

INDUSTRIAL
CHEMICALS
DIVISION

 The PQ Corporation

THE PQ CORPORATION

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Bulletin 41-27

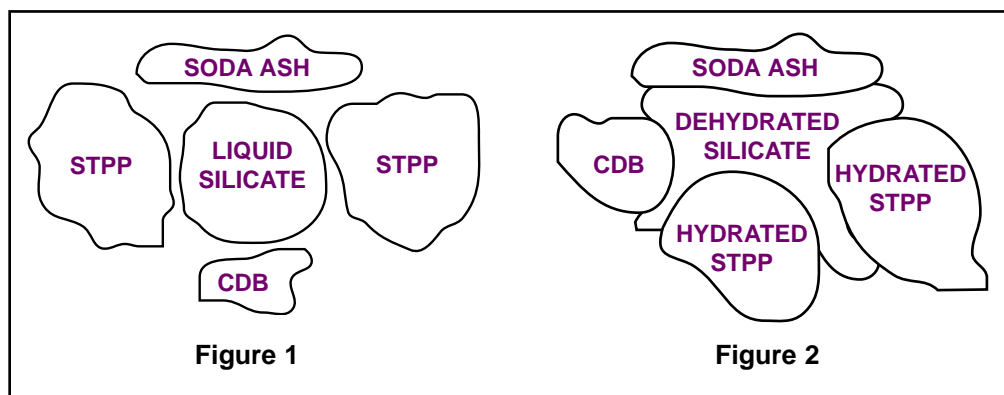
Detergent Agglomeration With PQ[®] Soluble Silicates

INTRODUCTION

Agglomeration processes provide an efficient and economical means for producing granular detergents that have uniform particle size and composition. This uniformity insures that the same chemical composition is present in every use of the detergent product. This is particularly important for achieving uniform cleaning results from automatic dishwashing and heavy duty laundry detergents.

HOW DOES AGGLOMERATION WORK?

Agglomeration is a physical/chemical process for combining various dry ingredients into single granular particles through the binding power of liquid silicate.



The silicate supplies water to hydratable materials such as STPP and soda ash to produce faster dissolving, moisture resistant granules (Figure 1). The dehydrated silicate then acts as a glue to bind the ingredients together into particles with sizes that can be varied according to the extent that the particles are retained in the process (Figure 2).

Agglomeration is primarily suited for producing detergents with the medium to high density characteristics desired for today's high density products. Bulk densities of 0.55 to 1.1 g/cm³, with particle sizes from 230 to 1500 microns or higher, are attainable.

In addition, agglomeration offers:

- Equipment space requirements that are much lower than for spray drying processes and more comparable to dry blending processes.
- High throughput, typical of spray drying processes, at much lower capital cost.
- Significantly lower energy requirements than conventional spray drying processes.

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- Reduced formulation cost by using more economical grades of raw materials than are used in conventional dry blending, to reduce formulation cost.
- Improved control of particle density and size distribution to increase product uniformity.

AGGLOMERATING WITH PQ® SILICATES

PQ® liquid sodium silicates are convenient, economical binders for agglomerating the dry ingredients of a detergent, plus they contribute to the cleaning activity. In the agglomeration process the liquid silicate is introduced as fine, uniformly dispersed droplets so that they come into contact with the continuously moving dry ingredients. The silicate provides a tacky surface for binding the fine dry ingredients to each other to form larger composite granules of detergent.

PQ liquid sodium silicates are available in a wide range of properties, particularly as defined by their SiO₂/Na₂O ratios, solids content and viscosities. These can be utilized to control both the process and the detergent's properties.

In addition to serving as a binder, the sodium silicate also functions as a detergent builder to enhance the cleaning properties. It also provides corrosion inhibition and is compatible with nearly all other detergent ingredients.

SILICATE SELECTION

To select the most suitable liquid sodium silicate for detergent agglomeration, several factors must be considered. For example, the silicate's SiO₂/Na₂O ratio, % solids, and viscosity will influence hydration capacity of the formula, particle size, product bulk density, solubility, storage stability, attrition resistance, and cleaning efficiency.

TABLE 1. TYPICAL PQ® LIQUID SILICATES FOR AGGLOMERATION

PRODUCT	SiO ₂ /Na ₂ O RATIO	Wt. % SOLIDS	DENSITY @ 20°C, °BE'	VISCOSITY @ 20°C, POISES
A3238	3.22	37.6	41.0	1.8
A2645	2.58	44.5	49.3	7.8
A2447	2.40	47.0	52.0	21.0
A2044	2.00	44.1	50.5	4.0

A 2.4 ratio sodium silicate is frequently the best choice because it offers a balanced combination of high solids content, reasonable viscosity, high tack, and low insolubles.

In some cases a combination of a high ratio and a low ratio silicate may be used. PQ's sales and technical service representatives can assist compounders in the selection of a suitable PQ® liquid silicate to achieve the optimum balance of properties and economy.

In addition, PQ's BRITESIL® hydrous silicate powder can be used in combination with a liquid silicate in agglomerated detergents. BRITESIL can modify the product's density, and because of its porous structure, it serves to increase the capacity of the mixture for absorbing liquid surfactants.

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SILICATE CONCENTRATION

The amount of liquid silicate used in an agglomerated detergent formulation has a major effect on the properties of the finished product. The maximum liquid silicate content is usually limited by the type of equipment used for agglomeration and ranges from 25% to 35% by weight.

Generally, the effects of varying silicate concentrations on the detergent's properties are as indicated in the following table.

Property of Detergent	Concentration	
	LOW	HIGH
Bulk Density	Lower →	Higher
Particle Size	Smaller →	Larger
Liquid Absorptivity	Higher ←	Lower
Attrition Resistance	Lower →	Higher
Flowability	Lesser →	Greater
Insolubles	Lower →	Higher

FIGURE 3. VISCOSITIES OF TYPICAL LIQUID SODIUM SILICATES AS A FUNCTION OF CONCENTRATION

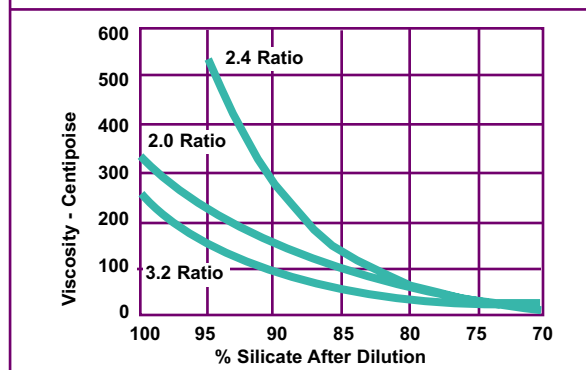
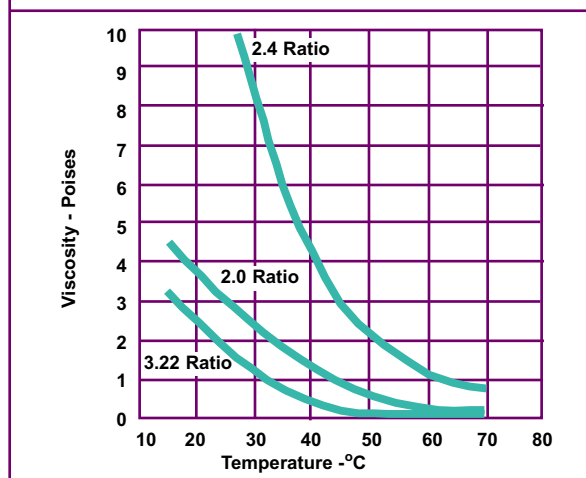


FIGURE 4. VISCOSITIES OF TYPICAL LIQUID SODIUM SILICATES AS A FUNCTION OF TEMPERATURE



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For an optimum combination of properties, the proper concentration balance must be established for a particular formulation.

Dilution or heating of the liquid silicate is sometimes desirable to reduce its viscosity to 200 centipoises or less. This will allow easier distribution, pumping, and wetting of the dry ingredients. Since both of these techniques can have an effect on the properties of the product and/or the process, the optimum procedure must be determined for each situation.

A Troubleshooting Guide (Table III) is provided as an aid for adjusting formulations and/or processing conditions to compensate for many of the effects described above or for processing or equipment variables. PQ's sales or technical service representatives can provide additional assistance.

TABLE III. TROUBLESHOOTING GUIDE

PROBLEM	CAUSES
No Agglomeration	Not enough moisture. Insufficient liquid dispersion. Silicate viscosity too high. Wrong silicate ratio. Too much light density ash. Too much mixing energy. Temperature too high.
Too Many Oversize Particles	Too much silicate. Too much water in raw materials. Poor dispersion. Raw material particle size too coarse. Poor mixing (overloaded equipment).
Insolubles	Over-drying. Silicate ratio too high. Wrong raw materials (ie.: NaHCO ₃). Insufficient hydration.
Caking (Poor Flowability)	Too much moisture, over-hydration. Too much surfactant. Particle size distribution too small. Insufficient conditioning.
Bulk Density Too High	Too much liquid. Too much moisture. Wrong raw materials. Over-handling, over-conditioning.
Bulk Density Too Low	Too little liquid silicate. Too little moisture. Wrong raw materials. Not enough agglomeration (not enough mechanical work).
Low Attrition Resistance	Not enough silicate. Not enough drying. Excess fines.
Low Surfactant Absorptivity	Too much moisture. Too much silicate. Wrong raw materials. Wrong surfactant. Too much mechanical work.
Poor Product Yield	See Problem Areas: "No Agglomeration" and "Too Many Oversize Particles"
Chlorine Instability	Too much moisture. Wrong order of addition of ingredients. Wrong choice of bleach. Silicate ratio too high.



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Agglomeration Equipment

Specialized equipment such as the O'Brien Agglomerator, Schugi Agglomerator and Patterson-Kelley Continuous Zig-Zag Mixer are available for detergent agglomeration. However, ribbon blenders, conical mixers, pug mills, disc pelletizers, and rotary driers have been used. PQ's technical service representatives can assist you in selecting the best silicate combinations to fit your particular equipment.

Technical Assistance

For more information or assistance in selecting or adapting a PQ silicate product for your detergent formulation or processing needs, contact your PQ sales representative or PQ's Industrial Chemicals Division.

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