ISSN 1070-4272, Russian Journal of Applied Chemistry, 2015, Vol. 88, No. 8, pp. 1311−1315. © Pleiades Publishing, Ltd., 2015.
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VARIOUS TECHNOLOGICAL PROCESSES

Effect of Mechanical Activation on the Composition if Mineral Components in Humic Acids Isolated from Carbons

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Received August 24, 2015

Abstract—It is shown that the mechanical activation of oxidized and brown coals is accompanied by an increase in the yield of humic acids and in their content of functional groups. It was demonstrated by atomic-emission spectroscopy that, under a high-intensity mechanical treatment, mineral elements are redistributed in the coal substance and incorporated into the structure of humic acids.

DOI: 10.1134/S1070427215080133

Humic acids (HAs) contained in all natural media, including natural water, soil, peat, sapropels, and coals, play an important ecological part in the biosphere. The interest in studies of HAs capable of accumulating and delivering nutrients and microelements to plants and binding metal ions into stable complexes has been steadily growing [1, 2]. However, HAs contained under natural conditions in soils and caustobioliths are in a bound, low-mobility state, which is reflected on their reactivity and biological activity. Therefore, new principles are being permanently developed and techniques for obtaining humic preparation are steadily improved.

The authors of [2–4] have shown that HAs can be chemically modified as new-generation plant-protection means. Enrichment of HAs with quinoid fragments will make it possible to obtain effective preparations for detoxication of soils contaminated with heavy metals, iron humates serve as chlorosis correctors for plants, and silicon humates, as bioactivators under abiotic stress conditions. Performing an acid hydrolysis of HAs under mild conditions makes higher their content of skeleton fragments, which predetermines the binding constants of HAs with polycyclic aromatic compounds.

The results of [5, 6] demonstrate that the HA structure can be modified by mechanochemical activation. The chemical activity of caustobioliths under a mechanical treatment changes not only due to the dispersion, formation of new pores and opening of previously inaccessible pores, and increase in the external and internal surface area. In addition to these phenomena there occur changes of physicochemical properties, associated with rupture of chemical bonds and formation of soluble products, volatiles, etc. The mechanical treatment gives rise to excited states whose relaxation is accompanied by emission of electrons.

When peat is subjected to a high-intensity mechanical treatment, the chemical composition of its main components significantly changes, which results in that the yield of HAs becomes higher, their solubility grows, and their content of functional groups increases. It has been shown that HAs can be oxidized and activated in the course of a mechanical processing of peat or coal, with highly efficient plant growth stimulators obtained on their basis [7].

The physiological role of HAs is associated not only with their organic part, but also with mineral components