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CONVERSION OF SOME AGRO-INDUSTRIAL WASTES INTO USEFUL INDUSTRIAL PRODUCTS

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Corn cobs. bagasse. sawdust and pericarp of peanuts are abundantly available as agro-industrial wastes These arc important precursors of pentosans. On dilute acid hydrolysis. pentosans are converted into furfural. a chemical or industrial importance. Raw materials were hydrolyzed with various concentrations of H_2SO_4 and HCI and furfural was extracted. The residue left after the extraction of furfural was activated at 700°C in a muffie furnace and active carbon of a good quality was obtained. Adsorption capacity of active carbon was determined with iodine and methylene blue. Significant yield of furfural was obtained from corn cobs and bagasse (13.86% and 16% respecnvctvi Sulphuric acid was found to be a better hydrolyzing and activation agent than hydrochloric acid.

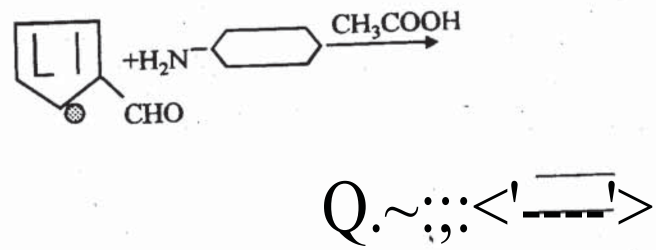
Key words: acid hydrolysis. active carbon, agro-industrial wastes. furfural, Pakistan

INTRODUCTION

Pakistan has an agro-based economy and a large amount of agricultural wastes are abundantly available. In recent years attention has been focussed on the utilization of cellulosic materials for the production of important chemicals viz. active carbon. furfural and carboxy methyl cellulose etc. A number of successful attempts have been made to exploit different indigenous materials such as Sarkanda. Kai. Dhabb, Khable grass. poplar and peanut pericarp for the production of furfural and active carbon (Chughtai et al.. 1985. 1986. 1989. 1990. 1999.2000; Yasmin et al., 1999). Furfural is largely used for the manufacture of furan and other furan derivatives. Its use as solvent, fungicides, glue preservative. perfume making etc. is well established. In addition. active carbon is an extremely useful product used in almost every industry and laboratory. In a quest to exploit the indigenous materials economically, the present work involves the utilization of corn cobs. bagasse. sawdust and pericarp of peanuts for the production of active carbon and furfural. The effect of different concentrations of H_2SO_4 and HCI at different digestion times on the yield and quality of furfural and active carbon was also studied.

MATERIALS AND METHODS

Corn cobs were collected from CPC Rafhan Ltd.. Faisalabad. pericarp of peanut from Faisalabad market. bagasse from Crescent Sugar Mills Ltd.. Faisalabad while sawdust was collected from one of the local sawmills. All of these materials were washed with clean water and sun dried. Dry materials were ground to a. fine mesh and stored in desiccators as stock samples. Stock samples (50g of each material) were refluxed with 500cm^3 of various concentrations of (14% and 16%) commercial H_2SO_4 and HCl. separately for 100 and 140 minutes. The refluxed materials were distilled and the distillate thus obtained was redistilled to get aqueous furfural. The percentage of furfural was calculated by using colorimetric method using aniline acetate (Chughtai et al., 1985).



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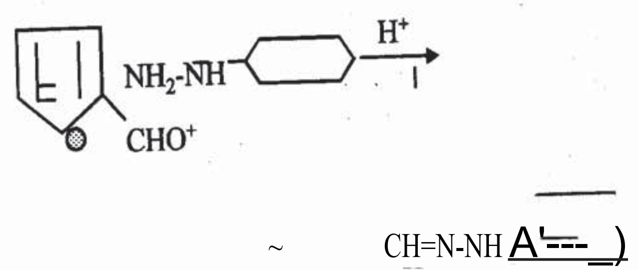
The furfural was thereafter separated from its aqueous solution by fractional distillation.

Identification and Verification: Some charactcristic physical properties such as colour. odour and hoilnuz point were noted and compared with the standard sample For verification.. a derivative. furfural phenyl hydnl/.onc. was prepared by treating the separated furfural with phenyl hydral.im: in glacial acetic acid and its melting point "was compared with that of standard compound.



Furfural phenyl hydrazone

The carbonaceous residues left after the extract iou or furfural from various raw materials were dried and dircctlly activated in a muffle furnace at 700°C for one hour The 'product thus obtained was cooled in a desiccator. weighed and ground to a fine powder (active carbon). '[he adsorption capacity of the product was detennined by using iodine and methylene blue (Beg and Usmani. \IIX51

RESULTS AND DISCUSSION

The average yield (%) of furfural and active carbon are presented in Table 1. Bagasse and corn cobs emerged as the best source of furfural. Maximum yield of furfural was obtained when sulphuric acid was used as a hydro-lyzing agent. For longer digestion period and with high concentrauon of sulphuric acid, furfural yield decreased probably due to decomposition of furfural. Poor results were obtained when HCI was used as a hydrolyzing agent, but furfural yield increased by increasing concentration ofHCI. These results are in agreement with those ofKhundar and Islam (1960).

The average yield of active carbon was decreased by increasing the concentration and digestion time. Better yield of active carbon was obtained from corn cobs and sawdust (30%) when 14% HCl was used as a hydrolyzing agent. It is obvious from the results (Table 2) that rhe adsorption capacity of active carbon increased by increasing acid concentrations and digestion times. This may be due to the formation of oxidizing gases which increased the surface area of active carbon (Chughtai et al., 1999). The adsorption capacity of the product was lower than that of standard sample (E. Merck.). Best adsorption capacity was shown by active carbon prepared by using 16% H,SO ı for 140 minutes digestion time.

Recovered furfural was straw-yellow oily liquid which boiled at 160°C. Melting point of the derivativel'Irfural phenyl hydrazone was 96-97°C.

Table 1. Comparison between average yield (%) of furfural and active carbon at various concentrations and digestion periods using Bel and BlSO.•

Raw material used	Digestion time (min)	Acid used	Concentration ofacid(%)	Yield of active carbon (%)	Yield of furfural (%)
Corn cobs	100	H_2S0_4	14	20.00	13.15
			16	14.00	13.35
			14	30.00	10.53
		HCl	16	24.00	11.23
Corncobs	140	H_2S0_4	14	16.00	13.86
			16	10.00	11.26
			14	27.00	12.00
		HCl	16	22.00	12.86
Bagasse	100	H_2S0_4	14	20.00	13.65
			16	17.60	]6.00
			14	24.00	9.45
		HCI	16	20.00	12.31
Bagasse	140	H_2S0_4	14	16.00	14.25
			16	16.00	15.30
			14	20.00	10.90
		HCI	16	19.00	]4.06
Peanut pericarp	100	H_2S0_4	14	24.00	8.00
			16	15.93	9.40
			14	23.82	6.5]
		HCI	16	20.93	7.10
Peanut pericarp	140	H_2S0_4	14	16.00	8.70
			16	12.96	7.40
			14	22.10	7.00
		HCI	16	18.00	7.92
Sawdust	100	H_2S0_4	14	25.00	12.00
			16	18.00	12.72
			14	30.90	8.40
		HCl	16	26.00	10:08
Sawdust	140	H_2S0_4	14	22.00	12.19
			16	16.00	9.12
			14	28.00	9.12
		HCl	16	26.00	10.80

Table 2. Comparison between the average adsorption capacity expressed as mg of iodine and methylene blue adsorbed by Ig active carbon

Raw material used	Digestion time (min)	Acid used	Concentration of acid (%)	Adsorption capacity Iodine mglyg	Adsorption capacity Methylene blue/g
Corncobs	100	H_2S04	14	255.12	42.0
			16	330.20	50.0
		HCl	14	191.34	28.0
			16	217.63	35.0
Corncobs	140	H_2S04	14	278.30	49.0
			16	362.78	5:'.41
		HCl	14	199.73	29.0
			16	235.85	37.0
Bagasse	100	H_2S04	14	329.97	4ll.0
			16	331.36	54.7
		HCl	14	288.60	35.0
			16	307.06	40.2
Bagasse	140	H_2S04	14	351.68	52.3
			16	365.06	55.8
		HCl	14	313.97	:n.5
			16	328.31	4.U
Peanut pericarp	100	H_2S04	14	297.5	44.81
			16	297.5	52.00
		HCl	14	194.0	31.16
			16	253•2	42.00
Peanut pericarp	140	H_2S04	14	335.6	50.0Cl
			16	349.5	59.53
		HCl	14	233.2	39.03
			16	262.0	43.00
Sawdust	100	H_2S04	14	290.17	49.00
			16	362.78	59.00
		HCl	14	191.34	30.0
			16	272.08	35.0
Sawdust	140	H_2S04	14	330.20	56.00
			16	388.19	62.00
		HCl	14	200.17	31.0
			16	384.72	3X.O

*lg standard active carabon (E. Merck) adsorbed 663 mg iodine and 120 mg methylene blue.

Table 3. The pentosan content (%) and average yield of furfural (%) from some important raw materials

Raw material used	Pento-sans (%)	Avg. furfural content (%) on dry basis*	Yield of furfural (%)
Corn cobs	12	23.4	13.86
Bagasse	29	17.4	16.00
Peanut pericarp	15-25	11.7	9.40
Sawdust	15-25	13.6	12.72

• Anonymous (1984).

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