

THE INVESTIGATION OF SILVER AND COPPER (II) SORPTION FROM WATER SOLUTIONS BY CHLORINECONTAINING COALS OF UKRAINE

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Introduction

Earlier the authors have shown that Ukrainian salty coals (SC) are characterized by a series of considerable peculiarities of composition, structure and properties. Namely, a great quantity of alkaline salts (to 16 % of Na₂O in ashes), humic acids (to 35 % on coal organic mass (COM)), different valuable and toxic microelements contents in of salty coals composition. The main component, determining difficulties of salty coals utilization, is sodium chloride [1,2].

Taking into account the above-mentioned complex of SC properties, the silver sorption from exhaust cinephotosolutions and copper sorption from acetate solution have been studied. The attempt to established the main forms of silver and copper adsorpted with SC, and some transformations of COM structure during long-time interaction of SC and copper solution has been made. These knowledges are necessary for determination of rational ways for SC utilization.

Experimental

Salty coals of Novomoskowskoye deposit of Western Donbas (Ukraine) were investigated. Some characteristics of studying coals are (%): W^a - 5 ÷ 7; A^d - 10 ÷ 20; C^{daf} - 68 ÷ 72; H^{daf} - 4.9 ÷ 5.2; Na₂O in ash - 6 ÷ 16; chlorine content in the coals is 0.4 ÷ 0.8 % wt.

Silver adsorption from cinephotosolutions at C₀ = 11.77 mg/dm³ and different coal: solution ratio (1:10 - 1:100) was estimated by atom-adsorptional analysis.

Copper sorption from Cu(Ac)₂ solution at C₀ = 2.00 g/dm³ during 40 days at coal:solution ratio 1:100 was determined.

Equal copper concentration in solution has been determined with photolorimetrically at λ = 590 nm. Structural transformations of COM and forms adsorpted copper and silver were examined with X-ray analysis.

Results and Discussion

As it has determined earlier [1], the structural unity of salty coals organic mass is characterized by the compact packing of 3-4 polyarene layers (d₀₀₂ ~ 3.56 Å) with the bloc diameter (L_a) from 15 to 25 Å. The coals specific surface does not exceed 10 m²/g.

It has been established, the silver adsorption from cinephotosolutions by SC is submit to the Freundlich' law. The optimal ratio coal:solution = 1:100, that permits to obtain the silver extraction (at C₀ = 11.77 mg/dm³) of 99.2 %. In this case, lowering of adsorbent expense divisible by 4 has been observed in comparison with the phototype [3].

The forms of adsorpted silver were determined, they are AgCl and Ag⁰ (refleces 2,04; 2,36 Å, etc.). Figure.

The obtained results are explained from the point of view of the theory of reductive sorption. The natural coals are polyfunctional reagents and their variety - salty coals - are characterized by the expressed ability not only of ion exchange, surface complexes formation, but also the reductive sorption.

A high effectivity of Ag-sorption from solutions is connected with that Ukrainian salty coals have a larger length of chain of π-polyconjugation, presence of Cl⁻ ion in interlayer and interpack space.

As for copper, it has been determined the interaction between Cu-solution and coal during long-time period has periodical character, where it can allot sorption and desorption stages.

Copper sorption maximum has been observed on third day after experiment beginning, it consist of 86 % or 17,2 mg/g. The periodical variation of copper sorption is accompanying by pH change.

Then, periodical character of Cu sorption-desorption correlate with sedimental properties of system coal-copper solution.

According to X-ray data swelled in the Cu-solution coal have high-odered structure in the point of maximum Cu-sorption and in the point of minimum Cu-sorption - maximal disordered structure of COM [4].

References

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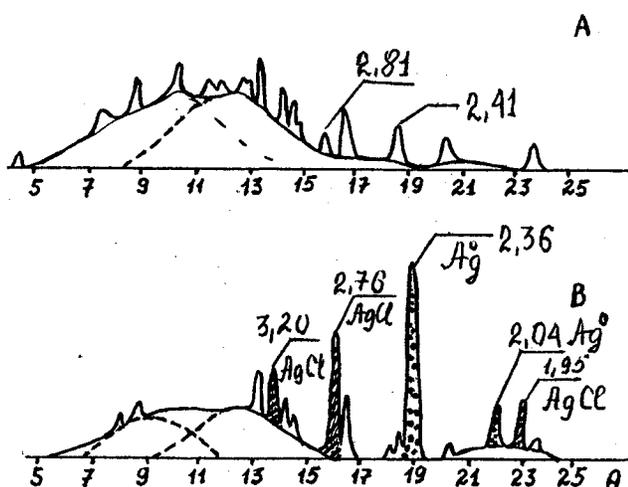


Figure X-ray diffractogrammes of initial coal (A) and coal after silver sorption (B).

According to X-ray data swelled in the Cu-solution coal have high-ordered structure in the point of maximum Cu-sorption and in the point of minimum Cu-sorption - maximal disordered structure of COM [4].

We suppose, the high-ordered structure of coal is formed as a result of water molecules insertion into coal structure ("crystalline hydrate of coal" formation) [4]. In this process complexforming copper ions take part (as and Fe^{+3} , Cr^{+3} , Mg^{+2} , etc).

Conclusions

- The principal possibility for SC utilization as the adsorbents of Ag and Cu from its water solution was shown.
- Optimal parameters for Ag-sorption with SC from sewages of cinephotoindustry were determinated.
- Some generalities of structure transformation of SC organic mass during long-time Cu-sorption process have been established.