Stopped-flow study of Ni\(^{2+}\) ions surface complexation by 5-phenyl-azo-8-hydroxyquinoline (5PH8HQ) grafted on Aerosil silica particles in colloidal suspensions.

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This work is a part of a more general study in which we aim at studying the kinetics of solutes adsorption on solids. This is a subject of great importance since most adsorption studies are driven at the equilibrium whereas the relevancy of the equilibrium state of the adsorption is one of the questions raised, for instance, by recently developed very fast chromatographic processes. In a first approach we consider colloidal particles for which, contrarily to what happens in adsorption studies driven in column, the impact of hydrodynamic conditions and the concentration gradients may be minimized.

We describe the reactivity of preformed silica particles, namely Aerosil A200 or A300, functionalized by grafting 5-phenyl-azo-8-hydroxyquinoline. Aerosil A200 and A300 offer the advantage of being silica nanoparticles, commercially available and rather well characterized. 5-phenyl-azo-8-hydroxyquinoline is known to complex metal ion and can be grafted on silica. We considered in this work Ni\(^{2+}\) ions.

Once the silica particles were grafted, the preparation and characterization of colloidal suspensions of 5PH8HQ-Aerosil silicas were described by dynamic light scattering and zeta potential measurements. The kinetic of complexation of Ni\(^{2+}\) was studied by the stopped-flow technique. The dependence of the observed rate constant on the metal concentration at pH=4.0±0.1, the Ni\(^{2+}\) counterions (acetate and chloride), the ionic strength, and finally the pH was described.

Stopped-flow optical density versus time curves exhibit a non exponential shape. Nevertheless, taking into account the particular spectrophotometric behavior of the complex formed, the experimental curves may be described taking into account a pseudo-first order model. The observed rate constants suspension are discussed in comparison with those obtained for 5PH8HQ solubilized in cationic and neutral micellar micelles (CTAB and TX-100 respectively). When 5PH8HQ is grafted on solid Aerosil particles it’s react with Ni\(^{2+}\) was slower than when it was solubilized in neutral micelles, but faster than when the considered micelles were cationic.

Modeling the effect of ionization states of the silica surface, complexing agent and complex formed will be necessary to go further in this comparison.