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Electronic Supplementary Information

Targeted design of water-based humic substances-silsesquioxane soft materials for nature-inspired remedial applications

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Table S1. An impact of pH on fractal dimensions of humic-siloxane networks during its evolution over 48 hours*

Time, hours	Fractal dimension					
	pH4	pH5	pH6	pH7	pH8	pH9
0.5	2.7	2.5	2.3	2.4	2.3	2.6
1	2.8	2.5	2.4	2.1	2.5	2.8
2	2.8	2.6	2.4	2.6	2.3	2.5
3	2.9	2.8	2.3	2.6	2.7	2.6
4	2.8	2.9	2.5	3.0	2.7	2.2
5	2.8	2.7	2.4	3.0	2.6	2.3
6	2.9	2.9	2.7	2.7	2.8	2.6
7	2.8	2.9	2.7	2.6	2.8	2.4
8	2.8	2.9	2.8	2.5	2.8	2.8
22	2.7	2.7	2.7	2.2	2.7	2.8
30	2.9	2.6	2.1	2.2	2.2	2.3
48	2.8	2.9	2.0	2.1	2.4	2.7

*CHP concentration was 5 g/L, CHP:APTES= 1:1. The clear cells refer to mass fractals dimensions, the shaded cells – to surface fractals.

Table S2. An impact of CHP:APTES ratio (w:w) on fractal dimensions of humic-siloxane networks during its evolution over 552 hours (at CHP concentration of 5 g/L, pH 7). The clear cells refer to mass fractals dimensions, the shaded cells – to surface fractals.

Time, hours	Fractal dimension at CHP:APTES rations (w:w)					
	0.5	0.67	1	1.33	2	4
0.5	2.3	2.7	2.4	2.4	2.2	2.3
1	2.5	2.7	2.3	2.3	2.3	2.2
2	2.9	2.9	2.6	2.3	2.3	2.3
3	2.9	2.7	2.6	2.3	2.3	2.2
4	2.7	2.7	2.9	2.3	2.3	2.4
5	2.6	2.8	2.9	2.6	2.6	2.4
6	2.7	2.6	2.7	2.8	2.6	2.4
7	2.6	2.7	2.6	2.9	2.6	2.5
8	2.7	2.4	2.5	2.8	2.7	2.5
22		2.1	2.3	2.5	2.6	2.5
30		2.2	2.2	2.1	2.8	2.5
48		2.2	2.1	2.1	2.7	2.5
56					2.8	2.4
72					2.9	2.6
80					2.9	2.5
96					2.8	2.5
104					2.8	2.5
168					2.6	2.3
216					2.6	2.6
264					2.6	2.4
336					2.5	2.5
552						2.5

Table S3. An impact of CHP+APTES concentration on fractal dimensions of humic-siloxane networks during its evolution over 48 hours (at, CHP:APTES ratio of 1:1, pH 7). The clear cells refer to mass fractals dimensions, the shaded cells – to surface fractals.

Time, hours	Fractal dimension at CHP+APTES concentration g/L			
	2.5	5	7.5	10
0.5	2.2	2.3	2.6	2.5
1	2.4	2.2	2.6	2.5
2	2.2	2.6	2.9	2.7
3	2.2	2.6	2.9	2.9
4	2.6	2.9	2.4	2.5
5	2.7	2.9	2.3	2.3
6	2.5	2.7	2.3	2.3
7	2.8	2.5	2.3	2.3
8	2.7	2.5	2.4	2.3
22	2.2	2.2	2.4	2.3
30	2.1	2.2	2.3	2.1
48	2.1	2.1	2.3	2.1

Table S4. An impact of Ca^{2+} concentration on fractal dimensions of humic-siloxane networks during its evolution over 48 hours (at CHP concentration of 5 g/L, CHP:APTES ratio of 1:1, pH 7). The clear cells refer to mass fractals dimensions, the shaded cells – to surface fractals.

Time, hours	Fractal dimension at Ca^{2+} concentration mM			
	0	1	2.5	5
0.5	2.3	2.4	2.4	2.8
1	2.2	2.6	2.8	2.9
2	2.6	2.8	2.6	2.9
3	2.6	2.8	2.7	2.5
4	2.9	2.7	2.7	2.3
5	2.9	2.5	2.7	2.4
6	2.7	2.1	2.1	2.3
7	2.6	2.2	2.1	2.4
8	2.5	2.1	2	2.1
22	2.2	2.1	2	2
30	2.2	2.1	2.1	2.2
48	2.1	2	2.1	2

Immobilization of the Humic Substances - Silsesquioxane (HS-SQ) Networks onto Silica Gel. To estimate sorption capacity of the HS-SQ networks, sorption batch experiments were conducted using silica gel as sorbent at room temperature (T = 22±2 ^{O}C). Stock solutions of the HS-SQ networks were prepared by adding APTES to the solution of CHP. They were used for a series of dilutions to prepare solutions with concentrations of CHP from 0.1 to 4 $g \cdot L^{-1}$. An aliquot (10 mL) of each solution was added with 0.1 g of silica gel. The resulting suspensions were placed into an overhead-shaker for 1 day. To measure concentrations of the HS-SQ networks, the optical density was monitored at 254 nm using UV-vis spectrometer (Cary 50, Varian Inc., U.S.A.). The amount of CHP sorbed was calculated as follows:

$$Q_{sorb} = (C_0 - C_w)\ V/m, \qquad (7)$$

where: Q_{sorb} is the amount of HS (mg) sorbed onto 1 g of silica gel (SiO_2), C_0 and C_w is initial and equilibrium concentration of HS in the solution ($mg \bullet L^{-1}$), respectively, V is the solution volume (mL); m is the mass of silica gel (g).

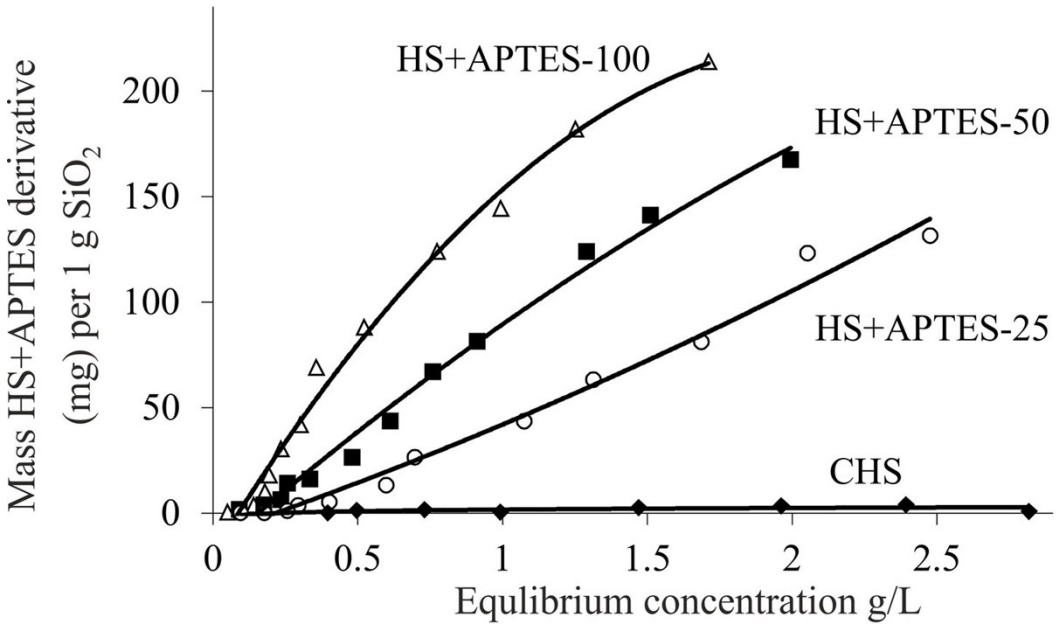

Figure S1. Sorption isotherms of the HS-SQ networks onto silica-gel. Sorption conditions: 0.028 M phosphate buffer, pH 6.0, 0.1 g SiO2 per 10 mL of HS solution, equilibrium time 24 h, T = 22 ± 2 ºC.