STABILISATION OF CERAMIC GLAZES AND ENAMEL SLIPS USING LAPONITE

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INTRODUCTION

Laponite is a synthetic layered silicate with a structure resembling the natural clay mineral, hectorite, but with a significantly smaller primary particle size (Figures 1 and 2). It is used as a high performance rheological additive in a wide range of speciality waterborne systems including surface coatings.

The highly shear thinning rheology of Laponite make it an ideal choice of set-up agent for suspension control in ceramic glazes and enamel slips without causing excessive increase in viscosity. Formulations stabilised by Laponite are easily pumped and are especially suited for spray application on to multi-faced bodies such as sanitary ware and tableware.

Laponite may be used as a partial or complete replacement for conventional organic polymer or clay based set-up agents - use level is typically in the range 0.05% to 0.5%, depending upon factors such as solids content of the formulation and point of addition

The processes that occur during dispersion of Laponite in water are shown in Figure 3. At a concentration of 2% or higher, in water, Laponite RD will form a very thixotropic gel with a "house of cards structure" as illustrated in Figure 4.

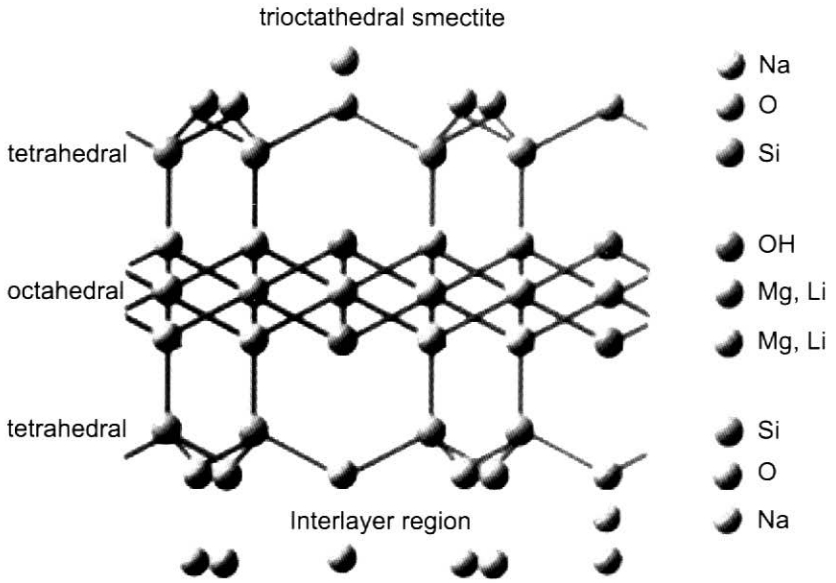

Figure 1: Structural formula of Laponite.

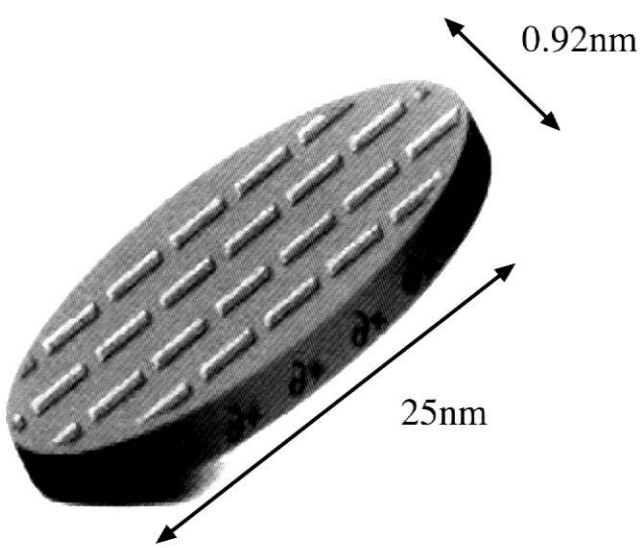

Figure 2: A single Laponite crystal.

GRADES FOR THE CERAMIC AND ENAMEL INDUSTRIES. METHODS OF ADDITION

- **Laponite RD**

This grade should be added to the ball mill before milling- in a fully formulated glaze it will build a thixotropic structure that can stabilise suspended solids without excessive viscosity build.

- **Laponite RDS**

Laponite RDS has been modified to allow it to be dispersed in water at up to ~10% solids without developing an increase in viscosity. Such a dispersion (viscosity < 20 m.Pa.s.) may be added to a glaze *at any time* during manufacture, including *after* the ball milling stage.

When a dispersion of Laponite RDS is post-added in this way, it will normally develop a thixotropic structure within minutes of addition to the formulation. The dispersion is suitable for adjusting viscosity immediately before spraying.

Laponite RDS powder is suitable for addition to premixed powder glaze products.

MAIN PROPERTIES OF LAPONITE

- High purity and consistency

Laponite is manufactured using purified salts of sodium, magnesium and lithium and sodium silicate to ensure that levels of heavy metals and transition metals present in the product are at a minimum. Typically, Laponite contains < 200 ppm Iron (Fe) and <20 ppm of combined heavy metals. As a synthetic material, manufactured by a controlled batch process, the consistency of Laponite is excellent, allowing reproducible control of rheological properties.

- High whiteness

Laponite is a free flowing white powder; it disperses readily in water without the need for high shear mixing to form clear, colourless, sols or gels. On firing, it will be converted to high brightness oxides of its component elements shown above.

- Ease of use

Laponite powder is added directly into the ball mill, along with the other ingredients, before milling. Alternatively, addition of a pre-mixed dispersion of Laponite in water to a ready-made slip or glaze will cause the rapid development a highly thixotropic structure.

- Chemical compatibility in formulations

Organic polymer set-up agents are often degraded under the conditions of high shear grinding, high temperature and alkaline pH that are produced during ball milling of a frit or glaze. Laponite shows optimum performance at alkaline pH and has good tolerance to high levels of sodium ions. High shear grinding and elevated temperatures cannot break down the inorganic silicate structure.

- Synergy with other thickeners

A syneristic increase in efficiency can be obtained by combining Laponite with certain polymeric thickeners, which can provide significant cost savings, as illustrated in Figure 5.

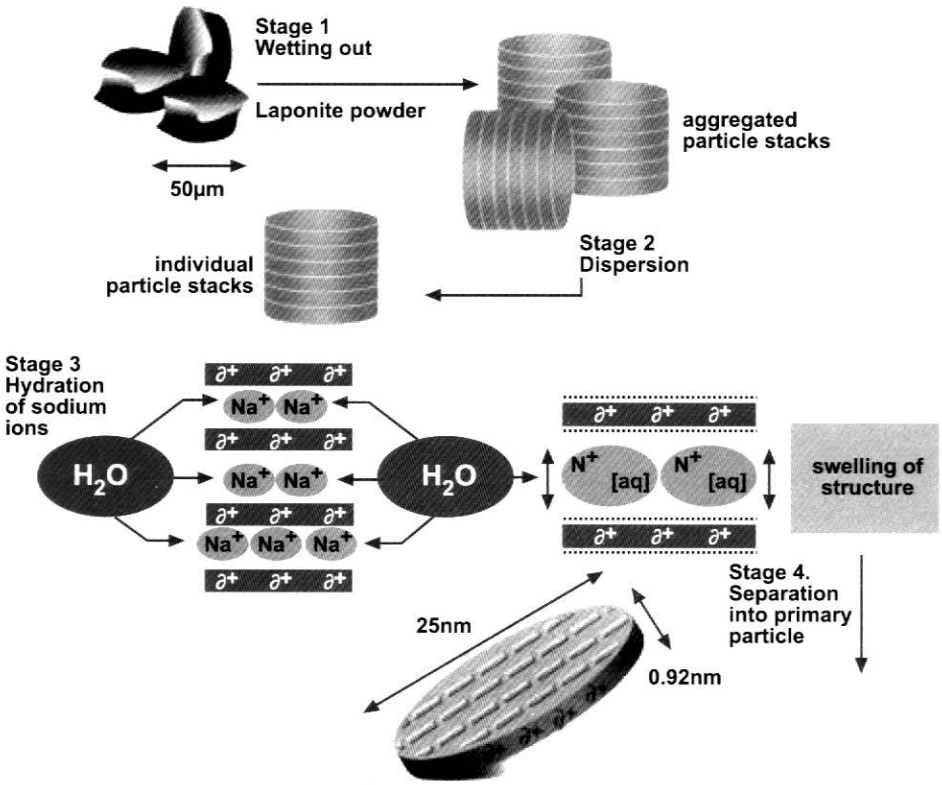

Figure 3: Addition of Laponite to water.

Figure 4: Gel formation. House of cards.

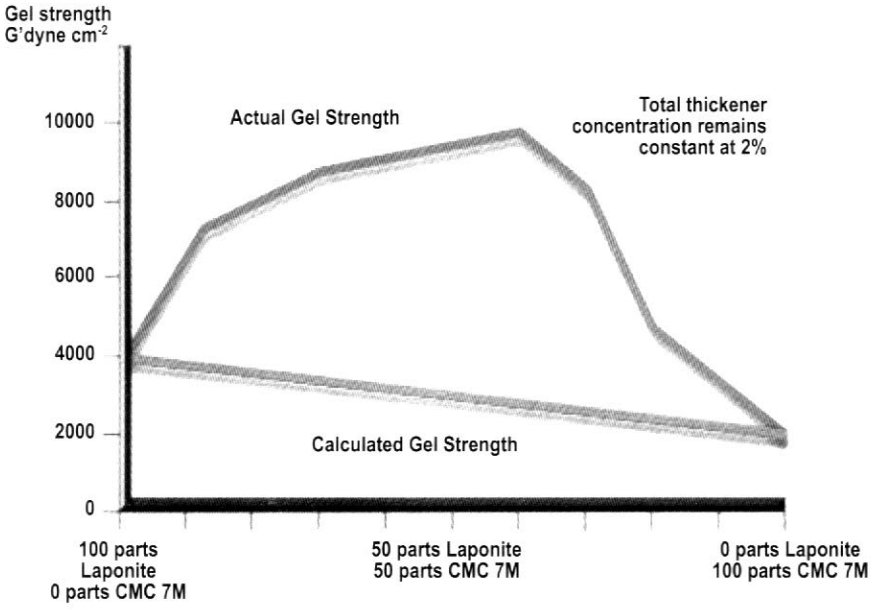

Figure 5: Synergy Laponite and CMC.