

DEFLOCCULANT CONSUMPTION AND SURFACE PROPERTIES OF KAOLINITIC AND ILLITIC CLAYS

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The production processes for ceramic tile manufacture by the wet method require the preparation of aqueous clay suspensions with high solids content and low viscosity. Although the deflocculation mechanisms are well known, the scarcity of quantitative information with relation to the chemical equilibrium that is established between the clay particle surface and the solution hinder a better understanding of the system. In this study, the deflocculant consumption and rheological behaviour of clay suspensions were examined. The results have been correlated with the physical properties of the clays, with the type of deflocculant, and with the evaluation of the resulting chemical equilibrium. The study was conducted using five clays: three kaolinitic and two illitic clays, obtained from different regions in Brazil. The clays were characterised in terms of their chemical composition, mineralogy, particle size distribution, thermogravimetry, cation exchange capacity (CEC), organic carbon content, zeta potential, and specific surface area (BET) (Table 1).

Characterisations	Clays				
	Kaolin	AC-1	AC-2	I-1	I-2
Major phase	K	K	K	I/M	I/M
CEC (meq/100g)	3,2	2,9	3,7	10,9	13,1
BET (m ² /g)	25	38	77	49	73
Fraction < 0,2 µm (x100)	2,4	14	37	25	26
Fraction < 2 µm (x100)	35	60	75	60	90
D ₅₀ (µm)	4,6	2,2	0,58	2	0,55
Clay fraction	0,95	0,47	0,71	0,64	0,75

Table 1 - Summary of the raw materials characterisation results

Deflocculant consumption was determined as the point of minimum viscosity of the suspensions with a solids mass content of 50% and with silicate- and polyacrylate-based deflocculants of Li⁺, Na⁺ and K⁺ cations. The liquid extracts of the suspensions were separated and the Li⁺, Na⁺ and K⁺ concentrations were analysed. Deflocculant consumption was expressed as a measure of the concentration of the monovalent cations present in the system (Li⁺+Na⁺+K⁺) (those that were added in addition to those contributed by the clays themselves) by BET (mol/m²). The BET values lay between 25 and 78 m²/g, displaying larger values with a greater clay mineral fraction and smaller particle size. Deflocculant consumption varied between 0,08.10⁻⁵ and 0,37.10⁻⁵ mol/m², and was greater for the kaolinitic clays. The cation exchange capacity varied between 2,9 and 13,1 meq/100g, and was greater for the illitic clays.

After trying to identify a pattern in the deflocculant consumption of the quite different systems chosen, as shown in Figure 1, success was achieved after analysing the cation consumption per square metre surface area in terms of the cation

exchange capacity per square metre surface area (CEC/BET) (Figure 2). The correlation coefficient was $R = -0,936$. Each experimental point corresponds to the average consumption for the deflocculants used.

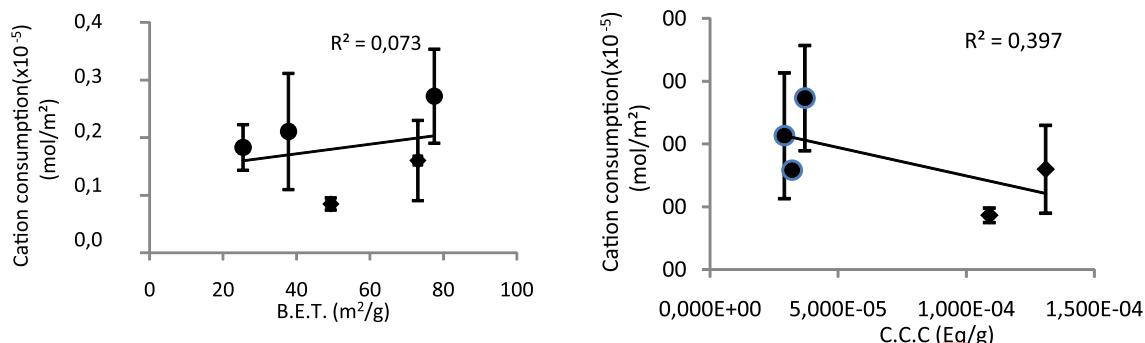


Figure 1. (a) Cation consumption (mol/m^2) as a function of specific surface area (BET), (b) Total cation consumption (mol/m^2) as a function of cation exchange capacity (CEC). (●) kaolinitic clays; (◆) illitic clays.

The greater the CEC/m², the lower was the deflocculant consumption (mol/m²), regardless of the type of clay phase, its organic carbon quantity, particle size distribution, zeta potential and type of deflocculant. For all studied cases, the equilibrium relationship between the cations adsorbed on the surface of the clays and the total cations in the system varied between 0,55 and 0,69, without any apparent pattern being detected.

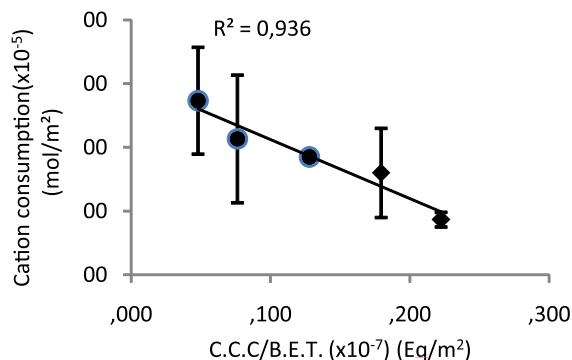


Figure 2. Cation consumption (mol/m^2) as a function of the specific cation exchange capacity (CEC/BET). (●) kaolinitic clays; (◆) illitic clays.

On the other hand, the minimum viscosity of the deflocculated suspensions was inversely proportional to the average particle size. The understanding of the clay–water system, as attempted in this study, can contribute to optimising the process of developing a body composition with appropriate rheological properties and minimum water consumption.

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