PQ® Sodium Silicates

Liquids and Solids

PQ Corporation

Advancing the art of silicate chemistry™

INDUSTRIAL CHEMICALS DIVISION

Soluble Silicates

N®
N®-CLEAR
RU™
O®
D™

Sodium Silicates – Solutions

Available in a variety of weight ratios and viscosities.

SS®
SS®-C
G®
GD®

Sodium Silicates – Solids

Available in a variety of weight ratios and particle size distributions.

METSO BEADS®
METSO PENTABEAD®
BRITESIL®

Sodium Metasilicates and Polysilicates

METSO® products come in both anhydrous and pentahydrate forms. BRITESIL products are hydrous powders.

KASIL®
KASOLV®
AgSil®

Potassium Silicates

Available as solutions or as solids in the form of flake glass or hydrated and anhydrous powders.

Magnesium Sulfate

PQ®
Epsom Salt
MagnaBrite™
MagnaGrow®

Magnesium Sulfate Heptahydrate

Available in crystal and liquid solutions.

Advancing the Art of Silicate Chemistry™

PQ produced the first soluble silicates for commercial applications in 1861. Over the years, PQ earned its reputation as the driving force in silicate chemistry by pioneering many industry innovations – from the first patented silicate furnace to high-value specialty silicate derivatives such as zeolite-based catalysts. Today, PQ is the world's leading manufacturer of silicates and silicate-derived inorganic chemicals, and the world's largest volume producer of soluble silicates, synthetic zeolites, and solid glass beads.

PQ innovation goes beyond the products it produces. We continuously look for new ways to improve your processes and the quality of your products in applications as diverse as specialty concrete, dry-blended detergents, acid-resistant enamelware and glazes, dry paint mixtures, and corrosion inhibitors. In fact, when you build your house, wash your clothes, or drink water…you are probably benefiting from PQ silicate chemistry.

Helping your business prosper is as important to us as our own success. So, we remain steadfast in our commitment to continuous quality improvement, superior products, and expert technical support.

All PQ manufacturing sites are ISO–certified. We employ common Good Manufacturing Practices (cGMP) in all facilities. PQ actively participates in the American Chemistry Council's Responsible Care® initiative to assure the responsible management of chemicals. In fact, many of PQ's family of environmentally friendly products are used to address difficult environmental issues.

On the world stage, PQ's presence extends to more than 60 manufacturing facilities in 20 countries on 5 continents. No other silicate producer has PQ's global reach. Regional customer service centers support you from the lab to the plant. So no matter where you are, PQ is there – prepared to meet your global sodium silicate needs.

Pure Performance

Detergents and Cleaning Compounds
Pulp and Paper Processing
Metal Cleaning
Petroleum Processing
Water Treatment
Building Products
Textile Processing

Supplying the World with Quality Sodium Silicates

PQ offers the industry's most complete line of sodium silicate products, from liquids of varying alkalinity and viscosity to hydrated and anhydrous powders and solid glass lumps.

An extensive knowledge of silicate chemistry, along with global technology sharing, puts PQ in a unique position to help our customers succeed around the world. We'll work with you to find the right product for your application. Whether your application is traditional or innovative, our chemists, engineers and account managers will work with you from bench-scale development to full-scale production including storage, handling, maintenance, and distribution support.

Building Better Detergents

As detergent-builders in spray-dried, agglomerated, or dry-blended formulations, PQ® sodium silicates offer several properties to enhance detergents:

Wetting. Sodium silicates reduce the surface tension of liquids to improve soil removal.

Emulsification. Our silicates disperse oily soil into fine droplets suspended in the wash solution, keeping the particles separate and preventing them from recombining.

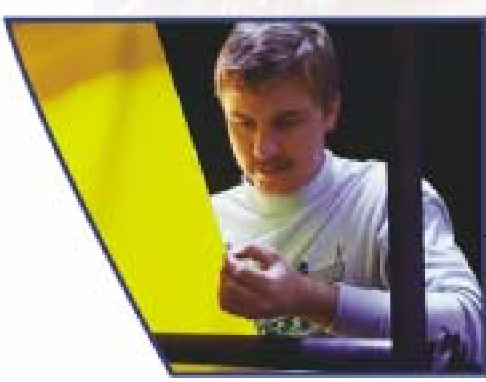
A comprehensive chart of typical applications for PQ® sodium silicates is available on page 10.

Deflocculation. PQ sodium silicates help break up inorganic or particulate soils into fine particles, making them easier to remove from surfaces and easier to suspend in solutions.

Prevention of soil redeposition. Sodium silicates help prevent suspended soils from reattaching to cleaned surfaces.

Alkalinity and buffering. The alkalinity of sodium silicates enables them to neutralize acidic soils, emulsify fats and oils, and disperse or dissolve proteins. Their buffering capacity – stronger than most alkaline salts – maintains the desired pH in the presence of acidic compounds or on dilution.

Value-Added Solutions

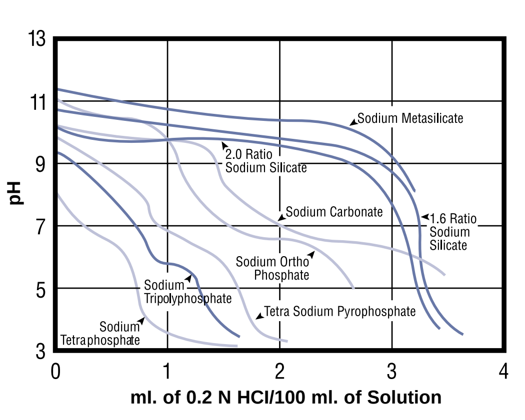


Supplying the World with Quality Sodium Silicates *(continued)*

Figure 1 compares the excellent buffering capacity of sodium silicate to other alkalis commonly used in detergent formulations.

Figure 1

Buffering Capacity of Various Alkali Solutions at 0.02% Na_2O Concentration



Corrosion inhibition. The polysilicate ion acts to form a physical barrier to prevent alkali attack and protect sensitive glazed dishware, glass, and metallic surfaces, including metal buttons, zippers, and washing machine components.

Stabilization. Sodium silicates stabilize chlorine and oxygen bleaches during the cleaning cycle.

Phosphate replacement. Sodium silicates are widely used as a partial phosphate replacement in phosphate-free formulations. They also can be used in conjunction with synthetic zeolites to completely replace phosphates, while maintaining detergency performance.

Processing aid. In the manufacturing of spray-dried detergent powders, silicate solutions are added to the detergent slurry where they help control the viscosity at the proper level for producing a powder of the desired density. They also act as a binder to give the right degree of crispness to the detergent bead without impairing the powder's solubility in water. Proper silicate dosages also minimize the amount of undersized particles or fines produced. Sodium silicates provide similar benefits in agglomerated and dry-blended products.

Pulp Bleaching

Hydrogen peroxide is widely used in the bleaching of ground wood pulps. It is also rapidly gaining acceptance in Kraft wood bleaching, where it helps reduce chlorine demand and environmental impact. PQ sodium silicates are an important component of hydrogen peroxide bleach liquors. They work to deactivate metals such as iron, copper, and manganese, which catalyze the decomposition of hydrogen peroxide. In addition, silicates buffer the bleach liquor at the pH at which the peroxide is most effective.

Deinking Paper for Recycling

PQ sodium silicates are key ingredients in waste-paper deinking formulations. They help lift inks from paper fibers and aid in their suspension and dispersion, preventing the ink particles from redepositing on the fibers. Silicates also contribute alkalinity, allowing the process to run at a lower pH than possible with the use of caustic soda alone. Deinking at a lower pH minimizes alkali darkening, which tends to be a problem with mechanical pulps.

Silicates also stabilize hydrogen peroxide, which may be added to the deinking formulation. Silicates work efficiently in both washing and flotation deinking processes, and with a variety of inks and papers, including newsprint, colored or varnished magazine stock, and rotogravure stocks.

Cleaner Water

Activated silica sol is an economical, effective coagulant for treating industrial and municipal water. Used in conjunction with alum, ferric salts, and other primary coagulants, activated silica increases the speed of floc formation, as well as floc size, density, and stability. Activated silica offers more efficient coagulation at low

Innovative Applications

Supplying the World with Quality Sodium Silicates *(continued)*

temperatures and can also act as a filter aid. Many industries achieve a clear effluent by using activated silica to enmesh finely divided impurities into fast-forming floc. The floc is separated from the water by sedimentation and/or filtration.

Safer Drinking Water

Sodium silicates are one of the solutions recognized by the EPA to reduce lead, copper, and other heavy metals in drinking water. They function as a corrosion inhibitor to form a microscopic film on the inside of water supply pipes, preventing the leaching of lead solders and other metals throughout the system. Unlike other corrosion inhibitors, sodium silicate adds no phosphate or zinc to the water supply.

Also, when compared to phosphate-based corrosion inhibitors, sodium silicates have a beneficial effect on pH. Added in the proper amount, sodium silicate can raise system pH into the alkaline range – another EPA-recommended way to lower lead levels in a municipal water system. Acidic ($pH < 7$) and very soft water tends to dissolve more lead than water with a pH in the 8 to 10 range, which sodium silicate can help to maintain.

Small amounts of silicate can be added to water supplies containing high levels of iron or manganese to eliminate "red water" staining.

The American Water Works Association recognizes the use of sodium silicates for various water treatment applications in ANSI/AWWA Standard B404. Sodium silicates with NSF certification are also available from PQ.

PQ® sodium silicates are critical components in the manufacture of many everyday products – from detergents and textiles to paper stock and roofing shingles.

Better Textiles

PQ sodium silicates are used in many textile mill applications:

Bleaching. They deactivate metals that catalyze the decomposition of hydrogen peroxide. They also buffer pH at the optimum level for peroxide bleaching.

Yarn and fabric pre-treatment. Silicates are used to remove wax, oil, and motes from cotton. Choice of the proper silicate ratio and solids promotes better cleaning and prevents redeposition of soil.

Pad-batch dyeing processes. These processes are preferred over other dyeing processes because they use less water, exhibit better dye bonding, can be operated at lower temperatures, and have batch-to-batch uniformity. PQ sodium silicates buffer the pH of the dye liquor and can remove oils and dirt that interfere with dye bonding.

Agricultural Applications

Soluble silica is an important nutrient for plant health and vitality. PQ soluble silicates, when used in very low dosages, can help plants resist disease and increase yield. While potassium silicates are more commonly used in this application, sodium silicates are an effective, low-cost replacement.

Supplying the World with Quality Sodium Silicates (continued)

Adhesives with Staying Power

For such materials as paper, wood, metal, foil, and other non-plastic materials, PQ® sodium silicate adhesives offer several advantages:

- Good spreading and penetration.
- Good bond formation.
- Set-rates controllable over wide limits.
- Strong, rigid bond that resists heat and moderately resists water.

Silicates with weight ratios of 2.8 to 3.2 are very useful as adhesives or binders due to their higher content of polymeric silica. These materials are converted from a liquid to a solid by the removal of very small amounts of water. Silicates are a low-cost alternative to latex (e.g., PVA) adhesives and dextrin in many applications. While PQ sodium silicates for adhesives are shipped ready for use, they can be modified with clay, casein, and organic additives for special applications.

Strong Bonding Cement

PQ sodium silicates are important in air-setting refractory specialties and chemical-resistant mortars. Cements made with soluble silicate binders offer resistance to high temperatures, acids, slumping, and redissolving after set. PQ sodium silicates are also used to modify the physical properties of hydraulic materials such as portland cement. Adding silicate to cement can reduce permeability by increasing the total number of bonds formed between aggregate particles. Silicates can also be used to modify the set time in cold weather or adverse conditions.

More Durable Concrete

After a concrete mix has hardened, PQ sodium silicate can be surface-applied to penetrate the concrete and increase resistance to wear, water, oil, and acid. Lime and other ingredients react slowly with silicate solution to form an insoluble gel within the concrete pores.

Economical & Environmentally Safe Foundry Binders

PQ sodium silicates are well known as environmentally sound foundry sand binders. The use of sodium silicate inorganic binder systems promotes cleaner foundry environments because these binder systems are non-toxic, produce essentially no fumes, are odor-free, and are easy to use.

Sodium silicate binders are set by reaction with CO_2 gas or reaction with other acid-producing compounds such as aliphatic organic esters. The only source of fumes in these processes are the ester catalysts, which are used in very small amounts, and additives, which are used to improve shakeout and humidity resistance. Reclamation of silicate-bound sands is widely practiced. Spent sands from sodium silicate castings are low in residual organics, which permits easier, less expensive disposal.

Enhanced Ore Beneficiation

PQ sodium silicates are used in numerous mining and mineral processing systems to improve valuable mineral recovery, while reducing unwanted contaminants. Their chief use in ore flotation is as a deflocculant for dispersing undesired clay. Sodium silicates also inhibit the corrosive wear of grinding media. PQ sodium silicates help improve process throughput and reduce overall operating costs.

Agglomerating, Pelletizing, and Briquetting

PQ sodium silicate finds use in these applications because of its natural adhesive properties and its ability to provide a quick set and cost savings.

Agglomeration. Mined, processed, and recovered materials are agglomerated into fine granules to eliminate dust and improve heat processing in drying, calcining, and firing operations. Eliminating dust reduces air and stream pollution and kiln

Supplying the World with Quality Sodium Silicates *(continued)*

ring buildup. Agglomerating dusty materials also improves their conveying and storage characteristics.

Pelletizing. This is the name of a process where fine material is formed into damp balls termed "green pellets." Silicate blended with the material aids balling and increases the strength of the pellets in both the dry and fired state.

Briquetting, tabletting, and extruding. These processes use sodium silicate as a lubricant or binder to improve the flow or cohesive characteristics of the materials.

Thinner Slurries for Clay Processing

PQ sodium silicates are used as a deflocculant in the processing of raw clay and other mineral slurries. Silicates reduce slurry viscosities, making them easier to pump and process. This helps in the removal of impurities and provides savings in energy costs. Silicate also acts as a buffer for any alkali present, which may further reduce processing costs.

PQ sodium silicate is also used in clay slip casting. Lower viscosities improve casting times. Because less water is needed, firing times are reduced and the final product is stronger and exhibits less shrinkage.

A Solid Foundation for Chemical Grouting

Chemical grouting, or soil stabilization, combines PQ sodium silicate with one or more chemicals that will react with the silicate to form a grout-gel bond. In the Joosten process, for example, sodium silicate and calcium chloride are separately injected into the ground to react and form an instant grout. Other reactants are primarily organic in nature. Chemical grouting can be used in several situations:

- To strengthen soil formations that are not strong enough to carry the required load, such as underwalls and footings of structures.
- To make impermeable the porous soils that otherwise would allow the flooding of mines, shafts, and tunnels.
- To prevent water loss from cracks in dams and other containment structures.
- To seal porous concrete or brickwork in sewers, subway construction, and dams.
- To encapsulate soils contaminated with hazardous materials and prevent toxic components from migrating into groundwater.

Typical Applications of PQ® Sodium Silicates

Table 1

Industry & Typical Applications	Silicate Function	Principal Benefit
Detergent/Cleaning Compounds		
Household Laundry Powders	Binder, corrosion inhibitor, deflocculant	Processing aid for spray-dried and agglomerated products. Corrosion protection. Detergency.
Liquid Detergents and Cleaners	Deflocculant, buffer	Detergency. Corrosion protection. Corrosion inhibition.
Pulp and Paper		
Peroxide Bleaching of Pulp	Chemical reaction	Conserves peroxide. Produces whiter pulp.
Deinking	Detergency	Ink removal.
Raw Water Treatment	Flocculation	Clearer effluent.
Head Box Additive	Flocculation	Retains fines and fillers on the wire.
Coating	Film formation	Grease-proofs. Moisture resistant.
Adhesives for Laminating/Labeling	Adhesion	Economical. Strong bonds.
White Water Treatment	Flocculation	Increases size of floc. Improves clarification.
Paper Board		
Spiral-Wound Tubes	Adhesion	Adds rigidity. Economical.
Fiber Drums	Adhesion	Adds rigidity. Economical.
Water Treatment		
Lead and Copper Control	Chemical reaction	Reduces levels of toxic metals.
Raw and Wastewater Treatment	Flocculant	Increases size and speeds formation of floc.
Water Line Corrosion Prevention	Film formation	Protective film inhibits corrosive attack on metal.
Iron and Manganese Stabilization	Chemical reaction	Improves taste. Eliminates "red water."
Building Products/Construction		
Hardening Concrete	Chemical reaction, sealant	Hardens. Acid resistant.
Acid-Proof Cements	Binder	Ease of use. Economical.
Refractory Cements	Binder	Strong bond. Excellent refractory & acid resistance.
Thermal Insulation	Adhesion, film formation	Fireproof bond.
Soil Solidification/Grouting	Gel reaction	Economical binder.
Textiles		
Peroxide Bleaching	Chemical reaction	Conserves peroxide. Whiter whites.
Pad-Batch Dyeing	Buffering	Dye fixation. Lower processing costs.
Ceramics		
Refractory Cements	Binder	Air set, green strength.
Slip Casting	Deflocculant	High solids.
Slurry Thinners	Deflocculant	Reduces water.
Clay Refining	Deflocculant	Improves fluidity.
Petroleum Processing		
Drilling Muds	Chemical reaction	Controls heaving shale.
Corrosion Prevention	Chemical reaction	Efficient. Economical.
Emulsion Breaking	Chemical reaction	Breaks emulsion.
Metals		
Porous Castings	Impregnation	Seals leaks. Fills voids.
Coating Welding Rods	Binder	Good bond and fluxing action.
Ore Beneficiation	Deflocculant	Separation aid. Corrosion control.
Foundry Molds and Core Binders	Binder	High strength. Eliminates fumes.
Smelting Dusts	Agglomeration	Eliminates dust. Improves environmental conditions.
Pelletizing	Binder	Aids balling. Increases strength of formed pellets.
Briquetting	Binder	Improves flow characteristics & cohesive properties.

PQ® Liquid and Solid Sodium Silicates Physical Properties

PQ manufactures sodium silicates with a wide range of characteristics to meet various application needs. This section briefly discusses the major characteristics of PQ sodium silicates.

Ratio

Sodium silicate glass composition can be designated as: $Na_2O \cdot (SiO_2)_x$ – where x is the ratio of the components and falls in the practical range from 0.4 to 4.0.

Since a molecule of Na_2O weighs nearly the same as a molecule of SiO_2, molecular and weight ratios are very nearly equal. Consequently, silica-to-alkali weight ratios are customarily used in the U.S. for sodium silicates more siliceous than the metasilicates (which have a 1:1 mole ratio). It is important to identify the sodium silicate required by specifying both the weight ratio of silica to alkali and the concentration.

PQ offers liquid sodium silicates ranging in weight ratio from 3.25 to 1.60 and in densities from 35°Bé to 59°Bé at 20°C (Table 2). PQ silicates in solid anhydrous form have ratios from 2.00 to 3.22 (Table 3).

Table 2

PQ Sodium Silicate Solutions

Product Name	Wt. Ratio SiO_2/Na_2O	Density at 68°F (20°C)						Viscosity centipoise	Characteristics
		$\%Na_2O$	$\%SiO_2$	°Bé	lb/gal	g/cm^3	pH		
STIXSO™ RR	3.25	9.22	30.0	42.7	11.8	1.42	11.3	830	Syrupy liquid
N® and N®-Clear	3.22	8.90	28.7	41.0	11.6	1.39	11.3	180	Syrupy liquid
E®	3.22	8.60	27.7	40.0	11.5	1.38	11.3	100	Specially clarified
O®	3.22	9.15	29.5	42.2	11.8	1.41	11.3	400	More concentrated than N®
K®	2.88	11.00	31.7	47.0	12.3	1.48	11.5	960	Sticky, heavy silicate
M®	2.58	12.45	32.1	49.3	12.6	1.52	11.8	780	Syrupy liquid
STAR™	2.50	10.60	26.5	42.0	11.7	1.41	11.9	60	Brilliantly clear, stable solution
RU™	2.40	13.85	33.2	52.0	13.0	1.56	12.0	2,100	Heavy syrup
D™	2.00	14.70	29.4	50.5	12.8	1.53	12.7	400	Syrupy, alkaline liquid
B-W™ 50	1.60	16.35	26.2	50.3	12.8	1.53	13.4	280	High alkalinity, syrupy liquid

Table 3

Solid Form PQ Sodium Silicates

Product Name	Wt. Ratio SiO_2/Na_2O	Approximate Density					Particle Size Characteristics (Tyler Screen)
		$\%Na_2O$	$\%SiO_2$	$\%H_2O$	lb/gal	g/cm^3	
SS® & SS® 22	3.22	23.50	75.7	0	88	1.40	Coarse lumps
SS®-C	2.00	33.00	66.0	0	88	1.41	Coarse lumps

PQ® Liquid and Solid Sodium Silicates Physical Properties (continued)

Density

The silicate industry expresses density in degrees Baumé (˚Bé), which can be converted to specific gravity as follows:

$$\textbf{Specific Gravity} = \frac{145}{145 - \text{degrees Baumé}}$$

Table 4 shows the relationship between specific gravity and degrees Baumé. We measure density with specially designed narrow-range hydrometers at a standard temperature of 20°C. Silicate density decreases as temperature increases, as shown in Table 5. Density increases linearly with solids content, as shown in Figure 2 for selected PQ sodium silicates.

Table 4

Density (˚Bé) and Specific Gravity Equivalents

Degrees Baumé	Specific Gravity	Degrees Baumé	Specific Gravity
35.0	1.3182	48.0	1.4948
36.0	1.3303	49.0	1.5104
37.0	1.3426	50.0	1.5268
38.0	1.3551	51.0	1.5426
39.0	1.3679	52.0	1.5591
40.0	1.3810	53.0	1.5761
41.0	1.3942	54.0	1.5934
42.0	1.4078	55.0	1.6111
43.0	1.4216	56.0	1.6292
44.0	1.4356	57.0	1.6477
45.0	1.4500	58.0	1.6667
46.0	1.4646	59.0	1.6860
47.0	1.4796	60.0	1.7059

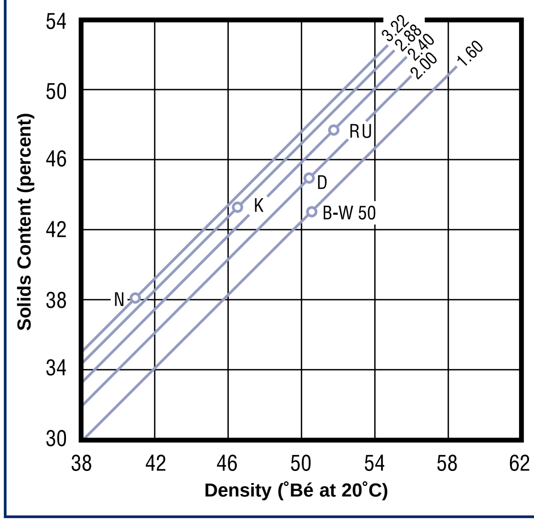
Table 5

Densities of Selected PQ Silicates at Various Temperatures

Temperature (˚C)	N® Density (˚Bé)	O® Density (˚Bé)	STAR® Density (˚Bé)	RU® Density (˚Bé)
10	41.5	42.6	42.4	52.3
21	41.0	42.2	42.0	52.0
32	40.6	41.7	41.5	51.7
38	40.3	41.4	41.3	51.3
49	39.9	41.0	40.8	51.0
60	39.4	40.5	40.4	50.6

Figure 2

Densities of Sodium Silicate Solutions as a Function of Solids Content



Viscosity

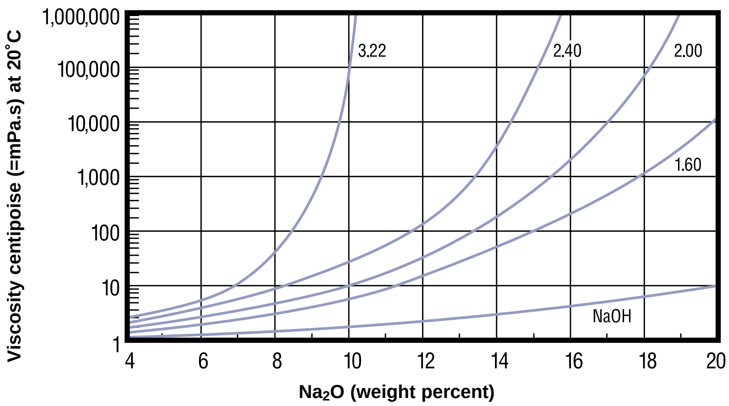
You must consider the viscosity of sodium silicate as a function of concentration, density, ratio, and temperature. Figures 3 through 6 present the relationship of viscosity to other characteristics of sodium silicates.

Concentration. The viscosities of the more siliceous (higher ratio) silicates rise more rapidly with increasing concentration than do the viscosities of the more alkaline products (Figure 3).

PQ® Liquid and Solid Sodium Silicates Physical Properties (continued)

Figure 3

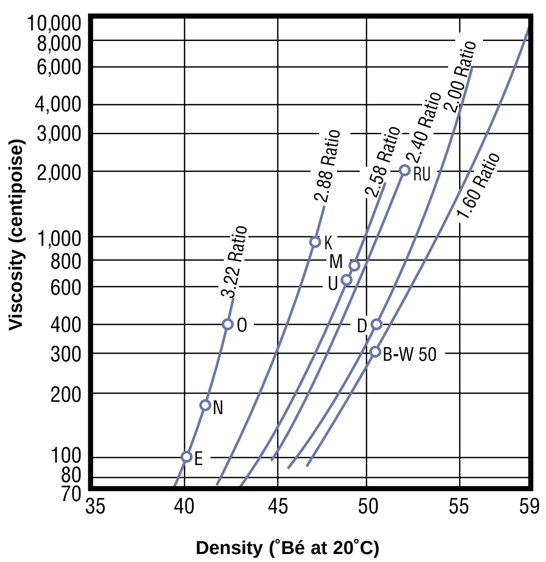
Viscosity of Sodium Silicate Solutions at Various Ratios & Percent Na_2O



Density. Sodium silicate solutions exhibit increased viscosity when water is removed (Figure 4).

Figure 4

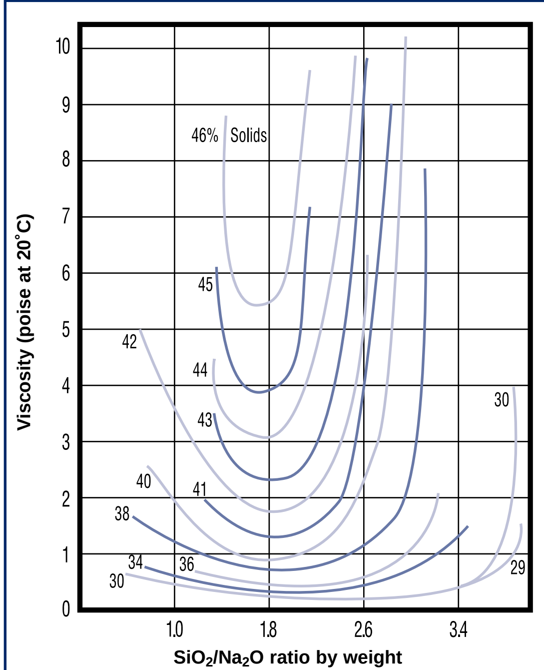
Viscosities of Sodium Silicate as a Function of Density



Weight ratio. The Figure 5 graph compares viscosity at a constant solids content but varying ratios. Silicate solutions have minimum viscosity at a 2.0 weight ratio. Viscosity increases as the weight ratio becomes either more siliceous or more alkaline.

Figure 5

Viscosities of Sodium Silicate Solutions as a Function of Ratio at Constant Solids

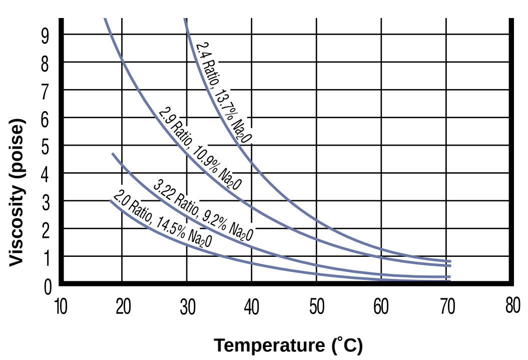


PQ® Liquid and Solid Sodium Silicates Physical Properties *(continued)*

Temperature. The viscosity of sodium silicates (at commercial concentrations) can be reduced to less than 1 poise if they are heated sufficiently and if evaporation is prevented (Figure 6).

Figure 6

Viscosities of Sodium Silicate Solutions as a Function of Temperature

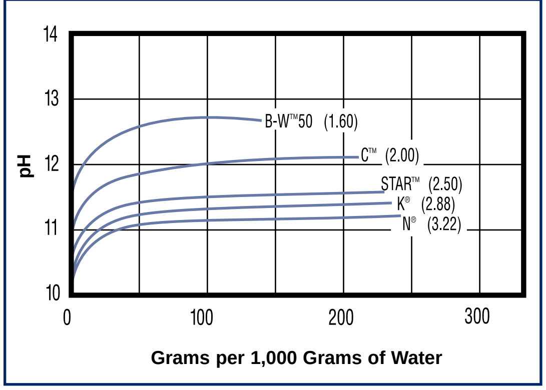


pH

The pH of silicate solutions is closely related to concentration and ratio. The pH decreases as the ratio increases (Figure 7). The high pH of silicate solutions is maintained until the alkali is almost completely neutralized. While this buffering action – the ability to resist changes in pH – increases with increasing proportions of soluble silicate, even dilute silicate solutions will maintain a relatively constant pH despite the addition of acid.

Figure 7

pH Values of PQ Sodium Silicate Solutions of Various Ratios



Analyzing Silicate Solutions

Density is measured with a hydrometer. Because silicate solutions expand when heated, all measurements should be made at 20°C. Place the hydrometer jar in a water bath and fill it to about 1.5 inches from the top. Fit the hydrometer with a one-hole stopper and carefully lower it into the silicate solution – do not drop it into the liquid. When the hydrometer comes to equilibrium, take the reading to the nearest 0.1°Bé.

The Na_2O content is determined by titrating a sample with standard hydrochloric acid and using either a methyl purple or methyl orange indicator. The SiO_2 content is determined by gravimetric methods. A sample is dissolved in water, acidified with hydrochloric acid, and dehydrated on a steam bath until dry. The precipitate is then isolated, ignited, and weighed as SiO_2. PQ will, on request, provide procedures for the numerous quality-assurance analyses we perform in manufacturing sodium silicates.

Chemical Reactivity of Sodium Silicates

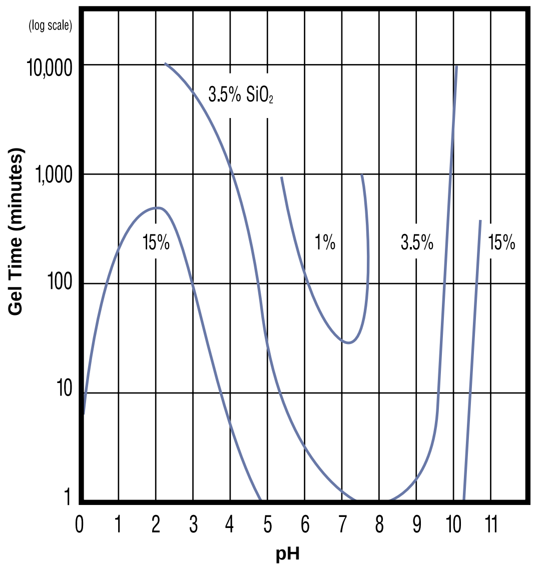
Sol and Gel Formation

Sodium silicates react with acidic compounds. When solutions of relatively high concentration are acidified, the silicate anions polymerize to form a "gel." Activated "sols" can be formed when relatively dilute concentrations of dissolved silica are acidified.

The degree of polymerization of silicate anions depends on solution concentration, temperature, pH, and other factors. Gelation occurs most rapidly at pH ranging from 5 to 8 (Figure 8). Time-delayed gelation – unstable sols – can occur in pH ranges of 8 to 10 and 2 to 5. Colloidal silica sols can be prepared from sodium silicates through ion exchange, dialysis, and other means.

Figure 8

Gel Times of 3.22 Ratio Sodium Silicate – H_2SO_4 Mixtures at 25˚C



Activated silica is used in clarification of municipal and industrial wastewater, while colloidal silica sol is used for high-temperature binders in precision investment casting, synthetic polymer reinforcing, fabric finishing, and skid-proof coatings. Silica gel is prepared most simply by neutralizing a silicate solution with a mineral acid. The wet gel is crushed, washed free of salt, and dried to prepare desiccants, adsorbents, carriers, and catalyst supports. Neutralization of silicate with acidic solutions or gases forms gel bonds with low solubility, but they are somewhat brittle and temporary in nature.

Precipitation Reactions

Sodium silicate solutions react with dissolved polyvalent cations to form precipitates. Depending on conditions – pH, concentration, temperature, and so forth – the result is either insoluble metal silicates or hydrated silica with adsorbed metal oxides or hydroxides. This type of reaction can be used to form pigments or compounds that can be used as extenders or fillers, ion exchange media, catalysts, adsorbents, and other products.

Calcium chloride reacts instantly with silicate solutions to provide an effective mechanism for insolubilizing a silicate bond or coating.

Sodium aluminosilicates, formed by reactions with aluminum compounds, serve as ion exchange media for water softening and as synthetic zeolite molecular sieves.

The extent and rate of reaction of silicates with various metallic salts depends on the nature of the salt and its physical and molecular structure. Such calcium carbonates as calcite, for example, exhibit limited interaction with soluble silicate, while precipitated calcium carbonate shows high reactivity.

Interaction with Organic Compounds

Relatively few organic compounds are compatible with soluble silicate solutions. Simple polar solvents can cause phase separation or dehydration. In mixtures with water-immiscible oleophilic substances, the silicate separates into the aqueous phase; although, for liquid detergent formulations, this can be overcome by adding a suitable hydrotrope or emulsion stabilizer. A few miscible compounds, such as glycerine, sugar sorbitol, and ethylene glycol, are sometimes used as humectants or to help plasticize a silicate film. Organic ester setting agents are used to produce time-delayed gelation of silicate solutions. The hydrolysis of the esters consumes the alkalinity of the silicate solution over an extended period of time.

Storage and Handling of PQ® Sodium Silicates

Although sodium silicates are inherently safe and environmentally friendly, their alkalinity can irritate the skin and eyes. When handling PQ sodium silicates, make sure you're familiar with proper safety precautions and first-aid procedures. Read and become familiar with the Material Safety Data Sheets (MSDS) supplied by PQ. In addition, you can obtain a technical bulletin (Bulletin number 17-70) from PQ with detailed information on the storage and handling of liquid and solid sodium silicates. For your copy of Bulletin 17-70, contact PQ Technical Service at 610-651-4507 or visit us on the Web at pqcorp.com.

Safety

Sodium silicates constitute a family of moderately to strongly alkaline products. As such, they warrant careful handling to prevent injury or discomfort. PQ's commercial and sample packages carry appropriate precautionary labels developed in accordance with guidelines established by the Labels and Precautionary Information (LAPI) Committee of the American Chemistry Council, and adopted by the American National Standards Institute (ANSI Z 129.1-1994).

All the labels and MSDS instruct the user regarding potential hazards, appropriate precautions, and remedial treatment to prevent and counteract accidental contact with skin and/or eyes, or ingestion, etc. MSDS for all PQ sodium silicates are available upon request.

Soluble silicates are completely inorganic, and as such do not present hazards such as low flash point or flammability. They do not suffer degradation from molds, and they are unpalatable to insects.

The PQ Commitment

Doing all that it takes to support your global sodium silicate needs.

PQ specializes in developing better ways to use your products in your applications, and in developing new ways to make our products work for you. With unparalleled expertise in silicate chemistry and extensive experience in the industries PQ serves, our Technical Service department is a valuable resource to address all of your product, process, and application questions.

PQ operates manufacturing plants in major industrial regions in the United States, so we can deliver products to you quickly and efficiently. PQ Customer Service Representatives are available at plant and corporate locations, to provide you with responsive support.

PQ also provides emergency information 24 hours a day through our Emergency Response Answering Service. In the event of an emergency involving a PQ sodium silicate product or any other PQ product, please call **610-651-4200.**

When you need technical assistance, information, or product samples of a PQ sodium silicate, talk to PQ Corporation – the world's source for silicate and silicate-derived products.

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PQ Corporation, recently acquired by JPMorgan Partners, is a leading producer of silicate, zeolite, and other performance materials serving the detergent, pulp and paper, chemical, petroleum, catalyst, water treatment, construction, and beverage markets. It is a global enterprise, operating in 19 countries on five continents, and along with its chemical businesses, includes Potters Industries, a wholly owned subsidiary, which is a leading producer of engineered glass materials serving the highway safety, polymer additive, metal finishing, and conductive particle markets.

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