TiO_2 sample was obtained by hydrolytic method as described in [1,2]. Briefly, TiO_2 nanopowder was prepared using hydrolysis in aqueous and alcohol solutions by mixing water and Titania precursor at ratio 5 to 1. For the synthesis the mixture of reagents was heated up to 95 °C under continuous stirring and then kept for 40 minutes. The obtained precipitate was dried in an oven at 80 °C for 6 hours and then ground in mortar.

In this study, we investigated adsorption characteristics and photocatalytic activity of the obtained nanomaterial. Method of nitrogen adsorption/desorption was used in order to evaluate BET specific surface area of the synthesized nanopowder (S_{BET} = 199,4 m^2/g). Degradation rate of methylene blue (MB) model solution (cationic organic dye) under UV irradiation was used to determine photocatalytic activity of the TiO_2 sample. It was found that the synthesized TiO_2 sample was highly active and allowed 90% discoloration of the model dye solution under the experimental conditions (MB solution concentration – 10 mg/L, MB solution volume – 50 mL, photocatalyst doze – 50 mg, UV irradiation time – 20 min).

The obtained results demonstrate great dependence of catalytic activity on the structural and adsorption properties of the material, namely, specific surface area. The results also suggest that it is crucial to synthesize nanomaterials with highly developed morphology and therefore with large specific surface area for application in heterogeneous photocatalysis.

REFERENCES

1. A.S. Kutuzova and T.A. Dontsova, “Characterization and photocatalytic properties of Titanium oxides obtained by hydrolytic methods,” Young Scientist, vol. 12.1, no. 40, pp. 1–4, 2016.

2. A.S. Kutuzova and T.A. Dontsova, “Synthesis, characterization and properties of Titanium dioxide obtained by hydrolytic method,” Proceedings of the 2017 IEEE 7th International Conference on Nanomaterials: Applications & Properties, pp. 286–290, 2017.

S.O. Kyrii, I.V. Kosogina, M.P. Osmuk, K.V. Okhrimenko
(National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Kyiv, Ukraine)

THE STUDY OF COPPER REMOVAL BY ACTIVATED CARBON MODIFIED WITH RED MUD

In recent years, the wastewater treatment from heavy metal ions is an urgent environmental problem due to their biological resistance during biological treatment. Traditional technologies for water treatment from multicomponent contaminants include chemical precipitation, advanced oxidation

processes, biological purification, membrane filtration, and adsorption. Among these methods, adsorption is the most efficient and economical technology and is widely used to remove numerous pollutants in wastewater treatment practice.

As sorbents, activated carbon is usually used. However, the use of this sorbents is quite costly and it is not always effective for the removal of heavy metals, which necessitates a search for a way to improve its characteristics. The promising direction of creating an effective sorption material with grafted functional groups on the activated carbon surface is the use as a modifier of metal-containing components of waste alumina production, such as red mud.

To check the effectiveness of heavy metals removing that can be present in sewage, copper salts were chosen as commonly used in the synthesis of polyacetals, arylamine dyes, azine dyes, direct metal-containing azo dyes, and others. Copper is a necessary element for the normal life of the human body but with excess copper in the human body, there is a functional disorder of the nervous system (deterioration of memory, depression).

Modified and unmodified (for comparison) activated carbon Filtrasorb 300 was used as a sorbent. To modify the surface of activated carbon Filtrasorb 300 by metal oxides, the liquid phase after processing the waste of alumina enterprises with 12–15% hydrochloric acid at a temperature of ~ 100 °C was used. The composition of the liquid phase is shown in table 1. The method for producing modified activated carbon by red mud components is described in [1].

Table 1. The composition of the liquid phase after acid treatment of wastes of alumina enterprises red mud

Element	Fe	Al	Ca	Ti	Si	Na	Zr
Content, %	71,25	19,02	2,58	2,48	2,33	0,77	0,22

The structural-sorption parameters of activated carbon F300 (ACF300) and modified activated carbon (ACM) by metal oxides were evaluated by the adsorption of p-chloroaniline. The substance p-chloroaniline was used as a standard adsorbtive, meeting the conditions for reliable assessment of the specific surface of carbon materials by adsorption from aqueous solutions. Comparative measurements are presented in table 2.

Copper extraction from water was carried out under static conditions on unmodified and modified sorbents. In fig. Figure 1 shows the adsorption isotherms of copper on ACF300 and ACM from $CuSO_4$ solutions.

Table 2. Comparative data of changes in the structural-sorption parameters of modified activated carbon Filtrasorb 300 by the adsorption of p-chloraniline

Sorbent	a_∞, mol/g	V_a, ml/g	S_a*, m^2/g
ACF300	4,3	0,47	1270
ACM	4,6	0,48	1195

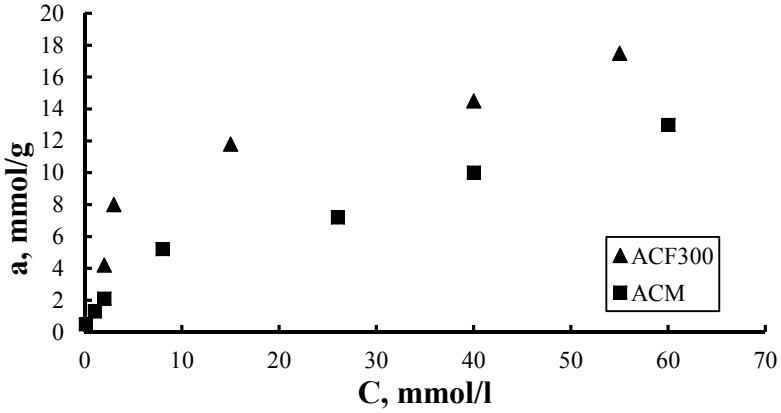

Figure 1. Copper adsorption isotherms on ACF300 and ACM from $CuSO_4$ solutions

The processing of the presented experimental data was carried out in accordance with the Langmuir and Freundlich models. From the calculated values of the determination coefficients R^2 it is established that both models describe the experimental isotherms quite accurately.

The sorption of copper on ACF300 corresponds to the total exchange capacity of the sorbent. This is due to the fact that $CuSO_4$, being a salt of a weak base and a strong acid, hydrolyzes with the formation of bases or basic salts, which causes the realization of both cationic and anion-exchange capacities.

Although the specific surface area is reduced, a sufficiently high degree of sorption of copper on the modified sorbent compared to unmodified due to the possible catalytic action of the metals present in the sorbent pores remains.

REFERENCES

1. S.O. Kyrii, I.V. Kosogina, I.M. Astrelin, L.S. Obodenko. “Investigation of the properties of activated carbon modified by wastes of alumina production”. Voprosy Khimii i Khimicheskoi Tekhnologii. no. 2 (2018): 70–78.