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Research Paper

Management Of Liquid Waste By Its Treatment Through Indigenously Prepared Cation-Exchanger From Agricultural Waste

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ABSTRACT
Liquid waste is the bulk created by industrial establishments by their production methods and metal extraction procedures. Scarcely any instances of modern squanders are fluid solvents, colors, ooze, metals, debris, paints, sandpaper, paper stock, mechanical side-effluents and radioactive squanders, and so forth. The management of commercialized waste has risen as an issue of concern. Many of the industrial plants generate sewer water and its management has become a serious warning to the environment. Its degradation and disposal have turned into a difficult task for environmentalists and engineers. Many methods are invented for the eradication of numerous varied pollutants of drinking and sewer water of many industrial plants. The ion exchangers made from wheat straws were utilized in treating of emergent of assorted industries like manufacturing, distillation, chemical plants. The ion exchanger handler made up of wheat straw was exposed to various studies like exchanging capability, exchanging equilibrium, exchanging dynamics, variation in the amount of electrolyte, variation in flow rate, and particle size on exchange. Their typical exchange capability is 0.9meq/gm as compared to the exchange capability of artificial ion exchanger handlers 1.5 to 3.0 meq/gm. However, these ion-exchangers are financially more feasible in comparison to artificial exchangers. The commercialized accessible compound is Rs 250/500gm and ours is Rs 40/500gm approx. When tertiary treatment of liquid waste of Paper, Steel, and other industrial plants was successful then it was used for irrigation functions.
KEYWORDS- *Ion exchange handler, Effluent, Sulphated wheat straw, Contaminants*

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I. INTRODUCTION

Today, waterborne toxic chemicals pose a great threat to the safety of water supplies in developed and developing countries alike. There are many sources of toxic chemicals in the environment, such as badly managed landfills [1], industrial pollution, and pesticide runoff [2]. However, industrial wastewater is a major source of liquid waste. The main techniques, which have been utilized to reduce the toxic effluents, include lime precipitation, ion exchange, adsorption into activated carbon [3], membrane processing, and electrolytic techniques. Such techniques have been for restricted use, as they generally contain high capital and operation and maintenance costs and may be included with the formation of secondary wastes which generates treatment troubles, for example, the large amount of sludge produced by precipitation processes. Contrary to this ion exchange, reverse osmosis and adsorption is more catchy processes because the metal amount can be recovered along with their removal of the effluents. Reverse osmosis and ion exchange do not appear to be economically functioning due to their comparatively high investment and operation and maintenance costs. The innovation of utilizing many agricultural substances and by-products for the eradication of heavy metal from solution has been studied by various researchers. Friedman and Waiss [4], Randall et al [5] and Henderson et al [6] have analyzed the effectiveness of various organic waste materials as sorbents for heavy metals. The exchange capacity and primary sorption characteristics of these materials are based on their constituent polymer unit (in approximately decreasing order of abundance): cellulose, hemicelluloses, pectin, lignin, and protein. Kou et al.[7] and Huangshan Shang et al.[8] have suggested the uses of biomaterials or abandoned biomaterials (BIOM), a new word for agricultural product, and the by-product of which the major component is cellulose (C6H10 O5)n. The cellulosic surface gets partially negatively charged when dipped in water and, therefore, holds Columbia interaction with cationic species. The high binding capacities of cationic species on the adsorbents are mainly due to columbic interactions. Ligno cellulosic substances and crop by-products/wastes have been used for the making of ion-exchangers[9-12]. Hence, these exchangers are used for water treatment.

The eradication and conversion of commercial emergents may be a difficult task in biology, as the prevention and treatment of pollution have gained significant value in past years. Irrigation wastes like wheat straw are copiously accessible in rising nations for example Asian countries. Wheat straw is often utilized in the production of ion-exchanger and further, they are often utilized for the treating of assorted industrial emergencies. Wheat straw derived ion –exchanger is a good absorbent for the removal of toxic metals too[13]. The effluents from numerous| industries ought to be tertiary treated so it is often used for many helpful functions. This paper deals with the treatment of synthetic effluents and work effluents by indigenously ready ion exchangers from farming wastes. i.e wheat straw.

II. PHYSICAL AND CHEMICAL CHARACTERIZATION OF WHEAT STRAW

2.1. Chemical & Elemental Composition

Table (2.1) shows the chemical composition, elemental composition, and pore structure parameters of straws. Straws are composed of macromolecules such as cellulose, hemicellulose, lignin, and protein, which are composed of elements such as C, H, O, and N. These macromolecules contain functional groups such as hydroxyl groups, carboxyl groups, and amino groups with strong coordination ability.

Table 2.1. Chemical and Elemental Composition and Physical Structure Parameters of the Wheat Straw

Chemical Composition (%)	
Parameters	**Wheat Straw**
Cellulose	44.92
Hemi cellulose	19.79
Lignin	12.50
Ash	4.99

Elemental Composition (%)	
Parameters	**Wheat Straw**
O	50.00
C	43.00
N	6.28
H	1.02
surface area (m^2 g^{-1})	12.59
BJH cumulative volume (cm^3 g^{-1})	0.04
Mean pore diameter (nm)	3.051

2.2. Analysis of SEM

The photograph and SEM of the straw are shown below. The straws have a harsh surface, and there are cell divider fine structures inside the straws. The structure of the straws is free, which can uncover more dynamic locales and helps in adsorption. Simultaneously, it is visible that many little pores revolve in the free pores of the straw, which is an important expansion of the particular surface area.

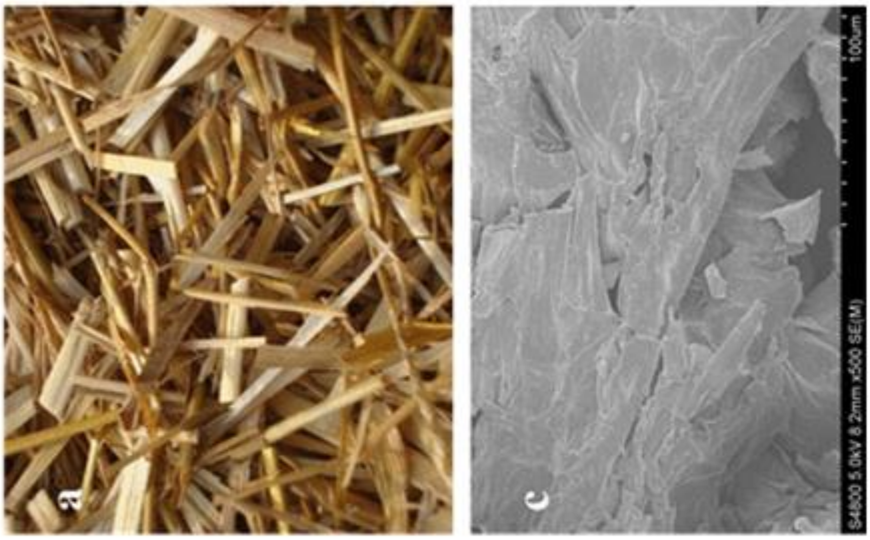
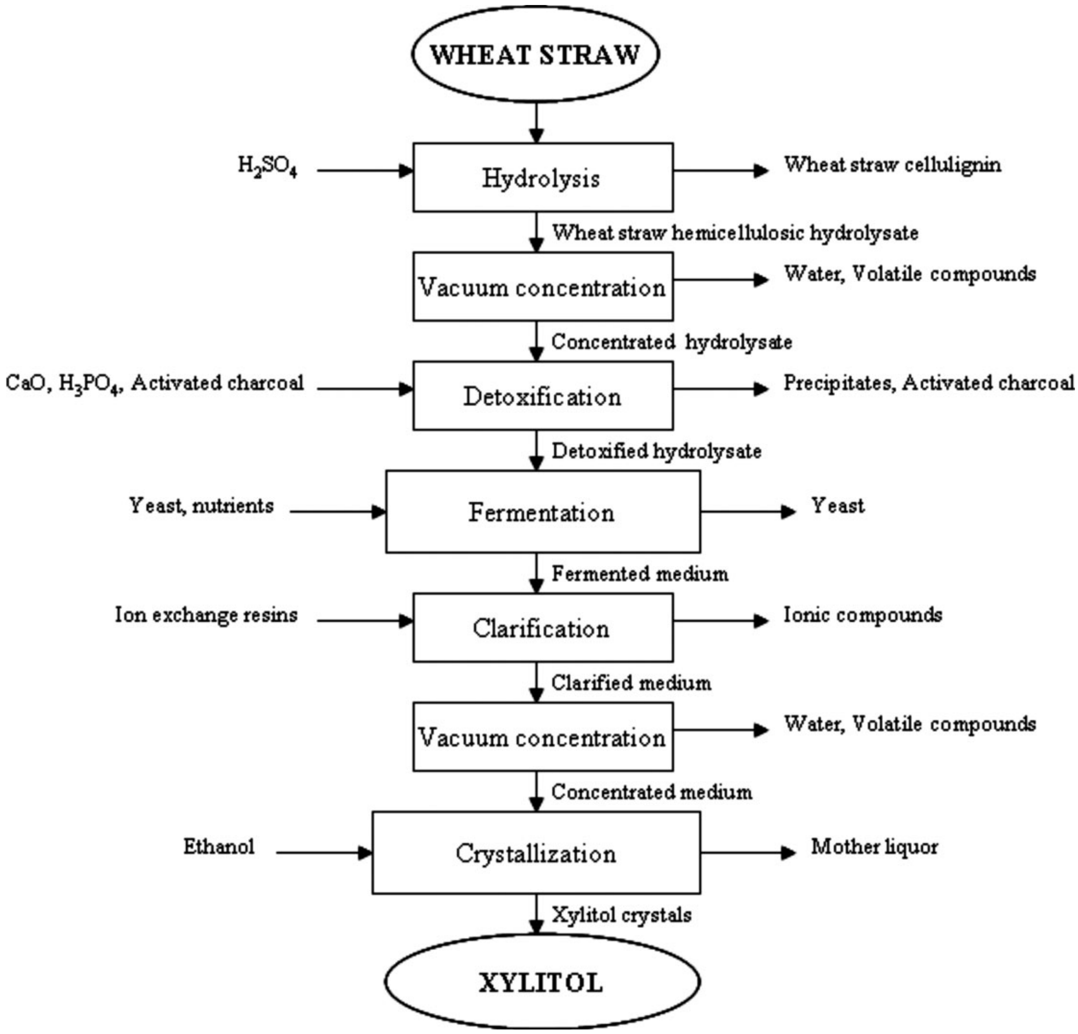


Figure 2.2: Wheat straw and its SEM image

III. METHODOLOGY

3.1. Changing of Wheat Straws in form of Ion Exchangers

Changing of wheat straw into an ion exchanger is a new technique for the utilization of irrigation and farming dead materials for the treatment of industrial effluents. The ion exchangers from wheat straw will reduce the pollution from effluents. The wheat straw undergoes hydrolysis with dilute H_2SO_4. The xylose content was raised by vacuum



concentration and the amount of inhibiting compounds was reduced by detoxification by pH change and activated charcoal adsorption. After nutritional addition, the detoxified hydrolysate was used as the source of xylose for xylitol bioproduction.

3.2. Primary Uses of ion exchangers

After use ion exchanger was washed and analyzed for many investigations like the content of ash, wet content, sulfur, carbon exchange capability, exchange equilibrium, exchange mechanics, variation in concentration of the solution on an exchange, the result of flowing, and the result of particles areas, etc. The ion exchangers were born-again into numerous types of form, metal type, and metallic element type metal. The results were analyzed and their comparison with artificialization-exchangers as reported in the tables (3.2.1 – 3.2.5).

Table – 3.2.1. -Proximate analysis of S.W.S

A. Proximate Analysis % by Mass	
Non combustible matter Content	4.79
Moisture content	9.12
Volatile Matter	67.96
Fixed Carbon	19.23

B. Ultimate analysis	
C	39.98
N	0.49
S	< 0.01
H	15.99
Ash	3.99
O	remaining

Table 3.2.2. Moisture Content and Noncombustible matter For Different Forms of Cation Exchanger from SWS

Types of SWS	% Non Combustible matter	% Moisture Content
Ba^+	15.99	16.99
Na^+	12.76	11.85
K^+	13.00	14.00
Mg^+	12.99	13.00
H^+	13.98	14.00

Table-3.2.3. Density of Swollen Form of SWS

Solvent	Amount of SWS(gm)	Time of Contact	Density
H_2O	1	20 minutes	0.9789
H_2O	1	22 hour	0.9943
H_2O	1	46 hour	0.9992
H_2O	1	70 hour	0.9954
Benzene	1	20 minutes	1.1921
Benzene	1	22 hour	1.2431
Benzene	1	46 hour	1.2991
Benzene	1	70 hour	1.3893
Acetone	1	20 minutes	1.0605
Acetone	1	22 hour	1.1243
Acetone	1	46 hour	1.1389
Acetone	1	70 hour	1.1727

Table 3.2.4. Exchange Capacities of Various Cation-Exchangers.

Trade Name	Porosity/Type	Exchange Capacity(Meq/gm)
Duolite C-3	10 W	4.0
Duolite A-2	High	9.5
Duolite C-10	High	3.0
Zea -Karb	High	2.5
Wafatit	Low	3.6
Zeolit 215	Low	3.7
SWS	Low	1.8

Table 3.2.5. Exchange Capacities of Various Forms of SWS

Types of SWS	Exchange Capacity in Meq/gm
Ba^+	2.2009
Mg^+	2.371
K^+	2.0400
NH^+	2.1030
Ca^+	2.502
H^+	1.9130
Na^+	2.3127

Table 3.2.6. Treatment of Distillery Effluents with SWS

S.No	Parameters (ppm)	Untreated Effluent	Treated Effluent with SWS	% age with SWS
1	Dissolved Oxygen	1.0	5.0	
2	Acidity	390	70	69
3	Chloride Content	185.8	97.8	88.02
4	BOD	445	243	49.20
5	COD	9760	2429	75.91
6	Alkalinity	270	170	43.60
7	Free CO_2	300	117	63.70
8	Total Hardness	4900	1525	75.89
9	Permanent Hardness	2767	573	74.80
10	Temporary Hardness	2133	952	1.09
11	Total Solids	99,314	68763	32.15
12	Dissolved Solids	85,432	54675	34.15
13	Suspended Solid	13,882	14,088	20.11

Table 3.2.7. Treatment of Steel Mill Effluent with SWS

S.No	Parameters	Untreated Paper Mill Effluent	Treated Paper Mill Effluent with SWS	% age with SWS
1.	pH	8.0	7.3	-----------------
2.	D.O	3.0	7.0	------------------
3.	Acidity(ppm)	62	46	33.10
4.	Chloride Content(ppm)	182.5	97.0	48.10
5.	BOD(ppm)	186	59	70.20
6.	COD(ppm)	380	208	46.01
7.	Alkalinity(ppm)	220	150	31.60
8.	Free CO_2 (ppm)	27	19	33
9.	Total Hardness(ppm)	3850	2000	49.12
10.	Permanent Hardness(ppm)	3360	1810	50.80
11.	Temporary Hardness(ppm)	500	190	51.09
12.	Total Solids(ppm)	1854	1400	32.15
13.	Dissolved Solids(ppm)	1150	730	31.15
14.	Suspended Solid(ppm)	704	670	30.11

Table 3.2.8. Treatment of Steel Mill Effluent with SWS

S.No	Parameters	Paper Mill Effluents	After treatment Paper Mill Effluent with SWS	% age with SWS
1.	pH	1.9	5.1	
2.	Dissolved Oxygen	1.0	3.9	
3.	Acidity(ppm)	48000	1810	62.10
4.	BOD(ppm)	5220	1830	64.00
5.	COD(ppm)	390	209	45.81
6.	Alkalinity(ppm)	10700	4049	97.60
7.	Free CO_2 (ppm)	84	22	73
8.	Total Hardness(ppm)	19000	7400	66.12
9.	Permanent Hardness(ppm)	15000	4900	50.80
10.	Temporary Hardness(ppm)	4000	190	52.00
11.	Total Solids(ppm)	81000	59000	27.15
12.	Dissolved Solids(ppm)	12000	39000 ppm	28.12
13.	Suspended Solid(ppm)	69000	20000	72.11

IV. RESULTS & DISCUSSION

The transformation of wheat straw into a cation exchanger is a native way of utilizing farming dead materials for the making of cation-exchangers. The mean value of ion exchange capabilities of many types of cation -exchangers from wheat straws was obtained 0.8meq/gm whereas the exchange capacity of synthesized cation exchangers is approximately (2.0 to 2.8 meq/gm). The costing of construction of cation-exchanger from the wheat straw incomplete form is approximately (Rs40/500 gm) in comparison to commercially present cation exchangers (Rs 300/500gm). Thus the amount of cation-exchanger from wheat straw is very less and economically more feasible in comparison to synthesized cation exchangers. Moreover, these cation exchangers can be regenerated quickly by immersing them in decinormal HCl for 24 hours. They can be stored easily. Results show that the emergents of many industrial plants after treating with S.W.S has a recognisable decrease in various Physico-chemical parameters such as Dissolved Oxygen, Acidity, Alkalinity, Biological Oxygen Demand, Chemical oxygen demand, Free CO2, and Total suspended solids as reported in tables (6 - 8). The cation exchanger from a wheat straw can significantly decrease the pollution of industrial effluents.

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