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PRACTICAL USE OF MODIFIED COALS AND HUMIC ACIDS

The cation-exchange properties of some coals and humic acids obtained from them are well known [1-5]. However, the widespread use of coal sorbents in this capacity is possible with the improvement of a number of operational and technological characteristics. One of the effective ways to solve this problem is the chemical modification of coal and HA, which makes it possible to increase their chemical resistance in various environments, introduce a number of functional groups capable of ionization and, consequently, increase sorption properties.

We have studied the ion-exchange properties of the initial humic acid (HA), chlorogenic acid (CGA), aminochloro-humic acid (ACHHA) with respect to the copper and nickel ion. The results of the studies show that, under equal sorption conditions, the values of the SEC of these samples depend both on the nature of the sorbed cation and on the structure of the sorbents studied.

Table 1 shows the values of the static exchange capacity (SEC) of chlorine-modified (CHC and CHHA) and aminochloro-humic acids (ACHHA). A comparison of the sorption capacity of the samples under study shows that they have a slightly higher SEC copper ion than humic acid (HA). In the case of sorption of nickel cations, aminochlorinated carbons (ACHC) have the best results. The introduction of an amino group into the compound increases the SEC for nickel by 8 times. Under the same conditions, ordinary coal (OC) sorbs nickel cations slightly, and HA exhibits specifically low activity to them. Thus, the modification has a great influence on the value of the SEC of humic acid.

Table 1 - Ion exchange properties of modified coals and HA

Coal	Extraction, %		
	Ni^{2+}	Cu^{2+}	Cu^{2+}
OC (ordinary coal)	0,04	0,92	-

CHC (chlorinated coal)	0,08	1,49	68,0
HA (humic acid)	1,30	3,21	87,5
CHHA (chlorhuminic acid)	2,09	3,85	75,8
ACHHA-F* (aminochloro-humic acid)	0,42	0,42	81,0
*-after heat treatment			

It was of interest to study the ion-exchange properties of the synthesized polycondensate ACHHA-F. This compound, after curing, is insoluble in water, alkalis, so the sorption process of various cations can be carried out at pH > 7. This is due to the formation of a three-dimensional polymer mesh due to the interaction between various functional groups, as a result of which the number of ionogenic groups in the sorbent structure decreases. We have studied various factors of the copper cation sorption process, the results of the studies are presented in Table 2.

Table 2 - Dependence of the sorption capacity of ACHHA - F with respect to copper ions on various factors

Factor			SEC, mg-eq/g	Degree of purification, %
S:L	pH	$[Cu^{2+}]$, mol/l		
1:500 1:250 1:150	6,1	0,0006 0,0006 0,0006	0,208 0,250 -	33,3 80,0 96,8
1:500 1:500	6,1	0,0013 0,0032	0,291 0,416	23,3 53,3

The degree of copper extraction depends on the pH of the medium, the concentration of copper ions, the ratio of the solid and liquid phases of the solution components. The largest sorption value for ACHHA-F is observed at a ratio of solid and liquid phases of 1:150. The concentration of metal ions in the solution is also important: with a three-fold increase in concentration, the degree of purification increases twofold. Under optimal conditions, the degree of purification reaches 96.8%. The use of ACHHA-F is preferable in highly alkaline and highly acidic areas.

Thus, the presented results indicate that compounds containing amino-, chloro- and carboxyl groups exhibit high sorption capacity with respect to metal cations. The degree of copper extraction is 81-96.8%, respectively. The data obtained suggest the possibility of using the compounds as an effective sorbent for wastewater treatment.

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