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The Peculiarities of the Use of Activated Charcoals Obtained from Native Plum Pips in the Treatment of Wastewater of Industrial Enterprises

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ABSTRACT: The purpose of the article is to treat the wastewater of industrial enterprises with the help of activated charcoals with high adsorptive properties obtained from the waste of native plum pips, a local raw material grown in large quantities in our country. The research methods were carried out on the basis of samples presented in the literature and GOST standard indicators. According to the results, carbon activated by steam at 800 ^{0}C showed its efficiency with higher adsorption properties compared to the samples activated by acid and alkali. The results of water purification showed that the adsorption activity of the selected carbon was almost 30 times higher. The effect of activated carbon on cations and anions in water and on water hardness, color, smell, taste and pH indicators was determined in wastewater treatment by selected activated carbon.

KEYWORDS: activated charcoals, native plum pips, treatment, wastewater, industrial enterprises, adsorptive properties, desorption, isotherm, steam activation, tar, ash content, moisture.

INTRODUCTION

Today, environmental problems are among the most urgent problems in the world. One such problem is the treatment of wastewater contaminated with various industrial wastes. One of the widely used methods of wastewater treatment is adsorption treatment. Both synthetic and natural substances with an active surface are widely used as adsorbents in adsorptive cleaning [1, 2]. Such materials include coal adsorbents used on an industrial scale. We know that wood adsorbents are not produced on an industrial scale in our country. The adsorption properties of such adsorbents can be known by studying their isotherms [3].

The problems of large tons of waste from the agriculture and food industry of our republic require the search for effective ways to solve them. In particular, the expediency of using plum seed waste as a raw material for the production of activated carbon is interesting as another new object to search for effective methods of obtaining expensive activated carbons that can replace imports, as well as eliminate the waste problem [4].

MATERIALS AND METHODS

Adsorbate P/Ps (adsorption–desorption isotherm of gases and vapors in the range of changes in relative pressure from 0...1) allows us to estimate the structure of the material (monolayer capacity, specific surface area, volume of micro– and mesopores, structural distribution of adsorption volume by pore diameter and differential curve). High–accuracy methods of measuring adsorption activity are determined by the weight method (by the increase in the weight of the adsorbent) or volumetric (by the decrease in the amount of adsorbate in the cell after exposure to the adsorbent) [4]. These methods also require special equipment, including deep vacuum cleaning of the material and long–term observation during testing. Moisture content of the pyrolyzed samples was determined using MA 210.R equipment. Determination of ash content was carried out according to GOST 11022–95 [5, 6, 7].

RESULTS AND DISCUSSIONS

Studies have shown that the composition of the initial plum kernel is C 61.1%, O_2 38%, Si 0.9%, and after thermal pyrolysis at 500 °C for 2 hours, C is 94.4%, O_2 5.6%. After activation with steam at 800 °C, C is 99.5% and Ca ion is 0.5%. SEM analysis was used to study their elemental composition (EVOMA 10 brand scanning electron microscope) [4]. The results of the analysis revealed that the samples activated with steam at 800 °C were used for the treatment of industrial wastewater due to their high adsorption activity and showed that the purified water of the “Pesticides” shop changed to 204–7 clarity level.

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In the following parameters, the test results of carbon adsorbents pyrolyzed at 500 ^{0}C for 2 hours and steamed at 800 ^{0}C for the same sample are presented. This sample was found to absorb 3.313 mol/kg of benzene vapor when activated by steam, as measured by McBen Bakra, and contained 99.5% C and 0.5% Ca ion when analyzed by SEM.

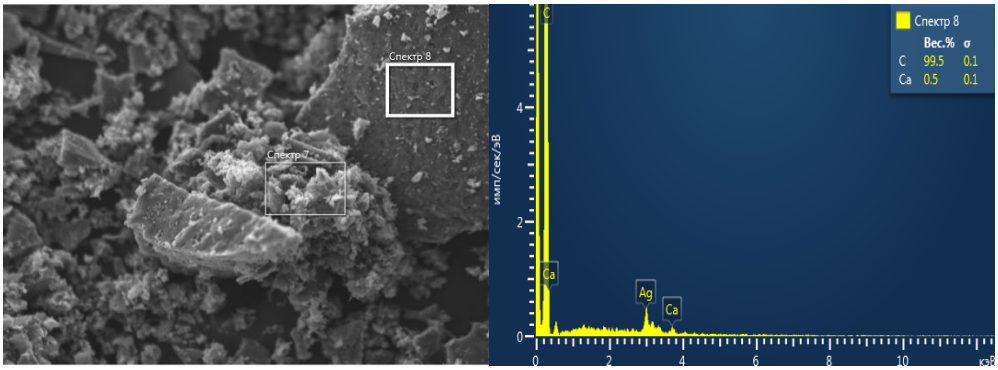

Figure 1. SEM analysis of the sample pyrolyzed at 500 °C and steamed at 800 °C

EXPERIMENT PART

These activated carbons were investigated by absorbing different adsorbates and for iodine and water purification. The waste waters of the "Pesticides" workshop of "IFODA AGROKIMYO HIMOYA" LLC, selected for cleaning, were tested on TB 210 IR brand LOVIBOND water clarity testing equipment, both before and after treatment. For water purification, 200 ml of wastewater was added to a 250 ml conical flask and mixed with a magnetic stirrer at a speed of 1000 rpm for 35–40 minutes. When the magnetic stirrer started to rotate, 6%, i.e. 12 g of adsorbent was added. 0.5 mm adsorbent was used for cleaning. The treated wastewater was filtered for 35–40 minutes and the results were compared [4]. The following tables show the parameters of selected wastewater before and after treatment.

Table 1. The textural indicators of water selected for treatment

Cations	Content per liter			Other definition	
	mg/l	mg–eq/l	%–eq/l		
Na^+	558	24,24	60	Hardness mg–eq/l:	
				General	16,50
K^+				Removable	
NH_4^+	Shifts chroma			Constant	
				Carbonate	6,00
Ca^{2+}	100	5,00	12	Non–carbonate	10,50
Mg^{2+}	140	11,50	28	pH	7,30
Fe^{3+}				CO_2 free mg/l	
				CO_2 agr mg/l	
Fe^{2+}					
Total:	798	40,74	100	Oxidability mg O_2/l	
Anions	Content per liter			SiO_2 mg/l	
	mg/l	mg–eq/l	%–eq/l	H_2S mg/l	
Cl^-	523	14,75	36	F mg/l	
SO_4^{2-}	774	16,12	40	Dry residue: mg/l	
NO_2^-	Shifts chroma			Experimental	2600
NO_3^-	240	3,87	9	Calculated	2518
CO_3^-	No			Physical properties:	

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HCO_3^-	366	6,00	15	Transparency	Opaque
Total:	1903	40,74	100	Smell	Specific unpleasant
Formula for salt composition of water: $2{,}6\ \frac{SO_4^{40}\ Cl^{36}\ HCO_3^{15}}{Na^{60}\ Mg^{28}\ Ca^{12}}$				Bloom	Grayish–dark green
				Taste	Weakly salty
				Sediment	Sediment forms when standing
				Change when standing	
				Na+ on flame photometer mg/l	

**summed $\frac{1}{2}$ HCO_3 mg/l.

This sample contains 60% eq/l of Na^+ cation, 12% of $Ca^{2+,}$ and 28% of Mg^{2+} in 1 liter of water. In addition, it was found that the NH_4^+ cation is partially present, and this is only present in the composition by changing the color of the water.

In addition, if Cl^- anion is 36% eq/l, SO_4^{2-} 40%, NO_3^- 9%, and HCO_3^- 15%, it was found that NO_2^- anion is partially present in the composition, causing the change in water color.

It was also determined that the water hardness is 16.5 mg–eq/l, pH index is 7.3, it is cloudy, has a specific unpleasant smell, grayish–dark green color, relatively salty, and settles in calm state.

Table 2. The textural indicators of treated water

Cations	Content per liter			Other definition	
	mg/l	mg–eq/l	%–eq/l		
Na^+	791	34,39	72	Hardness mg–eq/l:	
				General	12,80
K^+				Removable	
NH_4^+	9	0,50	1	Constant	
				Carbonate	12,80
Ca^{2+}	24	1,20	3	Non–carbonate	No
Mg^{2+}	141	11,60	24	pH	8,40
Fe^{3+}				CO_2 free mg/l	
				CO_2 agr mg/l	
Fe^{2+}					
Total:	965	47,69	100	Oxidability mg O_2 /l	
Anions	Content per liter			SiO_2 mg/l	
	mg/l	mg–eq/l	%–eq/l	H_2S mg/l	
Cl^-	539	15,20	32	F mg/l	
SO_4^{2-}	667	13,90	29	Dry residue: mg/l	
NO_2^-	0,02			Experimental	2850
NO_3^-	24	0,39	1	Calculated	2750
CO_3^-	18	0,60	1	Physical properties:	
HCO_3^-	1074	17,60	37	Transparency	Transparent
Total:	2322	47,69	100	Smell	Specific unpleasant
Formula for salt composition of water $2{,}85\ \frac{SO_4^{29}\ Cl^{32}\ HCO_3^{37}}{Na^{72}\ Mg^{24}}$				Bloom	Colorless
				Taste	Weakly salty
				Sediment	Sediment forms when standing
				Change when standing	
				Na+ on flame photometer mg/l	

**summed $\frac{1}{2}$ HCO_3 mg/l.

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This sample contained 72% eq/l of Na^+ cation, 1% NH_4^+, 3% Ca_2^+, and 24% Mg^{2+} in 1 liter of water.

In addition, Cl^- anion was 32% eq/l, SO_4^{2-} 29%, NO_3^- 1%, and HCO_3^- 37%.

In addition, it was determined that water hardness is 12.8 mg–eq/l, pH value is 8.4, it is transparent, has a specific unpleasant smell, is colorless, relatively salty, and settles in a calm state. The picture below shows the status of wastewater before and after treatment.

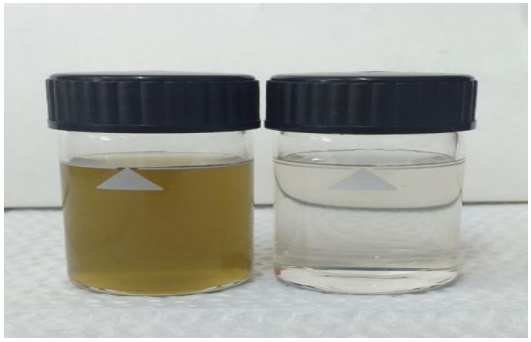

Figure 2. Test results of the TB 210 IR brand LOVIBOND water clarity testing device of the "Pesticides" workshop of "IFODA AGROKIMYO HIMOYA" LLC

CONCLUSIONS

In this work, the physic–chemical parameters, adsorption activity, carbonization process and properties after steam treatment of activated carbons obtained on the basis of plum seed waste were studied. After thermal and steam treatment, it was studied that the release of O_2 and Si elements in the grains increases the number of C and increases the adsorption properties of the obtained activated carbons. In addition, the effect of activated carbon on cations and anions in water, as well as water hardness, color, odor, taste, and pH parameters during wastewater treatment using selected activated carbon was determined. The results of water treatment were almost 30 times higher, indicating the adsorption activity of selected carbon.

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