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Critical Coagulation Concentration of Oxide Rich Soil Colloids: Implications on the Stability and Transport of Nanoparticles in the Environment

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Introduction

The critical coagulation concentration (CCC) is the concentration of electrolytes in a colloid suspension above which the suspension will coagulate

Bellow the CCC the suspension is stable and colloidal particles can be transported in the environment

The behavior can be extended to metallic nanoparticles with charged surfaces

The mechanism of coagulations is related to the energy barrier on the surface of soil colloids which can be overcome by double-layer depression at high ionic strengths

Cation hydration also influences the electrochemical interactions

Materials and Methods

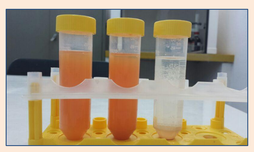
Oxide rich soil (Oxisol) dispersions (0.05%)

Stirred and allowed to settle for 24h

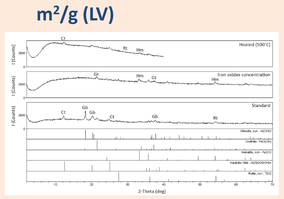
Salt solution concentrations: NaOH 0 mmol/L (distilled water); NaOH 1 mmol/L; NaOH 10 mmol/L; NaOH 100 mmol/L; NaOH 200 mmol/L, and NaOH 400 mmol/L

With (OM=1) and without (OM=0) natural organic matter

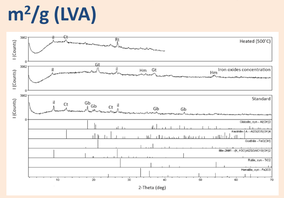
Transmittance of sample evaluated at 420 nm
↑ transmittance = coagulation
↓ transmittance = dispersion



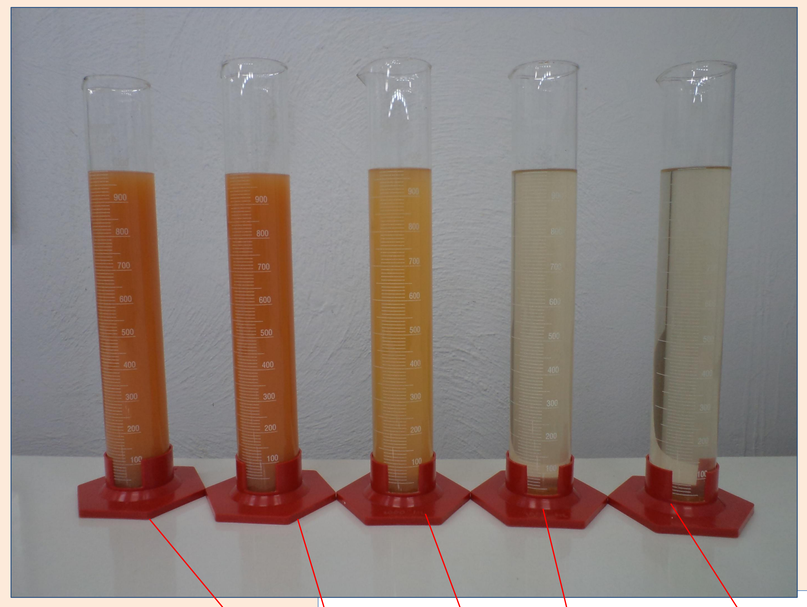
Hematite rich soil material from oxic horizon, clay content is 81.7% , SSA is 52.3 m^2/g (LV)

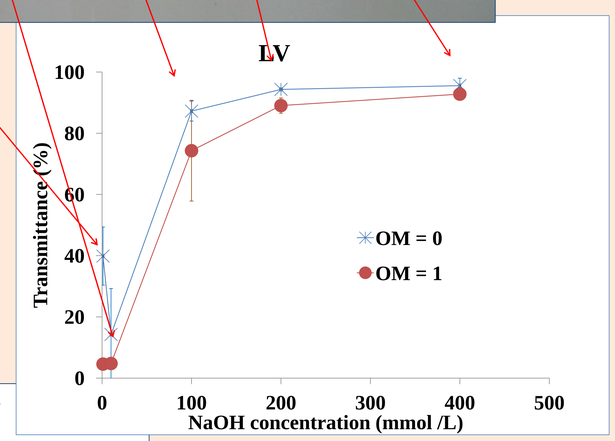


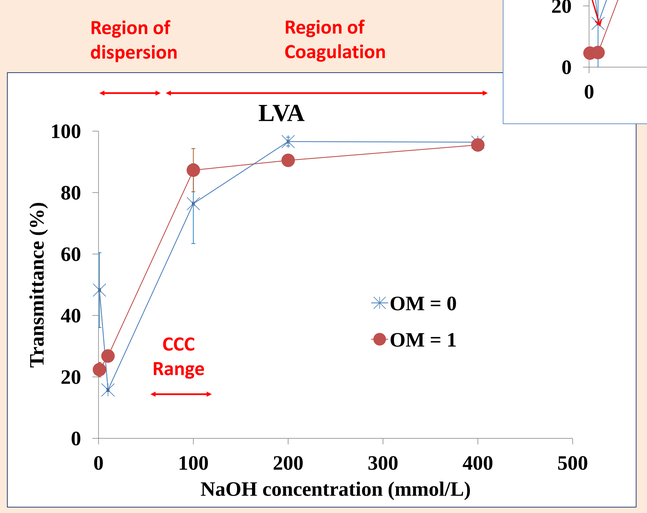
Goethite rich soil material from oxic horizon, clay content is 66.7% , SSA is 49,7 m^2/g (LVA)



Results







Conclusions

Amount of particles in suspension is controlled by ionic strength of solution

Stability of charged iron rich nanoparticles in ground and surface water will depend on water chemistry