PREPARATION AND CHARACTERIZATION OF ACTIVATED CARBON FROM BANANA STEM

*Satish M. Manocha, Jignesh Bhagat, L.M.Manocha & *R.V.Jasara*
Department of Materials Science, Sardar Patel University
Vallabh Vidyanagar-388 120, INDIA.
** CSMCRI, Bhavagnagar, Gujarat*

Introduction

The porous structure of an activated carbon is a function of the precursor used in the preparation of carbon, the activation procedure and the extent of activation(1). The suitability of an activated carbon for a particular application depend on the ratio in which pores of different sizes are present. The surface area and processing can be increased by suitably controlling the processing conditions. Polyacrylonitrile is considered to be the best precursor for making high performance carbon fibers. However, for making activated carbon fibers, cellulosic materials have an edge over PAN as precursor because of the inherent porous structure of cellulosic materials. These cellulosic materials in the fibrous form can be had from vegetation and agriculture wastes. Therefore it was thought advantageous to perform a study on the development of the activated carbon from fibrous agricultural waste such as banana stem. Present paper report studies on the activated carbon made from banana stem using steam and phosphoric acid for activation.

Experimental

The banana stems obtained from three different areas were dried in the sun for 15 days. Small pieces (5-7 cm. in length) of dried mass were pyrolysed in the furnace at the rate of 20°C/hr. The chars obtained were grounded and were given different activation treatments.

Characterization of carbon

The chars as such as well as after activation were characterized for yield, ash content and specific gravity etc. Surface area of chars and activated carbons was determined by Dye-adsorption method. Surface oxygen groups(2) on chars and activated samples were determined volumetrically using bases of different strengths such as sodium bicarbonate, sodium carbonate and sodium hydroxide. Iodine adsorption was studied by volumetric method.

Results and Discussion

Table-I shows the yield of chars from dried banana at different heat treatment temperatures. The yield decreases as the heat treatment temperature is increased, characteristic of pyrolysis. For comparison purpose, the yield of carbon from almond shell and from cellulosic material are also included. The yield from banana stem is the maximum. It shows the prospectiveness of banana stem as precursor for carbon and specially as activated carbon. The surface oxygen complexes present on the chars prepared at different temperatures and steam activated are compiled in Table-II. The total number of surface oxygen complexes are observed to be maximum for sample heat treated to 500°C. On activation with steam, surface oxygen complexes on all the char are found to increase but the increase on chars prepared at 500° C is much higher than the others. Surface area of the chars as measured by dye-adsorption method is also included in table-II. Surface area is maximum for the samples heat treated at 500°C and on activation with steam, surface area shows an increase for the sample prepared at 500°C. The activation of banana stem char was also done using phosphoric acid. The surface oxygen complexes, surface acidity and iodine adsorption values of these samples are given in Table-III. It shows that the surface oxygen complexes, total surface acidity as well as iodine adsorption values of the samples activated by phosphoric acid are the maximum.

The banana seam contains large number of compounds which are both organic and inorganic in nature. In order to see the contribution of banana stem juice, in the characteristic properties of carbon, the juice was extracted and the remaining solid portion (pulp banana stem) was dried and pyrolysed. Latter carbon is found to

have lower density and ash contents. It means the juice part of the stem has more inorganic contents. The pulp banana stem will have much more porous structure for activation. Further work is in progress to make activated carbon from pulp banana stem.

References

1. Rodriguez-Reinoso, F.; Linares-Solano, A.; Chemistry and Physics of Carbon vol.21,1989 .
2. Puri, B.R.; Chemistry and Physics of Carbon vol. 6,1974.

Table-I

Source No.	Heat treatment temperature ^{o}C	Banana stem yield, %	Almond shell yield, %	Regenerated cellulose yield, %
1	400	50	25	32
	500	44	23	26
	600	42	20	20
2	400	44		
	500	37		
	600	35		
3	450	50		

Table-II

Surface Characteristic

Source No.	Heat treatment temp. oC	Surface oxygen complexes millieq./100gm.			Surface area m2/gm.		
		Phenolic	Lactone	Carboxylic	Unactivated	Steam acti.	H3PO4 acti.
1	400	136	126	130	210	320	
	500	145	135	126	270	450	
	600	150	140	110	146	228	
2	400	134	122	119	86.16	148	249
	500	122	123	138	103.42	284	312
	600	163	166	157	280	434	391
3	450	145	260	180			

Table-III

Surface Characteristics

Name of the sample	Surface oxygen complexes millieq./100 gm.	Surface acidity Meq./100 gm.	Iodine adsorption %
Pyrolysed BS	285	120	58.83
Activated BS	464	324	66.54
Activated pyrolysed BS	640	348	66.72
Pyrolysed juice extracted BS	315	252	61.96