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X-Ray Diffraction Characteristic Of Humic Acids Of Alluvial Soils In Ob-Irtysh Floodplain, Formed In Various Moisture Conditions.

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ABSTRACT

This article provides new data that characterize composition and molecular structure of humic acid soil of the Ob-Irtysh floodplain. Their distinctive characteristics have been revealed, conditioned by the specifics of humification under conditions of different water cut. It was shown by X-ray diffraction, that humic acids of swampy alluvial soils have a greater proportion of aliphatic chains than alluvial turf soils. This article is devoted to the study of the processes of humification and humus accumulation, which play a pivotal role in understanding the genesis of soils under different zonal and introzonal conditions, which can be judged by the results of the interpretation of X-ray diffractogram. To study the chemical and physico-chemical properties of humic acids one can use the entire arsenal of modern instrumental techniques, but recently there have been almost no works on the X-ray diffraction characteristics of humic acids. At the level of current knowledge, it is obvious that the molecular structure and chemical nature of humic acids may contain valuable information that indicates the conditions and mechanisms of humification in soils. Therefore, there has been increasing interest in the study of "fine" structure of humic substances using modern instrumental techniques. Despite the fact that the practical importance of these studies has not yet been fully used by soil scientists and agrochemists, the majority of experts do not doubt prospect of such works. This area has favorable conditions for agricultural development in order to create forage lands (pastures and hayfields).

Keywords: humic acids, humification, alluvial soils, X-ray analysis, Ob-Irtysh floodplain.

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INTRODUCTION

Humic acids are widely spread in nature. They are part of soil organic matter, peat, decay ooze, shale and brown coal. [1]

The question of the sources of humic substances - compounds involved in humification and their origin is extremely important. As the right answer to this question is connected with reasonable representation not only of the ways of formation of humic acids, their genesis, but also of their structure. [2] Almost all modern researchers believe that the structural units (or structural fragments) of natural biopolymers are included as basic blocks in molecules of humic and fulvic acids.

The well-known variety of humic substances is conditioned by heterogeneity of their formation and interaction with mineral component, features of original organic matter and conditions under which the processes of soil happen. That is why genetic soil science and assessment of soil fertility have always had a great need for an objective characterization of the composition of humus and its individual components [3,4]. Humification process of excessively wet soils of the floodplain marsh occurs during prolonged flooding, where soil and ground water rises to the surface. Excessive moisture leads to acidification of soils and humification process becomes rather passive. Turf process corresponds to a more advanced humification since high population of not waterlogged soils of floodplain with soil organisms, soil fertilizing animals causes high intensity of soil processes, resulting in the destruction of peripheral circuits in molecule of humic acid, it has a more mature form and is characterized by high degree of benzenoid and the lowest molecular weight [5].

The degree of humification of the soil is characterized by a specific composition of humic acids extracted from it, which can be studied by X-ray diffraction.

Humic acid material is amorphous, and the assumption of its crystalline structure [6] are not correct. X-ray analysis of humic acids indicates coherent dispersion that indicates amorphous state of humic acids [7]. The total composition motif is characterized by low order, with local areas of monotonous repetition of some of the structural elements. Interferential strips near the primary batch indicate that fragments with large parameters are present in macromolecules of humic acids.

SUBJECTS AND METHODS

The objects of the study are samples of humic acids taken from the surface layers of soil of interstream area of the Ob and the Irtysh near the town of Khanty-Mansiysk (Table 1). They were formed under different conditions of water cut and one can assume that organic mass humification differences should be reflected in their molecular structure.

Table 1: Soils for humic samples extraction

Sample ID	Initial soil	The period of excess soil moisturization
Ad	Alluvial turf	Periodic moisturization in some years from 14 to 19 days
Ab/itg	Alluvial and marsh silt-peaty-gley	Constant moisturization with the process of gleying from 70 to 90 days (maximum - 97-135 days)

On the territory of the Ob-Irtysh floodplain alluvial soils are quite common. They were formed under conditions of long-maned and depressed relief of the Ob floodplain and tributaries.

The main factor involved in the formation of alluvial soil is high water that periodically overwhelms flood plain. High waters bring and deposit substances on the floodplain that differ in chemical, mechanical and quantity respect.

These waters that contain substances dissolved to different degrees affect soil forming processes and are the source of groundwater recharge. Under the influence of the huge mass of water special, different from the watershed areas, micro-climatic conditions appear.

One of the main factors of soil formation is turf process. Under the conditions of excess moisturization particularly dense turf is formed on alluvial soils. With further increase in soil moisture waterlogging occurs as well as marsh soils and alluvial peat bogs creation.

To settle the issues of the present research work samples of soil humus layers located near the Ob and the Irtysh confluence at villages Lugovskoy and Belogorie have been selected.

Cuts were made and morphological description given to characterize the soils.

The soil samples delivered to the lab were dried, rubbed in disk mill and sieved through a sieve with openings of 1 mm. Roots and other plant remains that did not decompose were removed mechanically beforehand.

Using alcohol-benzene extraction lipids were removed from the dried samples (1: 1), soil decalcification was carried out. Humic acids were extracted with decimolar sodium hydroxide solution. Then settlement and ash admixtures cleaning were carried out using multiple treatments with HCl and HF.

X-ray diffraction studies were carried out on the particle accelerator at the Institute of Nuclear Physics of SO ANFR.

RESULTS AND DISCUSSION

Radiographic study is important to describe configuration of macromolecules their size and spatial distribution.

In a collision of moving at light speed electrons with different spins and positrons X-ray occurs. The necessary for research wavelength of X-ray is set on special equipment. It is most effective to use "soft" radiation of cobalt or iron in conventional X-ray diffractometers (DRON) for amorphous humic substances. The studies carried out on conventional copper radiation with a shorter wavelength did not allow to achieve the necessary resolution for amorphous humic acids. These results may have only limited use for determining mineral composition of preparations. Therefore, when using the accelerator 1,7711nm wavelength was established.

Humic substances received from the soil of flooded and not flooded floodplain, are characterized with diffraction peaks, high intensity that is equal to these types of soils, which corresponds to the interplanar distance 4,8Å.

There are also peaks corresponding to the average period of 2.8 and 2,1Å. They define presence of silicone dioxide in the preparation.

Diffraction patterns of all the preparations of humic acids studied by us are characterized only by the presence of diffuse peaks, indicating a disordered molecular structure. Against this background some of peaks appear, which undoubtedly can be attributed to the mineral components due to the high ash content of the preparations. At the same time we should note that there are areas of local ordering in the macromolecule of humic acids itself (figure 1).

This applies primarily to diffuse peak in the region of 22 ° at 2θ diffraction angles that corresponds to 4,8Å of interplanar spacings. This is a characteristic γ band. It is commonly believed that the smaller intensity of this band, the fewer are peripheral circuits and molecules are more ordered [8].

The obtained diffraction patterns have less prominent interference at angles 2θ, equal to 21,78 ° with humic acids of turf soils in comparison with humic acids of swampy alluvial soils that indicates a lower content of peripheral fragments. To a certain extent this reflects peculiarities of the process of humification under different hydromorphic conditions.

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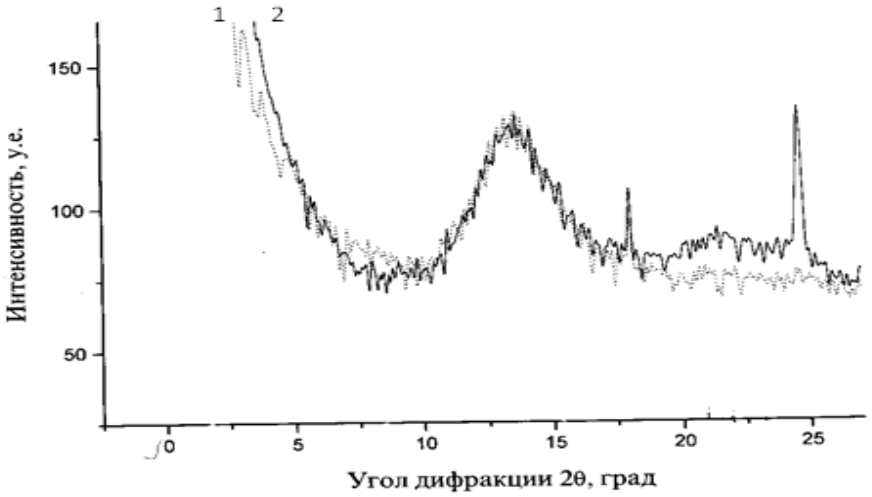

Figure 1: - X-ray diffraction patterns of humic acids: 1 - sod alluvial soils; 2 - alluvial marsh soils

The diffuse band of interference with peak at 2θ angles that are equal to 13,66 °, characterizes the distance between the adjacent aromatic rings. Its identity in humic acids of soils of different origin may indicate a similar skeletal structure of macromolecules of humic acids.

Maxima corresponding to the average period of 3,57-3,6Å indicate existence of interplanar distances between the grids of aromatically ordered carbon. If this band of interference has a high intensity, the structure of the molecules of humic acid can be considered more orderly. [8]

Thus, on the example of comparing the X-ray diffraction patterns of humic acids of alluvial sod soils and alluvial marsh soils, you can see the confirmation of the information about the peculiarities of humification in soils of the Ob-Irtysh floodplain, obtained by other methods.

CONCLUSIONS

1. X-ray diffraction method is shown in colliding beams that humic acid alluvial sod soils have a lower intensity of γ - band and different features of the other parameters of radiographic cartograms, indicating more regular ordering of macromolecules compared with humic acids isolated from the alluvial soils of the marsh.

2. Humic acids of alluvial sod soils, which are the most promising for agricultural development have the greatest formedness - "maturity" - of molecular structure.

SUMMARY

Thus, the principles of X-ray analysis allow to objectively evaluate the structure of humic acids, amorphous substances formed under different hydrothermal conditions. Based on the above mentioned material we can draw a conclusion about promising outlook of the proposed solutions in the realm of chemical nature study and biological characteristics of humic acids along with other instrumental methods.

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REFERENCES

[1] I.D. Komissarov Humic substances / I.D. Komissarov. Works. Tyumen. Agricultural Institute. -1970. - V.14. - P. 4-5.

[2] Selman, A.Vaksman Humus. The origin, chemical composition and significance in nature M. Selkhozgiz. 1937.
[3] Alexandrova Soil organic matter and its transformation processes / L.N. Alexandrova. L .: Nauka, 1980.-287 p.
[4] D.S. Orlov Humic soil acids and the general theory of humification /D.S. Orlov. - M .: MGU, 1990. 325 p.
[5] GV Dobrovolsky G.V. The soils of floodplains in the center of Russian Plain. M .; Ed. MGU, 1968. 296p.
[6] I.D. Sedletssky Results of studying the structure of humic substances using X-ray and thermal methods. Reserve of Kharkov Institute named after V.V. Dokuchaev. v.5. 1964
[7] I.D. Komissarov, L.F. Loginov X-ray characterization of humic substances, received from oxidized coal and peat using alkaline extraction. Tyumen. Agricultural Institute. - 1970 - P. 91-99.
[8] V.I. Kasatochkin, O.I. Zilberbrand Radiography and infrared spectroscopy applied to the study of humic substances structure / V.I. Kasatochkin, O.I. Zilberbrand II. Soil science. -1956. - № 5. - 80-85pp.