

# Interaction of Humic Substances with Kaolinite

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Ubiquitous humic substances (HS), mixture of organic macromolecules, are found in the ecosphere. The understanding of interaction of humic acid (HA) and fulvic acid (FA) with host rocks for an underground repository, like clay minerals, is important. Therefore, we have studied the interaction of humic substances with kaolinite, a typical clay mineral which mainly contains hydroxylated sites of Al, Si, Fe, and Ti.

HA forms a precipitate at pH below 3 whereas FA is not precipitated over the whole pH range [1]. For our experiments, Aldrich HA with concentrations 20-150 mg/L at pH 3.0, 5.0, 12 and Gorleben FA with concentration 10-150 mg/L at pH 1.0, 5.0, and 8.0 have been used.

Table 1: Parameters and conditions for the sorption of humic substances (HS) on kaolinite

Parameter	Conditions
Kaolinite, [KGa-1b]	4.0 g/L
[HS]	10-150 mg/L
Ionic strength	0.1 M NaClO <sub>4</sub>
pH	1.0, 3.0, 5.0, 8.0, 12
Preconditioning time	48 h
Contact time	5 days
pCO <sub>2</sub>	10 <sup>-3.5</sup> atm
Phase separation	1 h (~ 2500 rpm)
Detection	UV-VIS Spectrometry

The experimental parameters and conditions for the sorption of humic and fulvic acid on kaolinite are summarized in Table 1. The percentage of sorption of Gorleben fulvic acid on kaolinite was determined by UV-VIS spectrometry and is shown in Figure 1 as a function of pH with fulvic acid concentrations of 10, 20, 50, and 150 mg/L. As can be seen the sorption of FA is decreasing with increasing pH values for all FA concentrations. A similar sorption behavior has been found for the Aldrich humic acid. The decreasing sorption of HS with increasing pH might be explained by repulsion of negatively charged kaolinite surface and increasingly dissociated

carboxylic and phenolic groups of humic and fulvic acid with increasing pH value [2].

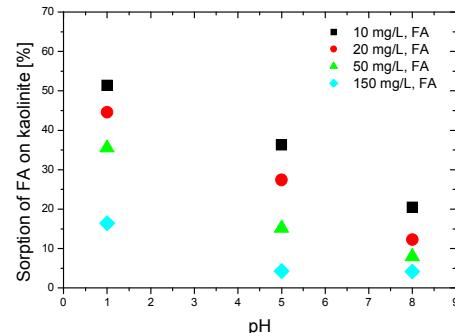


Figure 1: Sorption behavior of fulvic acid on kaolinite with varying FA concentration, [KGa-1b] = 4 g/L, contact time = 5 days

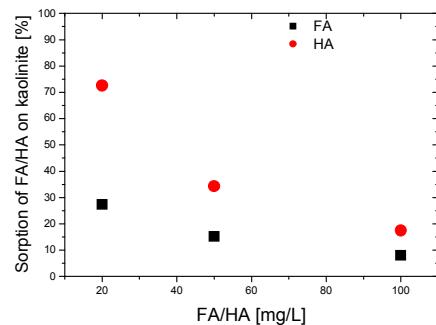


Figure 2: Sorption behavior of humic acid (HA) and fulvic acids (FA) on kaolinite as a function of varying concentrations at pH = 5

Figure 2 displays the percentage sorption of HA/FA on kaolinite at pH 5 for the concentrations 20, 50, and 100 mg/L. The sorption of fulvic acid on kaolinite is lower in comparison to humic acid. That might be explained by the lower molecular size of FA compared to HA and its more hydrophobic character.

## References:

- [1] Banik, N. L. et al., Institut für Kernchemie, Universität Mainz, Annual Report, C13, (2004)
- [2] Samadfami, M. et al., Radiochim. Acta, **88**, 717-721, (2000)