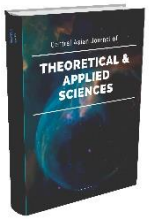

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COMPARISON OF PHYSICAL-CHEMICAL AND ADSORBATION PROPERTIES OF ACTIVATED PLANT TREE COAL ADSORBENT WITH IMPORT-ANALOGICAL COAL ADSORBENTS

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Annotation: *As a result of the research, an activated carbon adsorbent was obtained at a temperature of 800oC and using water vapor on the basis of maple tree stem waste. Physicochemical and adsorption properties of the obtained adsorbents were compared with imported-analog coal adsorbents. According to the results obtained, the lowest moisture content was found to belong to SBYoFChDK and Aqualine imported coal adsorbents. In the studied systems, the adsorption rate of benzene SBYoFChDK from adsorption isotherms was found to be higher than: AG-3 by 6%, Indocarb WT by 8%, BAU-A by 22.5%, AQUALINE by 48%.*

Keywords: *charcoal, adsorption, isotherm, benzene, adsorbent, monolayer capacity, saturation adsorption, specific surface area, porosity, average radius of pores.*

I. Introduction.

At present, adsorbents with high adsorption properties are widely used in the food industry, pharmaceuticals, drinking and industrial wastewater treatment and other industries in our country. Among them, coal adsorbents are of particular importance. But most of the coal adsorbents used in many industries are imported. Therefore, the production of adsorbents with high adsorption properties using local raw materials instead of imported adsorbents used in various industries and the fundamental study of their adsorption properties is one of the current issues. A number of studies are being carried out on the production and introduction of new adsorbents through the production of industrially activated carbon adsorbents and the study of their adsorption properties.

Waste from the stems of various fruit and ornamental trees, fruit pods, secondary food waste are cheap raw materials for the production of activated carbon, which is not widely used in industry. It is known that fruit trees such as apricots, cherries, walnuts, as well as maple, jasmine, etc. grow in the territory of the Republic. ornamental trees are common. The stems of maple, jasmine, walnut trees are used in furniture factories. In this case, during the processing of the round part of the tree stem, a large

amount of wood chips and unusable stems are formed as waste. The wood waste that is generated is mostly used as fuel quality. Also, in the autumn and spring seasons, a lot of tree stem waste is generated during the processing of fruit and ornamental trees, which in turn is often used as fuel.[1].

II. Object And Method Of Research.

Based on the above, the targeted preparation of carbon adsorbents on the basis of local raw materials, including waste from tree stalks, is of particular importance. Taking into account the above considerations, a carbon adsorbent (SBYoFChDK) was obtained by activating water vapor at 800oC on the basis of a local maple stem[2]. The obtained coal adsorbents were compared with the physicochemical and adsorption properties of imported coal adsorbents used in many industries in our country today.

Imported coal adsorbents BAU-A (birch charcoal, Russia), AG-3 (brown coal + resin-based granulated coal, Russia), AQUALINE (coconut shell coal, Turkey), Indocarb WT (coconut shell coal, India) for comparison taken. Moisture content of coal adsorbents was determined using methods developed on the basis of GOST 11014-2001, ash content GOST 11022-95, strength GOST R 55873-2013. The results obtained are presented in Table 1.

Table 1

Physicochemical properties of coal adsorbents

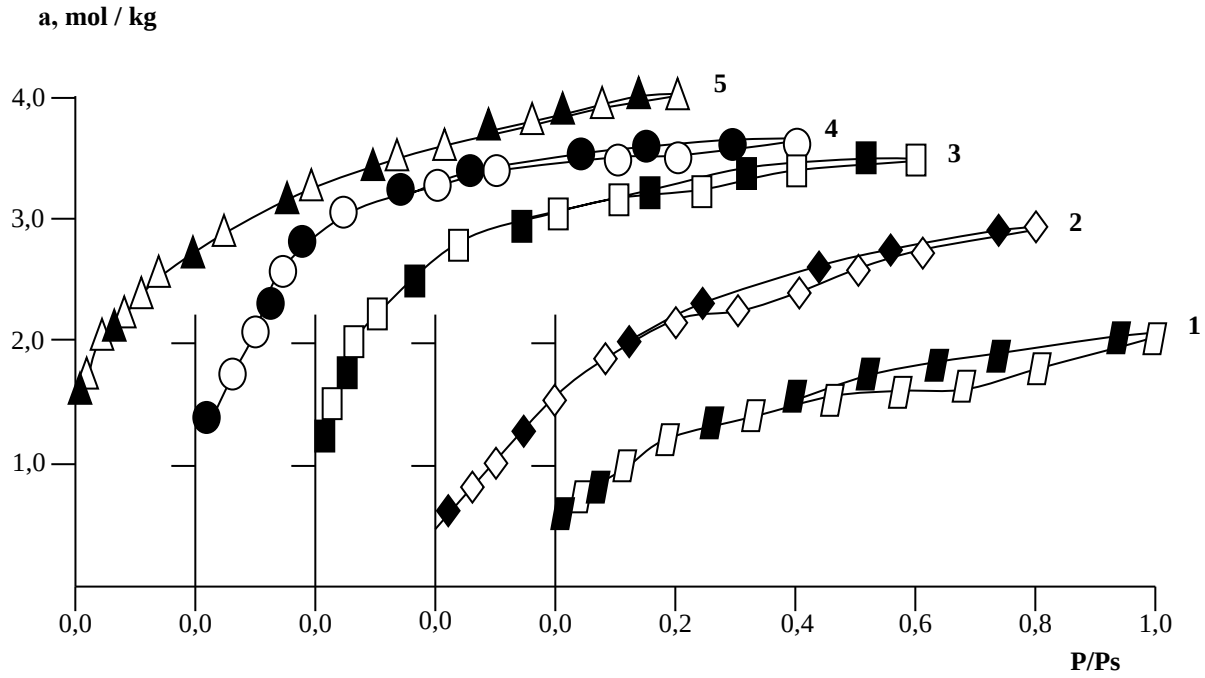
№	Adsorbent samples	Technical analysis		
		Moisture content,%, WA	**Amount of ash, %, As**	**Strength of adsorbents (MPa)**
1	SBYoFChDK	2,1	9,2	9,8
2	AG-3	5	9	10,1
3	Indocarb WT	5	6	9,4
4	BAU-A	10	6	8,4
5	Aqualine	3	2	9,0

III. Research Results.

According to the results obtained, the lowest moisture content was found to belong to SBYoFChDK and Aqualine imported coal adsorbents. The performance of the remaining samples is relatively high. Since all samples (except AG-3) are taken from tree stems and fruit pods, they contain low levels of inorganic substances, so the absorption properties of water molecules are low. In addition, under the influence of these factors, their ash content is also lower than that of lignite and coal. The strength of adsorbents plays an important role in the use of adsorbents for technological processes. If the strength of the adsorbents is low, there is an inconvenience in

separating the adsorbents from the systems after the adsorption process, ie their turbidity leads to the implementation of additional processes. The adsorbent-adsorbate interaction process affects the strength of the adsorbents. The strengths of all studied coal adsorbents were found to be close to each other.

Charcoals are adsorbents with hydrophobic properties. Therefore, on an industrial scale, they are used in the purification of systems from additional organic compounds. For this purpose, the adsorption of benzene vapors on the obtained coal adsorbents was studied. Benzene obtained as an adsorbate is purified and dried under vacuum before use in the adsorption process, its vapor pressure is first frozen, then heated until the vapor pressure data for pure benzene are the same as in the tables given in the tables [3]. It can be seen from the adsorption isotherms of benzene vapors of the studied coal adsorbents (Fig. 1) that the adsorption of benzene vapor on SBYoFChDK, AG-3 and Indocarb WT adsorbents was higher than that of the other two adsorbents (BAU-A and AQUALINTS). Adsorption isotherms of adsorbents It was determined that the classification of adsorption isotherms proposed by Brunauer belongs to type I. Adsorption processes in coal adsorbents often occur with capillary condensation. In such cases, the adsorption and desorption lines do not coincide, resulting in the formation of adsorption hysteresis



rings.

Figure 1 Adsorption of coal adsorbents with benzene vapor: AQUALINE (1), BAU-A (2), Indocarb WT (3), AG-3 (4), SBYoFChDK-400 (5)

IV. Discussion Of Results.

When the desorption lines of BAU-A and AQUALINE adsorbents are connected with the adsorption lines at a relative pressure P/P_s=0,4-0,45 an adsorption hysteresis surface is formed. In the remaining adsorbents, a very narrow adsorption in the range of P/P_s=0,6-1,0 occurs with the formation of a hysteresis ring. The formation of adsorption hysteresis surfaces in adsorbents occurs due to the

condensation of adsorbate molecules in different porosities that occur in the formation of crystalline layers formed by carbon atoms in the carbon. In the studied systems, the adsorption rate of benzene SBYoFChDK from adsorption isotherms was found to be higher than: AG-3 by 6%, Indocarb WT by 8%, BAU-A by 22.5%, AQUALINE by 48%. On the basis of benzene vapor adsorption isotherms in coal adsorbents, monolayer capacity am, saturation volume Vs (or adsorption as) and their specific surfaces (S) were calculated using the BET theory equation, which is one of the important parameters of adsorbents [4]. The results obtained are presented in Table 2.

Table 2

Structure - sorption indicators of benzene vapor adsorption of activated carbon adsorbents

№	Adsorbents	Single-layer capacity, a_m, mol / kg	Relative surface, $S \cdot 10^{-3}$, m^2/kg	Saturation adsorption a_s, mol / kg
1	SBYoFChDK	2,0	482	3,86
2	AG-3	2,0	481	3,64
3	Indocarb WT	1,9	459	3,55
4	BAU-A	1,2	287	3,0
5	Aqualine	0,96	232	2,0

In the studied systems, the specific surface area (S) was found to be higher than the remaining samples of SBYoFChDK and AG-3 adsorbent. The specific surface area (S) of SBYoFChDK adsorbent was found to be 1.05 times higher than Indocarb WT, 1.7 times higher than BAU-A, and 2.08 times higher than Aqualine. The main part of the absorption of benzene molecules in adsorbents: SBYoFChDK - 51.8%, AG-3 - 54.5%, Indocarb WT - 53.5%, BAU-Ada - 40%, Aqualine - 48% of the monolayer capacity of adsorbents. Adsorption isotherms of adsorbents on benzene and adsorption volumes determined at different relative pressures (P/P_s) on adsorbents on the basis of the MHTN equation micropores (W_0), mesopores $W_{me} = V_s - W_0$ and saturation adsorption capacity (V_s) and average radius values of the pores are given in Table 3.

From the results obtained, it can be seen that SBYoFChDK, AG-3, Indocarb WT imported coal has the same volume of micro-pores, but the volume of saturation adsorption is relatively high due to the relatively large number of meshes in SBYoFChDK. The other two adsorbents were found to have low both porosity and saturation adsorption capacity. All adsorbents with an average radius of porosity belong to the category of super-porosity (0.5-0.6 <r <1.5-1.6 nm) adsorbents according to the classification of pores proposed by MM Dubin [5].

Table 3

Indicators of the volume of pores on the adsorption of benzene vapors on coal adsorbents

№	Adsorbents	$W_0 \cdot 10^3$	$V_s \cdot 10^3$	$W_{me} \cdot 10^3$	The average radius of the pores is $r_{average}$, Å
1	SBYoFChDK	0,295	0,343	0,048	14,2
2	AG-3	0,295	0,324	0,029	13,5

3	Indocarb WT	0,295	0,316	0,021	13,8
4	BAU-A	0,231	0,267	0,036	18,6
5	Aqualine	0,134	0,178	0,044	15,3

According to the results of benzene vapor adsorption of adsorbents, they were placed in the following order in terms of adsorption capacity, specific surface area (S) and saturation adsorption (as):

SBYoFChDK > AG-3 > Indocarb WT > BAU-A > Aqualine

The adsorption rate of benzene vapors in SBYoFChDK was found to be 1.06-1.09 times higher than that of the other two adsorbents from AG-3 and Indocarb WT coal, 1.3 times higher than BAU-A and 1.9 times higher than Aqualine. This is characterized by the high volume of cracks and porosity between the layers in the SBYoFChDK compared to other adsorbents.

Conclusion

According to the results of adsorption of benzene vapor on adsorbents, instead of imported analogous coal adsorbents purification of coal adsorbents activated by water vapor at 1.5 oC (by pyrolysis in airless conditions) for 1.5 hours from organic compounds in various industries can be used as an adsorbent for the purpose.

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