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SORBENTS BASED ON BROWN COAL AND ITS PROCESSING PRODUCTS: REVIEW

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The article provides a comprehensive analytical review of modern scientific approaches to the use of brown coal (lignite) and its processing products as effective sorption materials for cleaning up polluted environments. It reveals the physicochemical characteristics of lignite that determine its high sorption activity, in particular its porous morphology, the presence of functional groups (carboxyl, phenolic, hydroxyl), and its pronounced ion exchange capacity. The results of experimental studies confirming the effectiveness of brown coal in removing toxic heavy metal ions (Cr(VI), Cd(II), Cu(II), Fe^{2+}, Ni, Pb, Zn) from aqueous environments, as well as its ability to stabilize contaminated soils, are summarized.
Particular attention is paid to humic acids as one of the most promising derivatives of brown coal. Humic acids isolated from lignite, due to their high-molecular polyelectrolyte nature, the presence of numerous functional groups (carboxyl, phenolic, hydroxyl) and the ability to chelate with metal ions, demonstrate high efficiency in removing heavy metals from aquatic and soil environments. The mechanisms of sorption, in particular ion exchange, complex formation, hydrophobic interaction and pseudomicellar organization, which determine the high selectivity and sorption capacity of humates, are analyzed.
The practical aspects of introducing lignite sorbents into technological solutions for purifying natural and waste water, as well as soil, were also analyzed, both as separate sorption agents and in combination with other natural materials, in particular modified zeolites. It is emphasized that brown coal-based sorbents are characterized by low cost, high availability, environmental safety and regenerative capacity, which determines their potential for use in environmental remediation and sustainable management of man-made waste.

Keywords: brown coal, lignite, humic acids, sorbents, heavy metals, ions, soil remediation.

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