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Bulletin 17-67

Dispersion Characteristics of Soluble Silicates

INTRODUCTION

The effectiveness of aqueous solutions of sodium and potassium silicates as deflocculants—i.e., their ability to disperse or peptize agglomerated masses into very fine particles which repel each other—has resulted in their use in such diverse applications as clay refining, ceramics processing, ore flotation, detergency, oil well drilling, and de-inking of waste paper.

DEFLOCCULATION OF CLAYS

When water is added to various types of clay, the water becomes oriented between the clay particles to form a strong bond. When a polyelectrolyte such as sodium silicate is introduced, ion exchange or ion adsorption occurs on the clay particle surface, creating like electrical charges between particles. This charge effect causes the particles to repel one another, thus fluidizing the system and allowing it to flow more freely. While all of the silicates exhibit deflocculation capabilities, PQ's N® sodium silicate (41° Baume, 3.22 SiO_2/Na_2O ratio) is frequently the most efficient.

This phenomenon is used in mining kaolin where the addition of 0.2% or less of sodium silicate permits a pumpable slurry of higher solids content. In ceramic applications, silicate additions provide a more fluid slip, so that the clay can be poured more quickly to take the exact shape of the mold. The deflocculating characteristics of silicate also aid in keeping pigments and other solid ingredients uniformly suspended in coating and glaze preparations.

EXTRUDED BRICK AND CLAY PRODUCTS

Products manufactured by the stiff mud process, such as building brick, tile, firebrick and clay pipe, benefit from silicate addition to the pugging water. The body becomes less stiff, yet the moisture content is not increased and may even be reduced. The use of soluble silicate can reduce the force (power) required for extrusion, as well as decrease shrinkage on firing. Since silicate is inorganic, it remains distributed throughout the body without migrating to the surface, and it has no deleterious effect on the color of the fired product.

ORE FLOTATION

Ores are reduced to fine particles and normally are separated by floating the mineral-bearing elements with the aid of a frothing agent. Simultaneously the siliceous matrix or gangue is depressed or sinks. Sodium silicate added to the flotation circuit in the range of 1 to 4 pounds per ton of ore, helps wet and disperse the siliceous residue. The silicate deflocculates quartz and separates it from the froth to be collected. At the same time it prevents the mineral pulp from agglomerating and settling out. In the case of reverse

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flotation, soluble silicate is used to disperse slimes and the mineral body is removed by gravity.

Silicates of various ratios are used, covering the entire spectrum from PQ's METSO BEADS® 2048 sodium metsilicate (1: 1 ratio) to N® liquid silicate (3.22 ratio). For optimum effectiveness, each ore should be studied in a pilot plant or laboratory to ascertain the best choice of silicate and its appropriate concentration.

DETERGENCY

Detergency or cleaning operations involve an interaction of many physical and chemical effects. In addition to solubilization and emulsification of certain soils, solid dirt particles are physically removed and must be held in suspension until rinsed away, rather than allowed to redeposit on the cleaned surfaces. Suspension of the soil depends on particle size, solution density, interfacial forces and surface charges. In the past, soap or detergent foam was utilized to entrain soil particles. However, with the advent of modern low-foam surfactants, optimum soil suspension and dispersion are supplied by the inorganic detergent builder.

While alkalinity has been demonstrated to be an important contributor to deflocculation, the polyelectrolyte nature of the soluble silicate anion itself is favorable for maximum dispersion. This is readily seen by comparing the superior suspension characteristics of sodium silicate, contrasted to that of caustic soda (NaOH) or soda ash (Na_2CO_3). The dispersing power of sodium silicate is effective over a wider range of alkali concentration than other salts.

The ratio of silica to alkali may have some effect on dispersion efficiency. Generally, for clay or siliceous soil, the higher ratio silicates exhibit greater suspending power than sodium metasilicate.

For additional information about the use of soluble silicates specifically for detergents or in cleaning processes, contact PQ Corporation.

OIL WELL DRILLING MUDS

In deep well drilling, thixotropic fluid is required to contain the pressure of oil and gas and to prevent sedimenation during interrupted circulation. Yet it must be sufficiently fluid to carry out drill cuttings from the bottom of the hole. For this use, sodium silicate is an effective deflocculant by itself or in combination with tannic acid.

Bentonite suspensions used as drilling fluids are easily liquified or "degelled" by adding silicate of any SiO_2/Na_2O ratio at the rate of 0.02 to 0.2%. In addition, the silicate in the drilling fluid prevents water blocking of sand and swelling or disintegration of the shale and clay that can interfere with oil recovery.

DE-INKING OF WASTE PAPER

Waste newsprint and magazine stocks can be repulped for use in the manufacture of other types of printing papers. Quality stock is obtained by de-inking the newsprint. The digestion involves the use of rosin soap or synthetic surfactant, peroxide for bleaching, plus sodium silicate which serves a number of functions. The principal purpose of the silicate is to disperse the ink

particles, prevent their redeposition on the fiber, and permit effective removal by flotation or other means. In addition, silicate aids penetration of the fiber and stabilizes the peroxide bleach so that it lasts longer.

Sales Technical Service

For additional details about the selection and use of PQ soluble sodium or potassium silicates for specific deflocculation processes, call the Technical Service Department of PQ Corporation's Industrial Chemical Division.

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17-67/694 Printed in U.S.A.