Humic substances migration in the surface water of Ukraine

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Introduction

Humic substances (**HS**) are complex ensembles of macromolecules of variable composition and irregular structure, resulting from the biochemical decomposition of plant and animal residues.

In aquatic ecosystems, they make up the bulk of dissolved organic substances (60-90% C org) and affect the pH of the water, the state of the oxygen regime and cycles of nutrients and the stability of the elements of calcium carbonate equilibrium. HSs have the properties of a regulator of the redox state and determine the migratory ability of many microvoltants. Directly and indirectly affect the life of aquatic organisms.

The overall **goal** of this study was focused on the complex research of migration processes and distribution of HS between abiotic components in surfaces water of Ukraine, study of their properties and transformation regularities under influence of various factors

Methodology

Two main fractions of HS which are humic (HA) and fulvic acids (FA) were investigated in soils, water, precipitation and sediments (Fig.1).

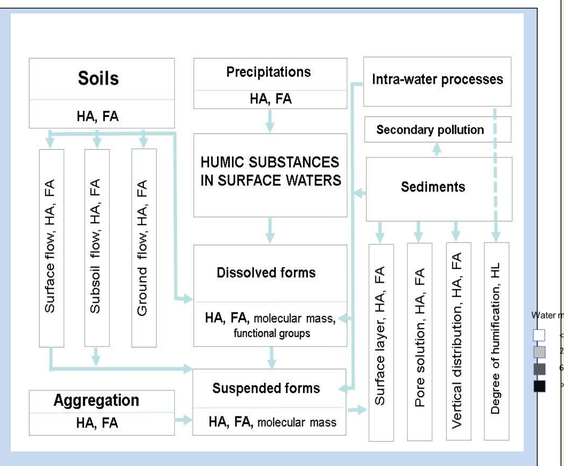

Fig.1. Research methodology

Results

1. The HS spatial-temporal distribution in the surface waters of Ukraine largely corresponds to the law of latitudinal zonality and is closely related to the zonal-genetic features of humus formation. The boundary conditions for the HS distribution in surface waters depend on the physical and geographical location of river basins, determine the reserves of humus in soils and its fractional group composition. Seasonal fluctuations in HS content are determined by changes in river water content.

The HS content in the azonal system of the Dnipro cascade reservoirs is determined by the income of the river Pripyat to the upper Kyiv reservoir and decreases towards the lower Kakhovske reservoir.

2. The coefficient of water migration which is characterized ratio in water and catchment soils was calculated for HA and FA, the zoning of the Ukrainian territory is carried out (Fig. 2).

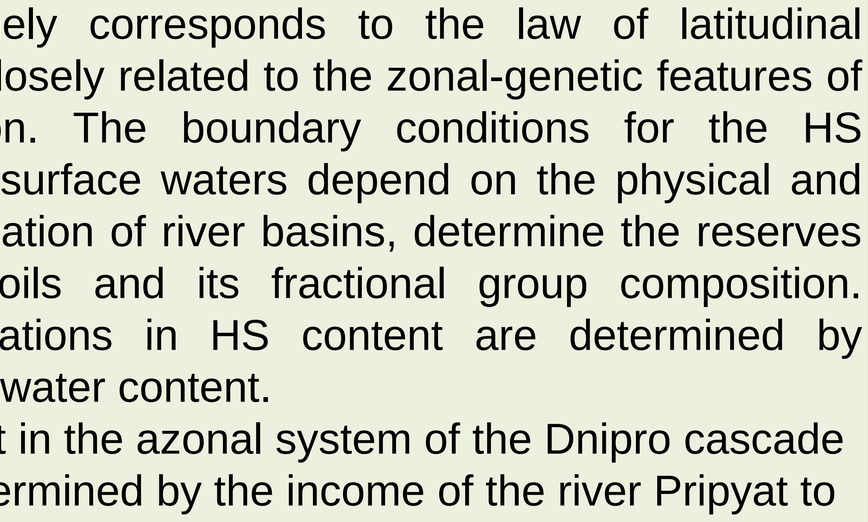

Fig.2. Zoning of the territory of Ukraine by the FA coefficient of water migration

Results

3. The solubility limits of the soil HS are determined. FAs are well soluble substances, thereby providing the transport function of HS in the environment. The mass fraction of soluble HA under the most typical surface water conditions of Ukraine does not exceed 2.2%.

4. The conformational changes of HS are predominantly due to a change in pH and water salinity (Fig. 3).

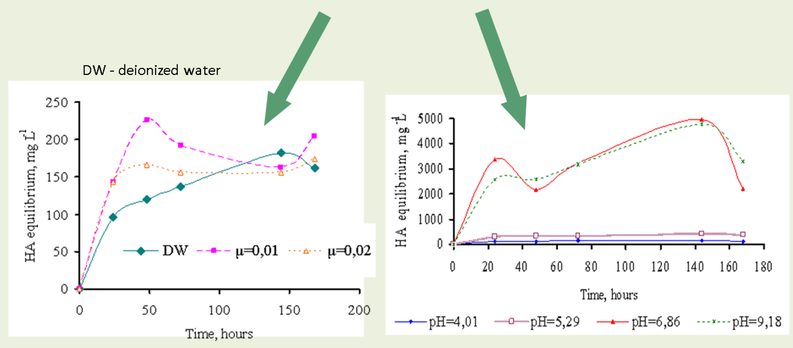

Fig. 3. HA solubility depending on the pH value and ionic strength of water (μ)

5. HA in surface water are characterized by heterogeneity and considerable polydispersity. The molecular mass of HA varies within the range of 11.3–18.6 kDa and the FA does not exceed 0.93–1.0 kDa. The polydispersity rate of HA and FC is respectively 2.50-3.32 and 1.9 (Fig.4).

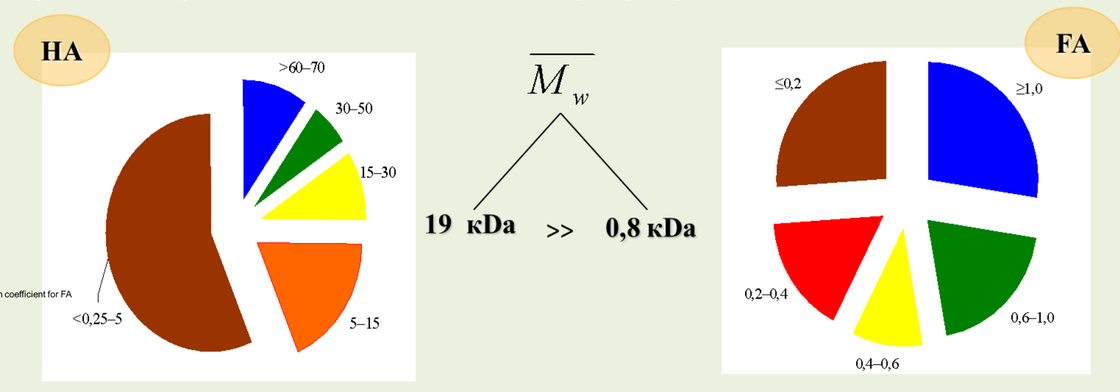

Fig. 4. Molecular weight distribution for HA and FA dissolved in water

6. Acid (–COOH and –OH) groups predominate among functional groups of HAs, which share reaches 38–55%.

7. Sorption by suspended substances play a major role in the processes of self-purification of water from humus, while the oxides and hydroxides of *Fe*, *Al*, and *Mn* have the maximum sorption capacity for the HS. Conducting the laboratory experiments, sorption isotherms of the HS are obtained by *Fe* hydroxides and clay minerals of suspended substances of the Dnipro reservoirs (Fig.5).

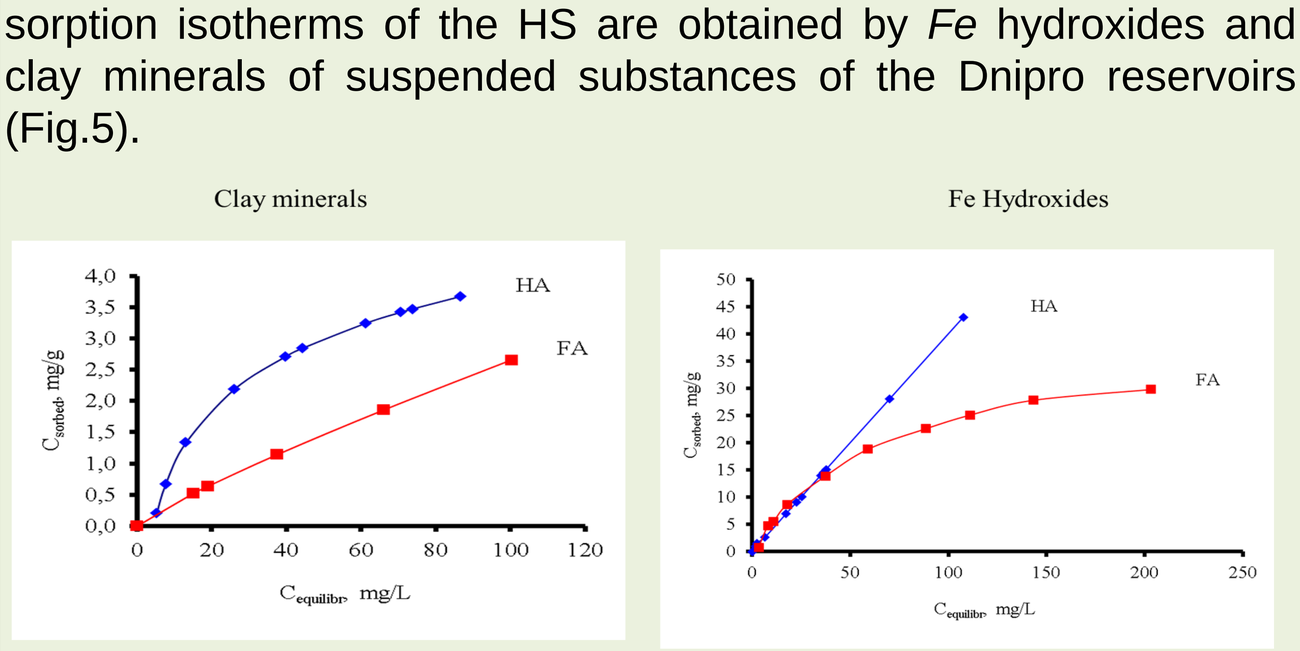

Fig. 5. HS sorption isotherms for clay minerals and Fe Hydroxides

8. The thermodynamic calculations of coexisting forms of HS in water were conducted. It is concluded that in the physicochemical conditions typical for the surface water of Ukraine, water contains 13–15% of free fulvate ions capable of binding heavy metals, which is an important characteristic for assessing the buffer capacity of water.