PORE SIZE DISTRIBUTION EFFECTS ON THE HYDRO-CHEMO-MECHANICAL BEHAVIOUR OF BENTONITE

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→ Material and its preparation←

Febex bentonite

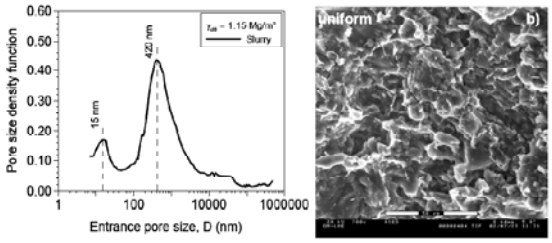
Calcium bentonite with a montmorillonite content higher than 90%

The effect of structure has been investigate by comparing the behaviour of remoulded and statically compacted samples (dry densities ρ_d=1.15 Mg m^{-3} and ρ_d = 1.65 Mg m^{-3}, respectively)

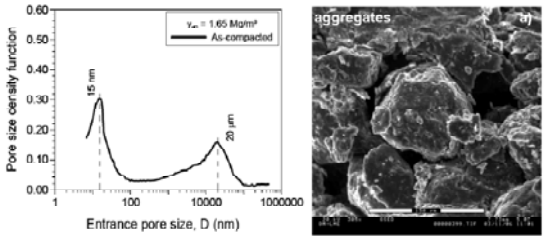
Macropores and aggregates were evident in the compacted samples

Liquid limit w_L(%)	102
Plastic limit w_P (%)	53
Specific gravity G_s (-)	2.7
Total specific surface Γ (m2/g)	725
Cation Exchange Capacity CEC (meq / 100 g)	100

Initial pore size distribution and ESEM picture of a remoulded sample



Initial pore size distribution and ESEM picture of a compacted sample

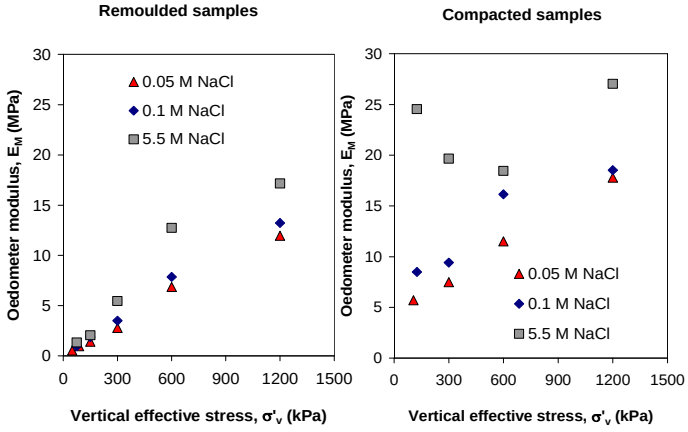


→ Hydro – mechanical behaviour in oedometer conditions with 0.05 M , 0.10 M and 5.5 M NaCl solutions ←

Remoulded samples were prepared at w = 1.2 w_L and exposed to a load cycle. Compacted samples were prepared at laboratory hygroscopic water content (w = 13 %), exposed to an oedometer load σ_v= 200 kPa, saturated with the different fluids and exposed to a load cycle. Both samples are at a normally consolidated state

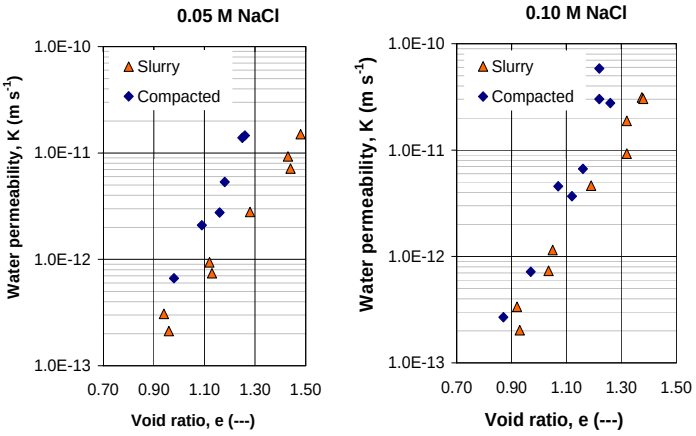
Mechanical behaviour

Stiffness increased with salinity in both remoulded and compacted samples. In remoulded samples, this evidence could be explained by the attraction of particles due to a reduced thickness of the double layer. In compacted samples, salinity induced stiffer and denser aggregates (enhances aggregation).



Hydraulic behaviour

Higher water permeabilities were observed in compacted samples, consistently with the bigger dimension of their macropores. Salinity increase, which enhances particle attraction and aggregation (leaving larger pores between aggregates), corresponded to higher permeabilities.

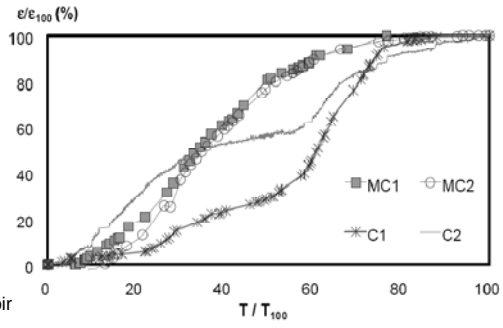


→ Chemical induced swelling of samples saturated with a 5.5 M NaCl solution ←

Samples saturated with 5.5 M NaCl solution were exposed to diffusion using distilled water (progressive dilution of pore water) under a constant total vertical stress, to check for the influence of microstructure on the processes of chemical induced swelling.

RIGHT: While the remoulded samples (MC1 and MC2) swelled continuously, deformation proceeded discontinuosly in the compacted samples (C1 and C2), as a consequence of the pronounced bimodal pore size distribution.

BELOW: In one test diffusion was applied using a reservoir above the compacted sample, initially filled with the saline solution, towards a reservoir below the sample, where distilled water conditions were imposed during the whole test.



Salt concentration in the upper reservoir appeared as well to decrease slightly discontinuosly, suggesting an evolving dilution

Nevertheless, the recovery of swelling at prolonged exposure times (200 days) strenghtens the hypothesis that the evolution of the deformation greatly depends on the delayed transfer process occurring from the inter-aggregate to the intra-aggregate porosity