Study of humic acid like substances synthesis in the presence of montmorillonite (STx-1)

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Clay-humic complexes are formed preferentially in statu nascendi of the humic substances [1], therefore, studies are needed in order to understand the role of the clay minerals. The formation of humic acid like substances (HALS) in the presence of montmorillonite STx-1 (Clay Mineral Society) was studied. An interesting pathway for the formation of humic acids in soils is the condensation of sugars and amino compounds [2,3], as initially proposed by Maillard in 1912 [4]. It is well known that humic substances may affect the mobilization or immobilization of actinides in the environment. First studies were performed in order to determine the impact of montmorillonite STx-1 on the formation of HALS, using L-tyrosine or glutamic acid, and xylose as reactants.

HALS were synthesized in a batch experiment starting from 16.5 g xylose, 13.5 g L-tyrosine or 11 g glutamic acid, 3.2 g montmorillonite STx-1 and 150 mL water. After reflux boiling (100°C, 90 h) for L-tyrosine and (80°C, 90h) for glutamic acid [5], HALS products were isolated from the batch. The humic substance-like sorbate on montmorillonite was also isolated and studied. In the same way, pure montmorillonite STx-1 was treated and studied (Treated STx-1).

We isolated three phases for the synthesis starting from L-Tyrosine, the sorbate on montmorillonite (THS), a light organic compound (THL) and a dark organic compound (THD). Two phases for the synthesis starting from Glutamic acid the sorbate (GHS) and a dark compound (GHD) were isolated. Table 1 shows the yields, and carbon content mean value for the syntheses. Figure 1 shows the IR spectra for the GHS in comparison with that of treated montmorillonite. The strong line at about 1040 cm^{-1} and the shoulder at about 1120 cm^{-1} correspond to the asymmetric stretching Si-O-Si and Al-O-Si band in the IR spectrum [6], and points to the occurrence of montmorillonite residues in HALS. This could also explain the yield of the reaction, and the fact that the C content is low. These results indicate that the presence of montmorillonite during the synthesis starting from glutamic acid mainly influences the HALS yield and its elemental composition. This is not observed for the synthesis starting from L-tyrosine

Sample	Yield (g)	mg C/g
GHD	*0.2584*	285.1
GHS	*1.6260*	*17.1*
THL	*8.5763*	*590.45*
THD	*0.0187*	*530.115*
THS	*1.8994*	*11.8*

Table 1: Yields and carbon content for the synthesis.

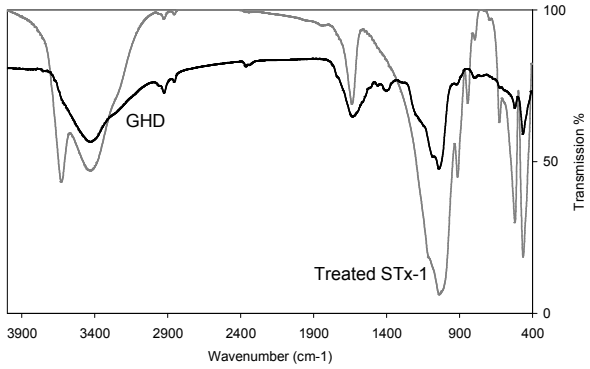

Fig. 1: Infrared spectra of Treated STx-1 and the dark organic compound GHD, synthesized in the presence of montmorillonite starting from glutamic acid.

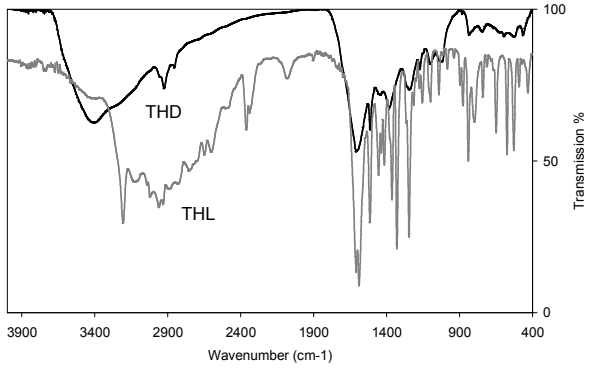

Fig. 2: Infrared spectra of the light organic compound THL and the dark organic compound THD, synthesized in the presence of montmorillonite starting from L-Tyrosine.

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