

INDUSTRIAL
CHEMICALS
DIVISION

 The PQ Corporation

THE PQ CORPORATION

CORPORATE HEADQUARTERS

PO Box 840
Valley Forge, PA 19482-0840
Phone: 800-944-7411

IN CANADA

National Silicates
Phone: 416-255-7771

IN MEXICO

Silicates y Derivados, S.A.
Phone: 011-52-55-5227-6801

IN EUROPE

PQ Europe
Phone: 31-33-450-9030

IN AUSTRALIA

PQ Australia Pty. Ltd.
Phone: 61-3-9708-9200

IN TAIWAN

PQ Silicates Ltd.
Phone: 886-2-2383-0515

Bulletin 17-104

Sodium Silicates: Hydrated and Anhydrous Powders

INTRODUCTION

Soluble silicates are water soluble glasses generally manufactured from varied proportions of an alkali metal and SiO_2 . PQ produces a wide variety of soluble silicate products to meet the needs of different users. Included among these products are sodium silicates which range from readily and highly soluble crystalline forms to lumps and powders which are sparingly soluble; from slightly sticky fluids to heavy viscous solutions which barely flow.

For those preferring sodium silicates in the form of amorphous powders, a variety of products is included in the PQ line. They include both hydrated and anhydrous forms with SiO_2 : Na_2O ratios from 2.00 to 3.22.

Sodium silicate powders are desirable for a variety of reasons: as an ingredient in dry blended detergents and specialty cements; to control interaction with other chemicals where liquid compatibility may be a problem or where reactivity must be delayed; for convenience in storage or handling to avoid freezing; or to increase the concentration of silicate solutions beyond commercially available ranges. The chemical and physical characteristics of the most common soluble silicate powders produced by PQ are described in this bulletin. If you would like further details on their properties or applications, or variations of these products to meet special requirements, please contact us.

CHARACTERISTICS

The various powdered sodium silicates are distinguished by one or more of the following characteristics:

- chemical composition, SiO_2 : Na_2O ratio;
- water content, anhydrous or hydrous;
- particle size distribution, fine powder or granular.

Anhydrous (water-free) sodium silicate glass is available as powders of various particle size at the same SiO_2 / Na_2O ratios as the two more popular commercial liquid silicates. Hydrated products at the same ratio are offered for their more rapid rate of solution. The various powdered silicates and their compositions are listed above in Table 1.

**INDUSTRIAL
CHEMICALS
DIVISION**



THE PQ CORPORATION

CORPORATE HEADQUARTERS

PO Box 840
Valley Forge, PA 19482-0840
Phone: 800-944-7411

IN CANADA

National Silicates
Phone: 416-255-7771

IN MEXICO

Silicates y Derivados, S.A.
Phone: 011-52-55-5227-6801

IN EUROPE

PQ Europe
Phone: 31-33-450-9030

IN AUSTRALIA

PQ Australia Pty. Ltd.
Phone: 61-3-9708-9200

IN TAIWAN

PQ Silicates Ltd.
Phone: 886-2-2383-0515

TABLE 1—TYPICAL PROPERTIES OF PQ SODIUM SILICATES IN POWDER FORM

PRODUCT NAME	WT. RATIO SiO ₂ /Na ₂ O	%Na ₂ O	%SiO ₂	%H ₂ O	APPROXIMATE DENSITY lb/ft ³ (kg/m ³)		PARTICLE SIZE DISTRIBUTION (TYLER SCREEN)
					Untamped	Tamped	
SS [®] 20 Pwd.	3.22	23.30	75.0	0	65(1041)	102(1633)	Thru 20 mesh
SS 65 [®] Pwd.	3.22	23.10	74.4	0	54(865)	88(1409)	Thru 65 mesh
G [®]	3.22	19.20	61.8	18.5	44(705)	66(1057)	90% Thru 100 mesh
SS-C [®] Pwd.	2.00	32.70	65.4	0	45(721)	73(1169)	Thru 65 mesh
SS-C 200 [®] Pwd.	2.00	32.70	65.4	0	46(737)	74(1185)	Thru 200 mesh
GD [®]	2.00	27.00	54.0	18.0	46(737)	61(977)	90% Thru 100 mesh

® Registered trademarks of The PQ Corporation

HYDRATED POWDERS

G[®] Sodium Silicate

A fine, white powder, G[®] has the same ratio (3.22) as PQ's commercial N[®], O[®] and E[®] liquid silicates. When dissolved, it forms a hazy, colorless colloidal solution.

G[®] sodium silicate is used for several specialized refractory compounds and acid-resistant cements. G[®] silicate functions as a binder for powdered materials which are intended to be mixed with water for use as cements (high temperature and/or acid-resistant) and for other purposes. When water is added, even if the G[®] is not totally dissolved, its bonding strength is developed. Such cements have proved very satisfactory in many applications.

G[®] soluble silicate should not stand for any length of time in open packages or in containers that are not airtight and waterproof. Prolonged exposure to the air may result in caking (due to moisture adsorption) and in reduction of its solubility (due to adsorption of carbon dioxide).

GD[®] Sodium Silicate

Although similar in appearance to G[®], GD[®] silicate has a ratio of 2.00. Because of its higher alkalinity, GD[®] is much more quickly and easily dissolved than G[®]. In solution it is similar to PQ's C[®] or D[®] liquid sodium silicates.

The pH of a one-percent solution of GD[®] silicate is 11.5

Because of its rapid solution rate, GD[®] is preferred in certain cases where G[®] dissolves too slowly. Also, it has some applications where a higher alkali content is desired. It is commonly used in specialized coatings and in refractory cements.

GD[®] is more sensitive to moist air than G[®], and should also be stored in tightly closed containers.

**INDUSTRIAL
CHEMICALS
DIVISION**



THE PQ CORPORATION

CORPORATE HEADQUARTERS

PO Box 840
Valley Forge, PA 19482-0840
Phone: 800-944-7411

IN CANADA

National Silicates
Phone: 416-255-7771

IN MEXICO

Silicates y Derivados, S.A.
Phone: 011-52-55-5227-6801

IN EUROPE

PQ Europe
Phone: 31-33-450-9030

IN AUSTRALIA

PQ Australia Pty. Ltd.
Phone: 61-3-9708-9200

IN TAIWAN

PQ Silicates Ltd.
Phone: 886-2-2383-0515

ANHYDROUS POWDERS

SS 65[®] Pwd. Sodium Silicate

This anhydrous powder has a ratio of 3.22. It is ground so that more than 96 percent passes a 65-mesh screen. SS 65[®] Pwd. dissolves somewhat more rapidly than SS[®] 20 Pwd., and dissolves more readily in boiling water.

A principal application for SS 65[®] Pwd. is in cements and binders, particularly where the cement is mixed with water on the job and can develop some bonding strength from the slow action of the water. It is also used in porcelain enamels and glazes.

SS[®] 20 Pwd. Sodium Silicate

It has the same ratio as SS 65[®] Pwd., but provides a "coarser" particle size distribution. 99 percent passes a 20-mesh screen.

It is usually preferred for making acid-resistant enamel frits. In making enamel frits, the speed of the reaction, or the rate of melting of the sodium silicate component, depends largely on the particle size. In this respect, SS[®] 20 Pwd. gives the most satisfactory results. Solubility is not a factor in this use. SS[®] 20 Pwd. also may be used as a binder in some cements and in "briquetting" of various ores, carbonaceous materials, and other mineral products.

SS-C[®]Pwd. Sodium Silicate

SS-C[®] Pwd. is anhydrous but, otherwise, is similar to GD[®] sodium silicate in its composition. Because of its relatively higher alkali content, it dissolves more rapidly in boiling water than other anhydrous powders, although not as rapidly as GD[®]. It dissolves slowly in cold water.

SS-C[®] Pwd. is useful as a binder for dry materials. It can be utilized in cements, in combination with liquid silicate binders, where it is desirable to increase the total silicate solids content without further increasing the viscosity of the compound.

SS-C 200[®]Pwd. Sodium Silicate

SS-C 200[®] Pwd. is a white, finely divided, anhydrous sodium silicate powder, with a relatively high alkali content. Approximately 95 percent will pass 200-mesh. SS-C 200[®] Pwd. is of particular interest in the manufacture of grinding wheels and for use as a binder for the abrasive grit material. In this application it permits an increase in the amount of silicate solids. It is also used in refractory cements and as an additive to machine dishwashing detergents.

FACTORS TO CONSIDER IN CHOOSING A SILICATE POWDER

Solution Rate

In selecting the proper sodium silicate powder for each use, it is important to consider its rate of solution. Even the most slowly dissolving solid sodium silicate dissolves eventually to form a concentrated solution. However, the correct choice of ratio, degree of hydration, or particle size can speed the dissolving process. Changes in dissolving conditions, such as temperature and concentration, can also alter the solution rate of the powders.

INDUSTRIAL
CHEMICALS
DIVISION



THE PQ CORPORATION

CORPORATE HEADQUARTERS

PO Box 840
Valley Forge, PA 19482-0840
Phone: 800-944-7411

IN CANADA

National Silicates
Phone: 416-255-7771

IN MEXICO

Silicates y Derivados, S.A.
Phone: 011-52-55-5227-6801

IN EUROPE

PQ Europe
Phone: 31-33-450-9030

IN AUSTRALIA

PQ Australia Pty. Ltd.
Phone: 61-3-9708-9200

IN TAIWAN

PQ Silicates Ltd.
Phone: 886-2-2383-0515

The following product properties have the greatest effect on the rate of solution:

Ratio: As the ratio ($\text{SiO}_2/\text{Na}_2\text{O}$) decreases, the rate of solution increases. For example, if other factors are the same, a silicate of a ratio of 2.0 will dissolve more rapidly than a silicate of 3.22 ratio.

Hydration: A hydrated silicate dissolves much faster than the corresponding anhydrous glass. As a rule, the hydration factor outweighs all other aspects in determining the rate of solution.

Particle Size Distribution: The rate of solution of a silicate powder is influenced by the exposed surface area, but this is normally not as important as ratio or hydration. Nevertheless, fine sizing can still notably shorten the time that it takes to dissolve powdered silicate glass.

Temperature: All silicate powders dissolve more rapidly with increasing temperature. Those that dissolve slowly at room temperature can be put into solution promptly by elevating the temperature. Fastest rates occur above the boiling point of water. Steam (@ 20-30 psig) in direct contact with silicate is effective in promptly dissolving those silicates which resist milder methods.


Concentration: The more "siliceous" (high ratio) silicate powders dissolve more quickly and completely in a small volume of water than in an excess of water. An amount of water about three times the weight of the silicate solids results in the maximum rate of solution. This occurs because silica is soluble only in strongly alkaline solutions and the available alkali cannot readily provide the proper pH conditions in large or flowing volumes of water. This effect does not apply in dissolving crystalline, alkaline sodium silicates, PQ's METSO® products.

OTHER FACTORS

In addition to rate of solution, other factors may come into consideration when choosing the correct sodium silicate powder for a particular application.

Melting: Different silicates have different softening points and accordingly, their heat resistance varies. The softening point and the fluxing action of the silicate, plus the resistance of the various fillers, determines the heat resistance of a refractory cement. The greatest fluxing effect comes from the more alkaline powders (SS-C®, SS-C 200®, and GD). The more alkaline powders also have higher liquidus temperatures (point at which silicate is completely fluid), but because of the greater fluxing action, cements made with these 2.0 ratio powders usually will not stand as high temperatures as those made with the 3.2 ratio powders.

Ratio: Where lower melting temperatures are of interest in making enamel frits, SS® 20 Pwd. with its high silica content is suggested. It fuses at about 870°C (1600°F), though the smelting of enamel frits may be carried to above 1100°C (2000°F).



**INDUSTRIAL
CHEMICALS
DIVISION**

 **The PQ Corporation**

THE PQ CORPORATION

CORPORATE HEADQUARTERS

PO Box 840
Valley Forge, PA 19482-0840
Phone: 800-944-7411

IN CANADA

National Silicates
Phone: 416-255-7771

IN MEXICO

Silicates y Derivados, S.A.
Phone: 011-52-55-5227-6801

IN EUROPE

PQ Europe
Phone: 31-33-450-9030

IN AUSTRALIA

PQ Australia Pty. Ltd.
Phone: 61-3-9708-9200

IN TAIWAN

PQ Silicates Ltd.
Phone: 886-2-2383-0515

PACKING AND HANDLING

Sodium silicate powders are available in 100 pound multi-wall polyethylene coated bags and in 500 pound (net) fiber drums with polyethylene liners.

Dry sodium silicates exhibit a natural tendency to adsorb water from the ambient air. When stored in humid air for prolonged periods, these products may become sticky and cake into solid masses. The packaging material provides protection for storage at moderate humidity conditions for reasonable periods of time. Additional protection should be provided if high humidity conditions are common and/or if the products are to be stored for long periods of time.

SAFETY

The sodium silicates constitute a family of products which range from moderately to strongly alkaline. As such, they warrant care in handling in order 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 (LAP) Committee of the Manufacturing Chemists Association, and adopted by the American National Standards Institute, Inc. (ANSI Z 129.1—1976). All the labels instruct the user regarding potential hazards, appropriate precautions and remedial treatment to prevent and counteract accidental contact with skin and/or eyes, or through ingestion, etc.

Soluble silicates are completely inorganic, and as such do not present hazards such as low flash point or flammability.

Material Safety Data Sheets for all products can be supplied on request

PQ TECHNICAL ADVICE

Table 2 on the next page lists some common uses for PQ sodium silicate powders. The properties discussed in this bulletin may suggest new uses. PQ's technical representatives will be happy to discuss individual requirements, submit samples, and provide application assistance. For information contact:

CORPORATE HEADQUARTERS

**PO Box 840
Valley Forge, PA 19482-0840
Phone: 800-944-7411**

**INDUSTRIAL
CHEMICALS
DIVISION**



THE PQ CORPORATION

CORPORATE HEADQUARTERS

PO Box 840
Valley Forge, PA 19482-0840
Phone: 800-944-7411

IN CANADA

National Silicates
Phone: 416-255-7771

IN MEXICO

Silicates y Derivados, S.A.
Phone: 011-52-55-5227-6801

IN EUROPE

PQ Europe
Phone: 31-33-450-9030

IN AUSTRALIA

PQ Australia Pty. Ltd.
Phone: 61-3-9708-9200

IN TAIWAN

PQ Silicates Ltd.
Phone: 886-2-2383-0515

Information herein is accurate to the best of our knowledge. Suggestions are made without warranty or guarantee of results. Before using, user should determine the suitability of the product for his intended use and user assumes the risk and liability in connection therewith. We do not suggest violation of any existing patents or give permission to practice any patented invention without a license.

TABLE 2—COMMON USES FOR PQ SODIUM SILICATE POWDERS

APPLICATION	FUNCTION	PQ PRODUCT(S) RECOMMENDED
CERAMICS <ul style="list-style-type: none"> ● Manufacture of grinding wheels ● Binder for abrasive grit material 	Binder Binder	SS-C 200 Pwd. SS 65 Pwd.
CONCRETE <ul style="list-style-type: none"> ● Improving hardness and increased resistance to water penetration 	Binder	SS-C Pwd.
ENAMELWARE AND GLAZES <ul style="list-style-type: none"> ● Making acid-resistant frits 	Binder	SS 20 Pwd.
FOUNDRY <ul style="list-style-type: none"> ● Sand binder in the Antioch process 	Binder	G, GD
METALS <ul style="list-style-type: none"> ● Cleaning aluminum ● Corrosion prevention 	Detergency Protective Coating	GD, G SS 20, SS 65, SS-C
PAINTS <ul style="list-style-type: none"> ● Dry paint mixture that can be combined with water when ready for application 	Coating	GD
REFRACTORY CEMENTS <ul style="list-style-type: none"> ● Furnace cements for laying up the brickwork of boiler settings & other heating units, also for kilns, industrial ovens, & hearths ● Linings for crucibles, brass furnaces, ladles ● Stove & patch cements for large & small jobs of cementing & patching ● Cements for repairing the linings around coke oven doors 	Binder Binder Binder Binder	G, GD, SS 65 Pwd., SS-C Pwd. GD G, GD, SS-C Pwd. GD