THE MODIFIED CARBON FIBRES AS SELECTIVE ADSORBENTS FOR COLOR AND NOBLE METALS FROM WATER SOLUTIONS.

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Introduction

The complex forming adsorbents in traditional (grain, powder) and fibre forms may be used for evaluation and concentration of mikroelements, including color and noble metals [1]. The high velocity of equilibrium reaching and in some cases the great value of sorption capacities are the advantages of carbon fibre adsorbents, Cfs, as well as the possibility of develop-ment of original adsorption technique, On the analogy between activated coals and CFs the target-oriented modification (activation, oxidation, sulfonation) of industrial CFs is supposed to result in obtaining of their new properties, e.g. of ion exchange ability and sorption selectivity, The possibility of their using for mikroelements extraction from complex mixtures for technology and analysis may be examined too.

The present communication includes the results of investigation of adsorption selectivity of CFs treating by different methods with reference to ions of iron(III), copper(II), chromium(III), nickel(II), cobalt(II) and platinum metals (ruthenium, rhodium, palladium and iridium) compounds.

Experimental

The modification of CF - activation, oxidation, sulfonation - was made by known methods commonly applying for treatment of routine grain and powder activated coals [2]. Sorption experiments were carry out as from one-component as from polycomponent solutions in static and dynamic conditions.

Results and Discussion

The activated samples of carbon fibres (CFA), which have anion-exchange properties, were found to demonstrate sufficiently small values of adsorption of iron(III) and color metals' ions, figure 1. The same adsorption values were shown for extraction iron(III) and chromium(III) from concentrated chloride solutions (10 -20% NaCl), it is probably connected with formation and adsorbtion of anion complexes. A pronounced (10- 20 mg/g) adsorbtion of metal ions pointed out was shown for cation exchange forms of oxidized(CFO) and sulfonated (CFS) carbon fibres. In these cases the cation exchange occurs selectively similarly to activated coals: the presence of competing cations of sodium or other one-charged ions as well as calcium or magnum ions, does not effect the adsorbtion. The selectivity of CFS samples is somewhat smaller than CFO ones and these results are also close to that for sulfocoals.

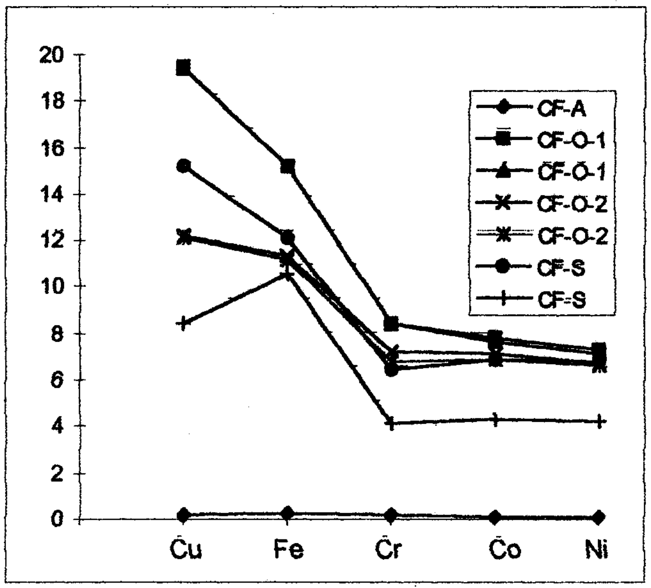

Figure 1. Sorption of unnoble metal ions by modified CF : activated CFA, oxidized CFO-1 and CFO-2, sulfonated CFS (one component water solutions, and 10% NaCl water solution)

The analogy between sorption behavior of CFs and other coals modified by the same way was observed for adsorbtion of microamounts of platinum metal compounds (PMC). Thus, ruthenium, rhodium, palladium and iridium compounds are absorbed effectively by all CFs to be studied from hydrochloric and sulfuric acid solutions. Dependencies of PMC sorption on their initial concentration, acidity, other factors were found to be the same as previously obtained for activated coals [2]. CFs demonstrate the strong selectivity of PMC extraction as other carbon materials. Thus, adsorbtion of PMC under study is the same as for one component solutions as for *polycomponent solutions containing apart from* element to be evaluated the mixture of iron(III), copper(II), chromium(III), manganese(II), cobalt(II) and nickel(II) sulfates, the concentration of each salt being equal 50 mg/l (figure 2). On the base of comparison of results of sorption of mikroelements to be studied and their desorption by various eluents - water, acid solutions, different salts and complex forming substances - the cation-exchange mechanism for iron(III), cobalt(II), nickel(II), copper(II), chromium(III) ions adsorbtion by CFO and CFS samples has been determined. This adsorbtion mechanism seems to be connected also with formation of surface complexes, presumably chelate ones. The pointed out cations are fully desorbed from modified CFs by 0.5 - 1.0 M acid solutions.

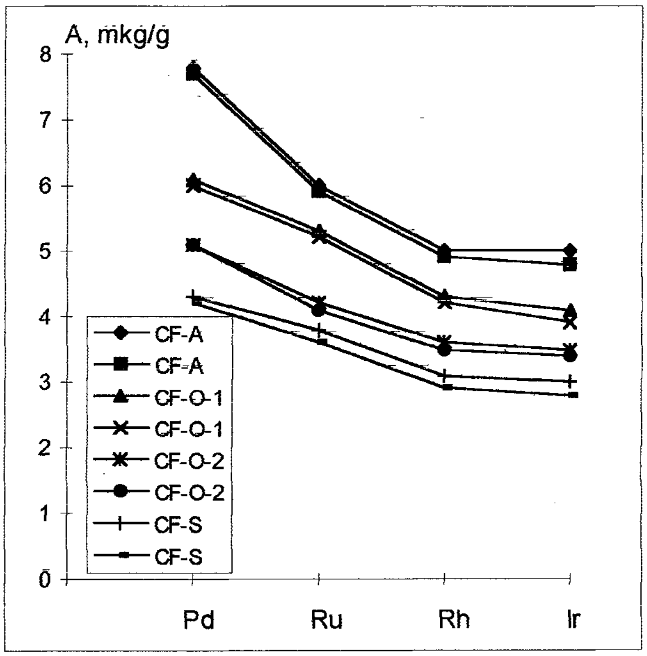

Figure 2. Sorption PMC by modified CFs: CFA (1,2), CFO-1 (3,4), CFO-2 (5,6), CFS (7,8).
(1,3,5,7- one-component 1 M hydrochloric acid solutions, 2,4,6,8 -polycomponent solutions)

The mechanism of PMC adsorbtion is more complex and includes physical sorption, anion exchange, and formation of complexes of chelate type with surface functional groups as well as complexes of donor-acceptor type with π-conjugated electron systems of carbon matrix. In some cases, particularly for palladium, the reduction of metal ions to metallic state is possible too. The interaction between PMC and carbon matrix is supposed to be the main reason of strong selectivity of these compounds extraction by CFs because this interaction is not typical for other metal ions.The samples of CFs of great activation without surface groups were shown to have some advantages for PMC adsorbtion between CFs with different treatment as it was shown for other carbon materials [3] because for all carbon adsorbents the interaction of PMC with carbon matrix is prevailing.

The modified CFs with selective sorption properties may be applied for extraction and concentration of mikrocomponents from complex systems for technology and for analysis.. Especially, evaluation and concentration of unnoble and platinum metals from water and from solutions with complex composition with using of disks from CFs in filters is very effective as it was found by spectral analysis of adsorbents and eluents.

Conclusions.

Activated, oxidized and sulfonated carbon fibres were found to be effective and in some cases selective adsorbents for iron, color and noble metals ions extraction from water and solutions with complex composition. The properties of CFs are close to the same of other carbon materials with the corresponding treatment. The modified CFs seems may be recommended for using as plates, bands, disks and so ones for selective evaluation and concentration of mikrocomponents from various water solutions with complex mixtures of accompanied species. Thus, these sorption materials are possible to be using in place of commonly applied activated coals in technological processes because they demonstrate some advantages as comparison with traditional grain and powder sorption materials.

References

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