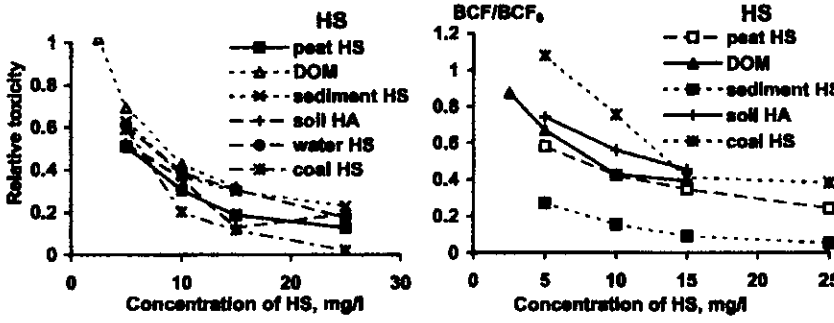
Mediating Effects of Humic Substances on the Toxicity and Bioconcentration of $HgCl_2$

Zhilin, D.M., Perminova, I.V., Matorin D.N., Petrosyan, V.S.
M.V. Lomonosov Moscow State University, Moscow, Russia.

An influence of the humic substances (HS) on the toxicity of $HgCl_2$ was investigated. The experiments were provided at pH=7 in the presence of 0.01 mol/L of KCl. Green alga *Chlorella pyrenoidosa* was used as test-object, the relative yeld of variable fluorescence - as test-function. The distribution of mercury between alga and water solution (bioconcentration factor) was also investigated. The exposure time was 4 hours. The experiments were provided at pH7 in the presence of 0.01 mol/L of KCl (in such a solution $HgCl_2$ is the predominant form of mercury). The investigated concentration of $HgCl_2$ was 0.8 mkmol/L (EK_{100}). The relative toxicity of mercury in the presence of humic substances was calculated as

$$T = \frac{R_0 - R_{d+1}}{R_0 - R_{0.8}},$$

where R_0 is the relative yield of variable fluorescence without toxicant, $R_{0.8}$ is the same at total concentration of mercury 0.8 mkM without humic substances and R_{d+t} is the same in the presence of humic substances. 24 samples of humic substances of different origin were under study. It was found out, that all samples of HS reduced bioconcentration factor of $HgCl_2$. 21 of 24 samples also reduced the toxicity. However three samples, on the contrary, *increased* the toxicity, despite they reduced the bioconcentration factor.



a) b)

Fig. 1. Influence of HS on the toxicity (a) and bioconcentration (b) of $HgCl_2$. The typical curves for HS from different environments are presented. BCF_0 is the bioconcentration factor in the presence of 0.8 mkM of $HgCl_2$ and the abscens of HS.

It was suggested, that the detoxification was caused by the removing of Hg(II) from toxic chloride to untoxic humate. To verify this hypothesys, the stability constants of mercury humates basing on bioconcentration factor (K_{BCF}) and toxicity (K_{tox}) were determined. For this purpose the equilibrium concentration of $HgCl_2$ was estimated under

sugestion, that only this form can be concentrated and provide toxic effect and the corresponding stability constant was calculated:

$$K = \beta(HgCl_2) \cdot \frac{C^2(Cl^-)}{C(HS)} \cdot \frac{(C(Hg) - [HgCl_2])}{[HgCl_2]}$$

All the values of the stability constants had the same order of magnitude (10^{14}). The stability constant determined from chemical experiment had shown good correlation with K_{BCF}, whereas no srong correlation were observed with K_{tox}. One can make a conclusion, that humic substances decrease the toxicity of $HgCl_2$ binding it into unuptakeable complex, but they also exert fine influence upon the biochemical processes in the algae cells, that complicates the impact of humic substances on the toxicity of $HgCl_2$.

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Study on possibility to apply humic substances for detoxication of soils polluted with rocket fuel components

Zlobina, Y.V., Kenesov, B.N., Ivanova, N.V.

Al-Farabi Kazakh National University, Chemistry Department, Karasay Batyr str., 95A, Almaty, Republic of Kazakhstan.

Pollution of environmental objects when exploiting rocket-space engineering is one of the main ecological problems. Huge Central Kazakhstan territories used for landing of rocket-carriers separating parts were found polluted with high-toxic rocket fuel components. The basic rocket fuel component is asymmetric dimethylhydrazine (ADMH), substance which belongs to the first class of danger and can remain in soil for a long time. Therefore a search of efficient methods of polluted territories detoxication is actual.

Known rocket fuel detoxication methods may be divided into several groups: chemical (oxidizing), thermal, radiation, biochemical and sorption. None of the methods being applied is universal. The use of oxidants results in the formation of substances more toxic than ADMH itself. Excess mineralization of soil can take place. Thermal and radiation methods are technically complicated and lead to atmosphere pollution. Efficiency of sorbents decreases because of good sorptional ability of soils in relation to ADMH.

Humates are widely used for detoxication of many contaminating substances. The purpose of this work was to investigate the possibility of using humic substances for ADMH bonding with non-toxic substances formation.

Model sand mixtures and soils sampled in rocket-carriers fall places in Central Kazakhstan were chosen as investigation objects. Humic acids and peat were tested as detoxicants. Concentration change of ADMH in mixtures of sand and soil with peat and humic substances was studied changing the ratio of mixture components, time, moisture content, pollutant concentration were studied. Asymmetric dimethylhydrazine was