



W. R. Grace & Co.-Conn. Silicic Acid, Sodium Salt Product Stewardship Summary

I. Overview

W. R. Grace & Co.-Conn. is a global manufacturer of silicic acid, sodium salt (sodium silicate). Grace both distributes sodium silicate as an aqueous solution (water glass) and uses it as an intermediate, raw material or component in a number of products that Grace manufactures.

II. Chemical Identity-Physical and Chemical Properties

Chemical Identity:

CAS Number: 1344-09-8
IUPAC Name: sodium hydroxy(oxo)silanolate
Molecular Formula: Na_xSiO_y
Primary Synonym: Sodium Silicate
Other synonyms: Water glass, soluble glass, silicate of soda, sodium silicate glass; sodium silicate solution; sodium water glass

Purity/Impurities/Additives:

The typical purity of sodium silicate is 85 - 99% based on solids. Other constituents present are oxides of various elements (for example, of aluminium, calcium, iron, magnesium or titanium), sodium chloride (NaCl) and sodium sulfate (Na_2SO_4).

Physical and Chemical Properties:

Sodium silicate is a compound derived from sodium oxide and silica in varying ratios. In solid form sodium silicate is stable at normal temperatures and pressures, is not combustible, volatile, self-igniting or explosive, and has no oxidizing properties. It is odorless, typically colorless, and is transparent or translucent. Solids are available in the form of lumps, granules, chunks, or powders. Some forms of sodium silicate can be dissolved in water by heating under pressure to form a transparent viscous liquid. The viscosity and other physical properties of the solution are functions of its concentration, density, ratio and temperature. Depending on the molar ratio of silica and sodium oxide, the solutions can be slightly to strongly alkaline with a pH value in the range of 8-13.

Solutions are of low volatility, are not combustible, self-igniting or explosive and have no oxidizing properties.

III. Applications

There are numerous uses of sodium silicate because of its versatile functionality and low cost. Sodium silicate is a critical raw material for many chemical processes and is also a key component in the manufacture of many common consumer and commercial products.

Specific industrial applications include use as a raw material for silica gel production, as corrosion inhibitors and anti-scaling agents, dust binding agents, flame retardants, flotation agents, impregnation agents, stabilizers and viscosity adjustors. The chemical activity of soluble silicates also makes it valuable in soil solidification and in catalyst production, as well as in the manufacture of silicate derivatives.

Sodium silicate is also used as an ingredient in a wide range of consumer products including adhesives, binding agents and sealants, construction materials, fabrics, textiles and apparel, glass and ceramic products, lubricants, greases, paintings and coatings, paper products, photographic and reprographic products, soaps and detergents and hair coloring preparations.

IV. Manufacturing Processes

Solid sodium silicate glass is most commonly produced by the direct fusion of precisely measured portions of pure silica sand (SiO_2) and soda ash (Na_2CO_3) in oil, gas or electrically fired furnaces at temperatures above 1000°F. Solutions of soluble sodium silicate ("waterglass") may be produced by dissolving the soluble silicate lumps. As the Si:Na ratio of the solid increases, progressively elevated temperature must be used to complete dissolution. At the highest ratios (e.g., 3.3) elevated temperature and pressure are employed. Solutions may alternatively be prepared by hydrothermally dissolving a reactive silica source (usually silica sand) in sodium hydroxide solution. Rate of dissolution depends on the degree of hydration, the amount of water that is used as solvent and the temperature.

V. Health Effects

Sodium silicate is one of a number of soluble silicates all of which are structurally very similar. Based on available data, the members of the soluble silicates family exhibit a similar toxicological profile primary governed by the molar ratio of sodium to silica. Sodium silicate solutions having a high molar ratio between sodium and silica can have irritant or corrosive properties. If in direct contact with the skin, eyes or respiratory system higher molar ratios can cause effects ranging from skin irritation up to burns and irritation of the eye to permanent damage. Sodium silicate has not been shown to be an

allergen. There are no known chronic health hazards associated with sodium silicate with studies indicating it is not mutagenic and has no recognized reproductive toxicity.

Silicon is the second most abundant element on earth. Silicon in the form of silicates or silicon dioxide comprises nearly 60% of the earth's crust, sediments and soils. Silicon in the form of silica or silicates is continuously released into surface and ground waters and is found in all natural waters with an average concentration of 10 – 20 milligrams per liter. Life on the planet has evolved in an environment in which silicon is ubiquitous. Silicon is an essential trace element in the normal metabolism of mammals. It is required in bone, cartilage and connective tissue as well as participating in a number of other metabolic processes. Toxicokinetic data suggests a very low potential for bioaccumulation of sodium silicate. Ingested sodium silicate is excreted via the urine and to a lesser extent the gastro-intestinal tract.

The US Federal and Drug Administration have classified sodium silicates as Generally Regarded as Safe (GRAS), listing them as indirect food additives, and are safe for use when formulated to avoid skin irritation. OSHA has not established an occupational exposure limit for sodium silicate and the EPA has not established Acute Exposure Guideline Limits (AEGLs) for these compounds.

VI. Environmental Effects

The release of sodium silicate from manufacturing is limited but, largely due to its uses, more material reaches aquatic systems than terrestrial ones. Waste material from plant production is typically disposed at chemical landfills or is recycled. Sodium silicate is not regulated by the Environmental Protection Agency under the Clean Air Act Risk Management Program, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), or as a section 302 or 313 substance under The Emergency Planning and Community Right-to-Know Act (EPCRA).

Acute toxicity testing in fish, invertebrates and algae of sodium silicate indicate a low order of toxicity. In general, toxic or lethal effects against aquatic organisms are related to the alkalinity of the test solutions rather than to any direct influence of sodium silicate. Sodium silicate, an inorganic substance, is not amenable to biodegradation and is not expected to be photodegraded. If discharged as wastewater, the substance has no COD or BOD impact on effluents. The diluted material will decompose to become silica that is no different than natural dissolved silica. Silica does not bioconcentrate up the food chain.

In summary, when released into the environment, commercial soluble sodium silicates become indistinguishable from the naturally dissolved silica of the environment and the earth's crust. They would not be anticipated to have any recognizable environmental impact. At neutral pH values, the soluble silicates tend to precipitate as poorly soluble amorphous silica and monomeric silicic acid indistinguishable from background environmental silicates.

VII. Conclusion

Sodium silicate is a substance with wide application in industry and consumer products. Soluble silicates are generally classified as safe, low risk chemicals and have existing regulatory approval for use in a broad number of applications. Toxicity is a reflection of its potential alkalinity. The substance would not be expected to bioaccumulate within living organisms and does not display secondary toxicity such as carcinogenesis nor reproductive toxicity. When released into the environment, the substance becomes indistinguishable from naturally occurring silicates, which are fundamental components of the earth's crust. Based on its chemical and physical properties and combined with its toxicological and ecotoxicological profile sodium silicate does not pose a risk to the environment or to consumers.

VIII. W. R. Grace Contacts

Please feel free to contact one of the following Grace representatives should you desire additional information or have questions.

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IX. References, Literature and Other Sources of Information

CEES (2003). Soluble Silicates. Chemical, toxicological, ecological and legal aspects of production, transport, handling and application. Centre Europeen d' Etude des Silicates, Brussels, Belgium.

Hazardous Substances Data Bank (HSDB), Toxicology Data Network, United States National Library of Medicine, HSDB Number: 5028.

Human Environmental Risk Assessment (HERA) On Ingredients of European Household Cleaning Products. Soluble Silicates (Draft), pp. 17-38. February 2005.

International Uniform Chemical Information Database (IUCLID). Potassium/Sodium Silicate. January 1995.

Merck Index, 10th Ed. 1983. The Merck Company, Inc., Rahway, NJ. P. 1490
Soluble Silicates - Highly Versatile and Safe, C.H. Baehr, W. Koehl - SÖFW Journal 133, April 2007.

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