CERAMIC AND COLLOIDAL PROCESSING - EXERCISES

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2021

Exercises 9

1. What are the different forces (attractive and repulsive) that could act between the particles of a powder suspension? What are their origin?

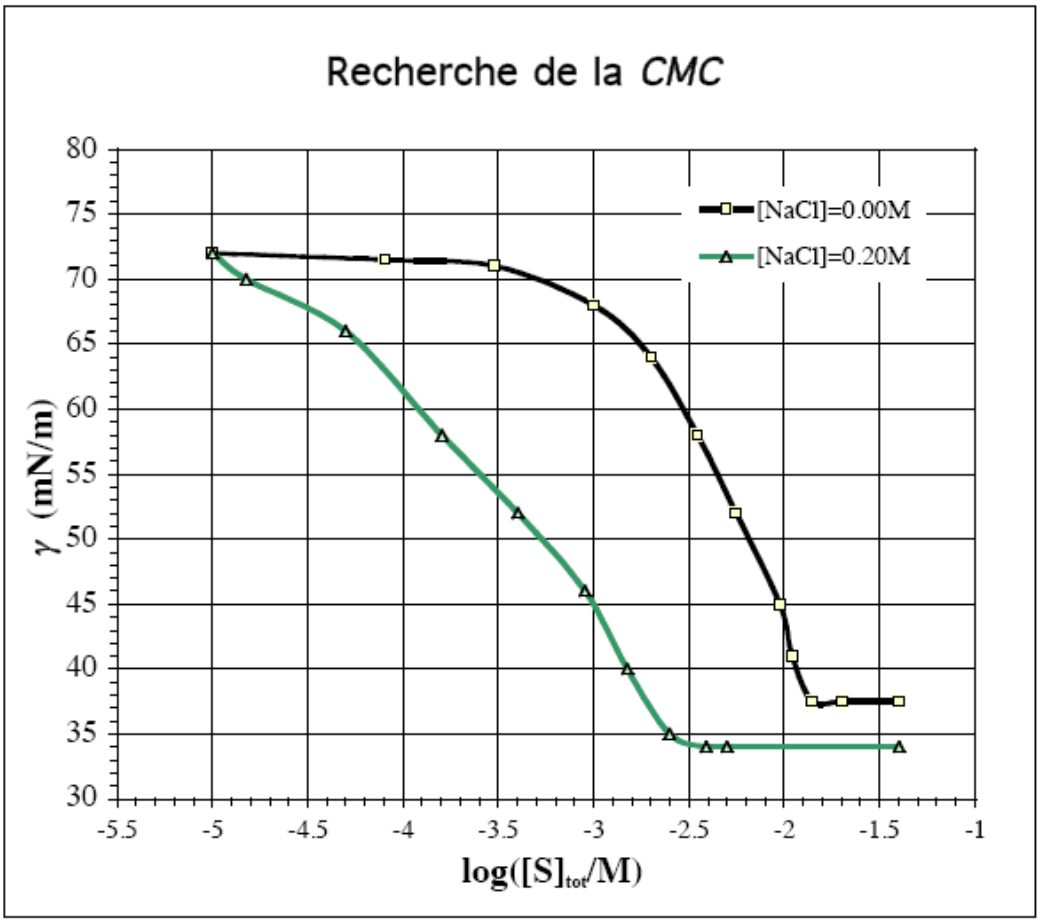
2. How does the interaction energy between two spherical particles in suspension vary according to the size of a particle and the concentration of ions in solution according to the DLVO theory.

3. What are the mechanisms that lead to colloidal stabilization by adsorption of polymers with long molecular chains (steric stabilization)? How important is the solvent-polymer interaction?

4. What type of polymer is polyacrylic acid (PAA)? How can it be used to stabilize a suspension of ceramic powder (e.g. alumina Al2O3) and at which pH is it most effective?

5. Calculate the aggregation number (NA) of a micelle formed by a single hydrocarbon (alykl) chain surfactant having 10 carbons, assuming that the hydrocarbon forms a sphere with a radius equal to the extended length of the hydrocarbon chain. Do the same calculation for hydrocarbon chains comprising 12 and 16 carbons. Note: the aggregation number is NA = volume of a micelle / volume of a surfactant molecule.

6. The figure below shows the change in the surface tension of aqueous solutions as a function of the concentration of dodecylammonium chloride (pure water, or 0.20 [M] aqueous NaCl solution).
i. Explain in molecular terms the influence of surfactant concentration $[S]_{tot}$ on surface tension.
ii. Determine the CMC corresponding to each of the curves.
iii. Explain the influence of NaCl on the CMC.



7. Using the Hamaker software - what is the distance of the secondary minimum for a Sumitomo AA04 alumina in the presence of Y^{3+} ions (concentration below). What is the electrostatic barrier necessary for a stability of one day for a suspension (30% by weight) of AAO4 doped with Y^{3+} . What is the thickness of the adsorbed layer necessary for steric stabilization?

Data : Al_2O_3 - Hamaker constant: $3.67 \cdot 10^{-20}$J, AA04 – Sumitomo - D_{v10} =200 nm D_{v50}=500 nm D_{v90} =1655nm, pH=4, zêta potential 60 mV (zeta plane = Debye length (double layer thickness). - HNO_3 (0.005M) Dopants Y^{3+} (nitrate salt- 0.005M)

8. Give an example of the use of colloidal chemistry in everyday life.