

BLOCK COMPOSITES MATERIALS BASED ON THE ACTIVE CARBON AND POLYMERS

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Introduction

There are many adsorbents of the grain structure. The using of the polymers on the synthesis of the composite sorbic materials (CSM) give us to obtain a new physical forms with specific properties [1]:

- high mechanical properties
- low level of the contamination during the exploitation processes
- different geometrical forms
- biocompatibility with different substances
- polyfunctional properties of the polymer matrix

In order to improve the properties of the active carbons we have prepared the CSM with using of polymers as active matrix. In this work we are investigated the polymer type influence as well as the polymer content in composition and the pores characteristics of the initial carbon material as well as the CSM. The additional part of the investigation was a boundary phase nature investigating.

Experimental

Synthesis

The KAU-type active carbon were used. The commercial polymers PVA (polyvinylalcohol) and PVC (polyvinyl-chloride) were used as well as ones of polyurethane type on the basis of aliphatic diol (PU1), aromatic dihydrazides (PU2), aromatic dihydrazide and ionogen group (PU3), which were synthesized by us [2]. Active carbon was suspended in the polymer solution of different concentrations and by means of hardening the CSM were obtained. Characteristics of the initial components are shown on the tables 1 (a, b).

Table 1a. Characteristics of the active carbon

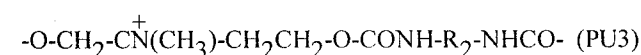
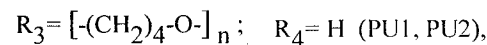
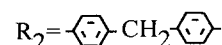
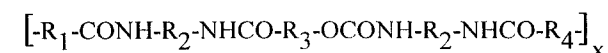
Active Carbon KAU		
Particles size, mm	Pore volume on benzene (W_s , cm ³ /g)	Specific surface area (S_{BET} , m ² /g)
0.5-1	0.6	1141

Table 1b. Characteristics of the polymers

Polymers	Chain structure	Dissolver
PVA	(-CH ₂ -CH ₂ OH-) _n	Water
PVC	(-CH ₂ -CH ₂ Cl-) _n	DMF*
PU1	**	DMF
PU2	**	DMF
PU3	**	Water

*DMF-dimethylformamide

**Polyurethanes:



Methods of the investigations

- Methods of the pores structure parameters investigations:
 - determination of the pores volume on benzene W_s , cm³/g (exhauster method);
 - determination the values of the S_{BET} , m²/g;
 - mercury porosimetry investigations on the high pressure (Por Sizer M 9200, "Cultronics France").
- Level of contamination [3]
- Methods of the polymer investigations:
 - DSC (Differential Scanning Calorimetry);
 - SAXS (Small Angles X-ray Scattering).
- Method of the boundary phase nature investigation:
 - IR - spectroscopy.

Results and Discussion

The dependense of the pores values on benzene W_s on the polymer concentration are shown on the Fig. 1(a,b) and the values of the specific surface area of the sorbents are shown on the table 2. From these data we have conclud

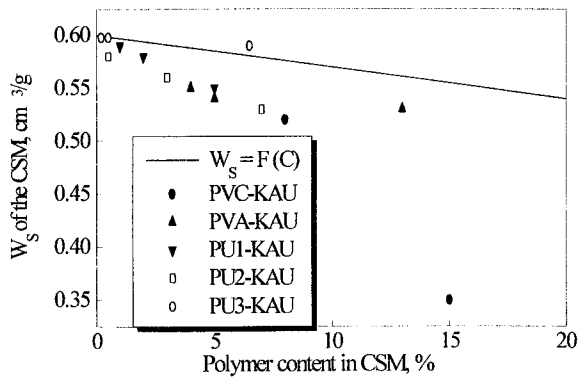


Figure 1a. Dependence of the pores volume on benzene of the CSM (W_s , cm^3/g) on the polymer content in the CSM (C,%).

that sorption properties of the CSM are decreasing in comparing with the initial active carbon.

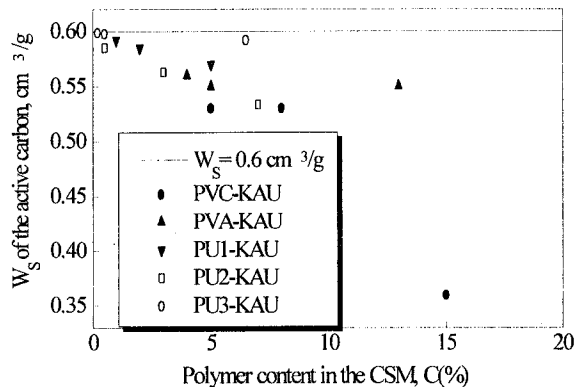


Figure 1b. Dependence of the pores volume on benzene of the active carbon (W_s , cm^3/g) on the polymer content in the CSM (C,%).

Table 2. Data of the specific surface area for sorbents

Sorbents	Polymer content in CSM, %	S_{BET} , m^2/g	$S_{\text{BET}}^{\text{CSM}}/S_{\text{BET}}^{\text{KAU}} \times 100\%$
KAU (in)	-	1141	100
KAU-PVA	15	738	65
	8	813	71
	8	977	86
KAU-PVC	13	1010	88.5
	5	1054	92
	4	1068	94
KAU-PU1	5	702	62
	2	815	71
	1	1063	93
KAU-PU2	7	437	38
	3	977	86
	0.5	1110	97
KAU-PU3	6.5	795	70
	0.5	1080	95.5
	0.45	1092	96
	0.2	1100	96

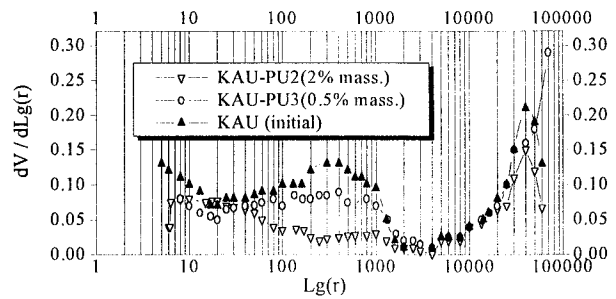


Figure 2. Data of the mercury porosimetry investigations for the CSM and KAU.

The obtained composite sorbents should be considered as a ultimate form of the polymers filled by carbon. When active carbon is introduced to the polymer the blocks of wick are distinguished by the polarity and flexibility, the initial carbon concentrates, mainly, in the microregions of the flexible blocks forming the essential part of polymer. The association of the rigid fragments promotes this process: formation of the rigid domains causes the movement the carbon in to the interdomain sphere [3].

In the polyurethanes macrochain a large quantity of polar groups are presented, such as $-\text{NH}$, $-\text{CO}$, $-\text{COC}$, $-\text{COO}$, which are able to interact with active carbon surface because the latter have high valency unsaturation. In accordance with IR-spectroscopy investigation of model system "urethane-active carbon" one may assume interaction between π -electrons of active carbon and urethane carbonyl group. It is necessary to note probable transformation of carbonyl bond of urethane group: $>\text{C}=\text{O} \rightarrow >\text{C}=\text{O}^{\ominus}$, that are confirmed by sharp decrease of intensity of $\text{C}=\text{O}$ bond (1660 cm^{-1}) and appearance of new bond (1485 cm^{-1}).

Conclusions

We have been concluded that sorption ability of the active carbon in the CSM is high in comparing with the initial charcoal in the range of the polymer content no more 10% mass. But because of covering of the macro- and mesostructure of the active carbon by the polymer the transport function of the charcoal is decreased and the kinetics processes of the adsorption are slower.

References

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2. Savelyev Yu.V., Veselov V. Ya., Grekov A.P. in "*Polymer Films and Coverings*", Leningrad, 1991. pp. 108-109.
3. Marushko S.Z., Savelyev Yu.V. in *Carbon'96 (Ext. Abstr.)*, Newcastle upon Tyne, UK, 1996. pp. 463-464.