PROPERTIES OF ADSORBENTS FROM WOOD AND PETROLEUM WASTES

Shendrik T.G.[1], Pashchenko L.V.[1], Kuznetsov B.N [2]., Lyubchik S.B[1]., Khabarova T.V[1]., Ostapko I.N[3]., Kamalov G.L.

1 –The Litvinenko L.M. Institute of Physical Organic Chemistry and Coal Chemistry, National Academy of Sciences of Ukraine, 70, R. Luxemburg str., 83114, Donetsk, Ukraine

2 - Institute of Chemistry and Chemical Technology, Russian Academy of Sciences, Krasnoyarsk

3 – Botanical Garden, National Academy of Sciences of Ukraine, Donetsk,Ukraine

4 - Institute of Physical Organic Chemistry , National Academy of Sciences of Ukraine, Odessa, Ukraine

Introduction

The goal of the work is the development of methods for obtaining of active carbons (ACs) from carbon-containing organic wastes by the way of thermal processing of blends on the base of wastes of biomass (L), low-grade salty coal (SC) and heavy washing off petroleum wastes (WPW). WPW are accumulated in the settlers near the stations for the unloading and transportation of petroleum. WPW are the emulsion with water content ~50%, they have molecular mass 750- 1100c.u., average aromaticity- 9.4-17.2%.

Experimental

Characteristics of parent salty coal and lignin are in the table 1. For investigation of carbon-containing raw materials the following methods have been used: X-ray diffractometry, thermogravimetry, IR-spectroscopy, chemical functional analysis, method BET of specific surface determination. Sorbents were obtained by the method of two-stage activation (all the samples were submitted to carbonization at the stationary conditions (T= 300-400^{0}C, 1-3 hours) followed by their activation with water steam at 800°C during different residence times 1-3 hours) and direct activation .

Results and Discussion

It have been analyzed the possibilities of two-stage activation and direct activation of the wastes and their blends with water steam.

After two-stage activation of lignin active carbons with specific surface up to 400 m^2/g .are obtained. The results of table 2 show the influence of additive on specific surface and distribution of pores in obtained ACs. The addition of WPW to system leads to decresing of S_{BET} but the agglomerized product is formed. It is observed the corellation between. specific surface of the samples and microporosity which are characterized by iodine sorption.

Two-stage activation of waste blends is the process long in time so the optimization of process parameters were carried out with the goal of decrease of energy consumption during sorbents obtaining (table 3). The direct activation of the blends in water steam at 800^{0}C during 3 hour allows to obtain the ACs with S_{BET} more than 600 m^2/g, but the yield of target product is not high**.**

By the methods of X-ray diffractometry thermogravimetry, IR- spectroscopy, chemical functional analysis it has been established the presense of chemical interaction between different functional groups in the components of the blends at the stage of preparation of these blends (table 4).

The data of table 5 show that it is possible to achieve the considerable growth of sorbent specific surface by variation of process parameters and increasing of heating rate. The addition of WPW to lignin allows to obtain the sorbents with binary distribution of pores on sizes.

Conclusions

At two-stage activation and direct activation of the blends of wastes with water steam it have been obtained the sorbents with different distribution of pores on sizes.

The sorbents of different appointment could be obtained used different methods of activation and varied the process parameters (for example the rate.of heating). The direct activation of the blends with water steam leads to obtaining of ACs with more high specific surface than two-stage activation. It is allows to decrease the power capacity of the process of sorbents obtaining.

For binary blend of wastes from lignin and WPW it is possible the obtaining of sorbents with developed surface and good mechanical strength.

Table.1. Characteristics of parent salty coal and lignin

Sample, original	Proximate analysis, %				Elemental analysis %			High heat of burning, Q^{daf},
	W^a	A^d	S^d	V^{daf}	C	H	H/C	mDj/kg
C_5, 4a (Donbass)	7,1	28,4	1,6	45,5	72,8	4,9	0,81	27,5
Lignin (Kras-k)	3,55	1,84	-	63,4	-	-	-	-

Table.2. Characteristics of ACs,obtained by the method of two-stage activation of lignin and blends of wastes with water steam (800 ^{0}C, 3 hours)

Sample	Yield,%	Burn off,%	Absorption ability, A		S_{BET}, m^2/g
			On MB, mg/g	On iodine,%	
L initial	-	-	-	17,1	~3
L	47,6	52,4	37,9	53,8	386
L+WPW=1:1	27,6	72,4	-	40,2	207
L+WPW+SC	42,0	58,0	51,8	19,0	91

Table.3. Characteristics of ACs,obtained by the method of direct activation of lignin and blends of wastes with water steam (800 ^{0}C, slow heating)

Sample	Time of activation, hour	Yield,%	S_{BET}, m^2/g	Absorption ability, A	
				On MB, mg/g	On iodine,%
L	2	31,2	370	-	-
L	3	16,1	621	233,3	91,8
L + WPW (3:2)	“-“-“-	26,2	311	81,9	-
L + WPW (1:1)	-“-“-“-	27,6	250	136,7	52,9

Table.4. Comparative X- Ray data for the activated blends

Precision of determination: L_a – 5 %; L_c – 1 %; d_{002} – 0,3 %

Samples	Conditions of activation		γ - bands			*La, nm*	L_c, нм		h/l
	T^0C	*τ, hour*	d_{002}	$d\gamma_1$	$d\gamma_2$		L_{c002}	L_c	
L	800	0.5	0,340	0,428	0,550	6,6	3,27	2,49	1,04
WPW	“-“	“-“	0.477	-	-	5.8	2.40	2.07	2.65
L+WPW	“-“	“-“	0,384	0,456	0,564	6,8	1,95	3,96	0,73

Table.5. Characteristics of ACs,obtained by the method of direct activation of lignin and blends of wastes with water steam (800 ^{0}C, 0.5 hour, quick heating)

Sample	Yield,%	Burn off,%	S_{BET}, m^2/g	Adsorption ability, A	
				On MB, mg/g	On iodine,%
L	16,9	83,1	654	232	100
L + WPW (1:1)	14,0	86,0	739	137	95,1