Mechanical and mechanochemical activation of West Siberian peat

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It is known that mechanochemical treatment in the presence of reagents of various nature (acid-base, redox, enzymes) leads to changes in the quantitative contents, physical, chemical properties and reactivity of the main components of peat, including humic acids [1]. The aim of this work was to study the effect of mechanical and mechanochemical activation of the West Siberian peat from forest steppe on its copper ions bind capacity. The peat under study contains 2.7% humic acids, 2.8% fulvic acids and 2.17% of ash.

The mechanical activation of peat was carried out in a planetary mill AGO-2. The mechanochemical activation of peat was carried out under the same conditions with 5% wt. dry sodium percarbonate $Na_2CO_3 \cdot 1{,}5H_2O_2$, which previously showed its effectiveness in the mechanochemical oxidation of brown coal humic acids [2].

The surface properties of peat before and after mechanochemical treatment were studied by thermal desorption of nitrogen. It was found that C_{BET} increases from 6.26 for the initial peat to 18.18 for mechanically activated (MA) peat and to 27.83 for mechanochemically activated (MCA) peat. The capacity of the monolayer for the initial peat is 0.957 mg/l, for MA peat it decreases to 0.858 mg/l, for MCA it increases to 1.092 mg/l. The specific surface area calculated by the Brunauer-Emmett-Teller equation for the initial peat is of 4.2 ± 0.3 m^2/g, for MA peat is of 3.7 ± 0.2 m^2/g, for MCA peat it increases to 4.8 ± 0.3 m^2/g.

The results of reverse potentiometric titration and IR spectrometry indicate that the mechanical and mechanochemical activation of this type of peat under the conditions used does not increase the content of phenolic and carboxyl groups. The IR spectra of MA and initial peat are similar, while the IR spectrum of the MCA peat shows a decrease in absorption in the regions of 1725 and 1260 cm^{-1}, with a simultaneous increase in the regions of 1613 and 1418 cm^{-1}, which indicates the passage of a chemical reaction neutralization of the acid groups of humic acids and their transformation into the form of sodium humate.

Cu (II) ions sorption experiments were carried out. The peat under investigation could be efficiently used for removal of cooper from low-level liquid waste. Graphical solution of the linear Langmuir equation for sorption on peat gives the following values Q = $2.5 \cdot 10^{-3}$ mmol/g, and a constant = $0.76 \cdot 10^2$. A comparison of the IR spectra does not show a significant difference in the content of the main functional groups in the studied peat samples. The spectra for mechanically activated peat before and after copper sorption is almost identical, which may indicate the physical nature of the sorption of copper ions on this peat. Sorption characteristics can be improved by changing the surface properties, for example, by mechanochemical treatment under the described conditions.

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References

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