uses; it is used in the production of television glass, crystal glass and special glass, frits and enamels, brick and tile, ceramic, magnets, electrodes, barium salts, paper, rubber, marble substitute and paints. It is also used for removing sulfates mainly in phosphoric acid production and chlorine alkali electrolysis and it is used as a rodenticide, an additive for glaze, an analytical reagent, oxidizing agent and filler.

In the production and processing facilities, workers might be exposed to barium carbonate dust by inhalation during handling, mixing or packaging the raw material. But in Korea and the EU, occupational exposure is controlled with personal protective equipments like goggles and dust filter masks and with ventilation. Korea has periodically collected monitoring data of occupational exposure. Based on the monitoring data from glass manufacturing factories, air concentration levels of total dust for workplace were less than 0.4 mg/m\textsuperscript{3}, which was below the permissible exposure limit of 10 mg/m\textsuperscript{3} in Korea. In addition, the recorded airborne barium ranged from 0.0002 to 0.0004 mg/m\textsuperscript{3}, which is below the American Conference of Governmental Industrial Hygienists Threshold Limit Value (0.5 mg Ba/m\textsuperscript{3}).

The legal emission limits for barium carbonate range from 20 to 660 mg/m\textsuperscript{3} for dust to air depending on the geographic location. There is no limit for waste to water outside a production plant.

The general population is exposed to barium primarily through ingestion of drinking water and consumption of food and beverages. Concentration of barium in seawater is 6µg/L and in fresh water 7 – 15,000 (average 50) µg/L. Ambient barium concentrations ranged from 0.0015 to 0.95 µg mg /m\textsuperscript{3} in a USA survey. Barium concentrations of < 0.005 to 1.5 µg mg /m\textsuperscript{3} have also been detected in the air of 18 cities and 4 suburban areas in the USA. Barium content in milk was found to range between 45 and 136 µg/g and in edible crops ranges from 10 µg/g in wheat to 3 - 4 mg/g in brazil nuts.

**RECOMMENDATION AND RATIONALE FOR THE RECOMMENDATION AND NATURE OF FURTHER WORK RECOMMENDED**

The chemical is currently of low priority for further work. The chemical possesses properties indicating a hazard for human health and the environment. These hazards do not warrant further work as they are related to acute toxicity which may become evident only at high exposure level. They should nevertheless be noted by chemical safety professionals and users.