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Why Treatment of the Water Based Clay Slurries are Not Effective; the Microstructural Review

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Introduction

Clay minerals were formed as result of the weathering of volcanic glass, lavas and igneous rocks like granites and basalts. Clays are useful for dam bed impregnation, to improve water retention properties and as drilling mud, to seal the cut, thus preventing fluid loss. They are also popular stabilising additives in engine oils, cosmetics, pharmaceutical and chemical industries. Their water retention phenomenon prevents aggregates of clay-water suspension from settling under gravity force which cause difficulties in clay rich sludge dewatering. Dewatering of sludge by physical and chemical treatments becoming increasingly urgent in view of the growing demand for sites for the disposal of mining slurries, tailings and other mineral ''wastes''. Mine tailings are often disposed of as high water content slurries into tailing dams with harm for the natural environment and is very costly. Primary dewatering processes include aggregate formation, bridging flocculation, settling rate and bed height (density) before compression. This can be achieved by physico-chemical processes like aggregation, coagulation and flocculation which were clarified recently in [1]. Aggregation is usually understood as a process of formation larger and stable structural elements by primary particles connecting in Face to Face phase contacts and becoming unstable [2]. Coagulation is connected mostly with interaction between primary particles within dense suspensions (gels) resulting in Face to Edge (FE) and Edge to Edge (EE) coagulating type contacts. Flocculation also is seen as a process of building larger structural elements and some authors [2,3] relate this with coagulation. Others present flocculation as a separate type of coagulation to be achieved by flocculation using long chain polymers; however, this process is still not well understood.

To help understand micro structural behaviour of clay gelled suspension, the microstructure investigation was conducted using a Transmission X-ray Microscope (TXM) and cryo-SEM. The application of a high resolution TXM, has increased with the availability of synchrotron photon sources. In the soft X-ray range (100eV – 1keV), a zone plate based TXM, has achieved a spatial resolution of 60nm [4,5]. In this article, we are using the microscope constructed in the National Synchrotron Radiation Research Canter (NSRRC).

All our results advocate [6-20], the structure building phenomenon within entire suspension may be blame for poor settling and dewatering. All these may be result of high water dielectric constant which polarising clay particles and generating electrostatic charge. This charge leads to structure building phenomenon within the aqueous suspensions. It becomes clear that further technologies have to eliminate using water in mineral processing and develop new approach involving close loop processing environment in low dielectric constant liquids (Figure 1).

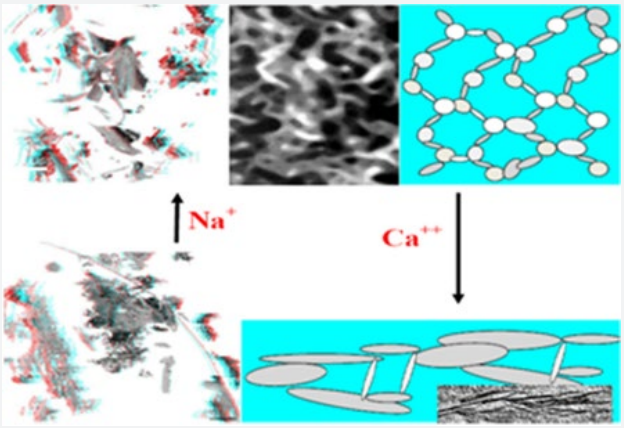

Figure 1: 3D microscopical images and associated models of chemical treatment influence on the clay-water suspension structure building phenomenon.

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