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Modification of Guar Gum Waste and its Applications for Removal of Industrial Pollutants

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ABSTRACT

Guar gum waste was treated with ethylacetoacetate. The resultant acetoacetyl guar gum (AGG) was then adducted with sodium bisulfate. The so called product was designated as SAGG. The various mixture of SAGG, pumkin peel powder, eggshell powder and activated charcoal were prepared. The waste water from different industrial zones was collected and then qualitative parameters were determined. All the wastewater samples treated with above various mixtures as adsorbent. The analytical parameters before and after adsorption process were documented and discussed.

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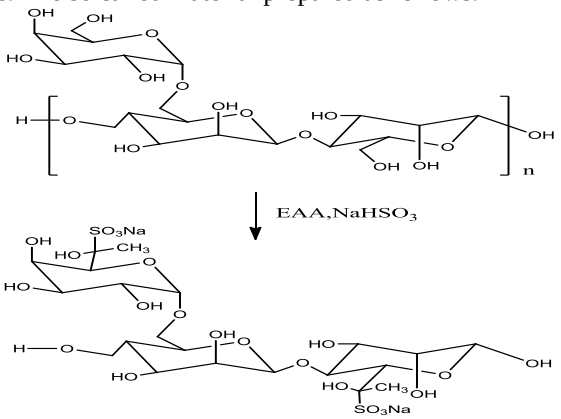
Introduction

The industrial pollutants creating water pollution of more particularly the textile effluents are toxic to mankind and animal living. Numbers of dyes are manufactured and applied for textile dyeing worldwide [1-3] and create water pollution. Thus it is badly need to remove color and dyes before this dyed water discharging in water sources. Many methods developed for dye bearing water treatment like oxidation, membrane separation, coagulation etc.[4-7] However adsorption is found as best method for enabling ease of chemical plant designing [8]. Some eco-friendly polymers [7-10] are found recently as efficient dye adsorbents. In context to this, the present deals with treatment study of dye effluents by agricultural adsorbent materials.

The agricultural absorbent were prepared from guar gum waste. The so called material prepared as follows.



Experimental

Materials and methods

The guar gum acetylation and sulfination were carried out by reported method[]. All the chemicals were used of pure grade. Various adsorbent mixtures were prepared as shown in Table - 1 shown below.

Table 1. Various adsorbent mixtures

Adsorbent mixture	SAGG	Actvated Carbon	Pumkin Peel flour	Egg shell Powder
GM-1	65	10	15	10
GM-2	55	10	20	15
GM-3	45	10	30	15

Synthesis of Guar gum acetyl acetate

It was preapared by following reported method for cellulose. The guar gum waste powder (0.2 mol) was suspeded with 1-allyl-3-methylimidiazolium chloride ionic liquid and heated upto 80-90C for complete dissolution. Tetrahydrofuran solvent added to dilute the solution. Then the solution was refluxed and ethylacetoacetate (EAA) () was gradually added keeping blanket of N2 gas. The reaction was carried at for 5 hrs. To this mixture then sodium bisulfate was added to for bisulphite adduct.

The dye bearing waste water samples collected from various industrial zones of projects. The pH, electrical conductivity, dissolved oxygen, BOD, COD and TDS were measured by standard techniques.

Adsorption study

Various dye bearing waste water samples 100ml charged in 250ml Erlenmeyer flask at room temperature. 2 g of

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adsorbent mixtures AM-1 to 3 shown in Table - 1, added into each of sample. The flask was put on the shaker with rotation 150rpm for one day. The contents filtered and tested for analytical parameters following the APHA 4500 F-method[10]. All the experiments carried out duplicately.

Result and Discussion

Modified guar gum (GAA) was light brown powder and soften around 200C. The elemental content is consistent with expected structure. The OH and COCH3 groups present in the polymer chain. The IR spectrum contains important bands due to absorption 1720cm^{-1} (CO group). The other bands at their respective positions. The thermogravimetry analysis indicate that the polyester starts it degrade around 230C and degrade regularly upto 700C with 85% wt. loss.

Table. 2 Elemental analysis of AGG: $C_{21}H_{36}Na_2O_{22}S_2$ (750)

	C	H	S
Calcd:	33.60	4.83	8.54
Found:	33.5	4.8	8.5

Adsorption studies of textile /dye industrial waste water

The effluents of various industrial zones in Gujarat were collected when before discharge in their effluent treatment plants. The studies on these neat samples and after treatment by adsorption mixtures GM-1 to 3 are furnished in Table - 1.

Properties of neat dye bearing waste water samples

The dye bearing waste water samples were collected were light to dark colored and are basic in nature. After treatment with GM-1 to 3 they becomes almost colourless. The organic abd inorganic species inthe samples reduced due to adsorptive materials. The sample bearing reactive dye may have difficult to remove but in presence of GAA polymer sample in the reactivd group OH is present. So the dye samples whatever may almost removed.

The conductivity of all the effluent samples was decreased. The TDS is due to chlorides, carbonates, sulphates, Calcium, magnesium etc. The TDS of all the samples decrease to very low level after adsorption process.

The hardness of all the samples is observed after the treatment. It is as per ISI standard. After the treatment the pH of all the samples exist under the suitable range of potable water.

The BOD values of all the sample are reduced to very low level after adsorption process. So the water can be used for agricultural use.

All the samples have high COD. So toxicity is high. The produced adsorbents have chemical structure which remain not only dye but also metals as well as removing colour.[The structure contains metal gripping group(ligand) bisulfate group(for removing colour) and OH group for dye removal.] Thus COD and BOD level reduce with decolourization at appropriate level. The animal charcoal and bagasse also play the role in all process. Thus the produced adsorbents are excellent for pollutant treatment.

Conclusion

From the results of produced work the conclusions are:

i. The adsorption mixture GM-1 is best out of three.

ii. The colour removal is almost excellent for all the adsorption mixture. This may be due to the polysaccharides in mixtures as well as colour removal group(i.e. bisulfite) on the GM-1 to 3.

iii. Overall the produced adsorbent mixtures are efficient for dye pollutant removal.

Table-3 & 4 . Analytical Parameters of dye bearing wastewater samples of various zone of Gujarat. Dye as Textile industrial effluent sample: The Neat sample and After treatment sample.

Sr. No.	Parameter		Z-1(AT)				Z-2(AT)				Z-3(AT)		
		Neat	GM-1	GM-2	GM-3	Neat	GM-1	GM-2	GM-3	Neat	GM-1	GM-2	GM-3
1	Color	Blue	Nil	Nil	Nil	Dark Brown	Nil	Nil	Nil	Dark Red	Nil	Nil	Nil
2	pH	9.8	6.2	6.1	6.0	9.5	6.4	6.7	6.9	10.0	7.0	7.2	7.0
3	Hardness Mg/L	1122	301	283	294	930	202	203	254	1100	250	305	310
4	Basicity	1270	189	201	203	935	187	180	180	1300	180	240	270
5	Conductivity μ_s/L	9.6	4.5	4.5	4.8	10.2	6.1	7.0	7.2	9.5	4.3	4.4	4.8
6	TDS mg/L	6800	2500	2600	2700	5200	1800	2000	2100	7000	2800	3000	3100
7	Cl^- mg/L	750	200	250	270	970	270	270	300	700	210	240	270
8	SO_4^{-2} mg/L	520	240	250	250	490	202	225	230	710	205	208	230
9	COD mg/L	770	210	270	275	560	160	180	190	650	220	260	275
10	BOD mg/L	430	50	50	50	420	35	37	45	460	50	70	80
11	Color removal %	-	94	95	93	-	98	92	96	-	96	94	92

Sr. No.	Parameter		Z-4(AT)				Z-5(AT)		
		Neat	GM-1	GM-2	GM-3	Neat	GM-1	GM-2	GM-3
1	Color	Dark Greenish Yellow	Nil	Nil	Nil	Blackish Blue	Nil	Nil	Nil
2	pH	9.7	6.7	7.0	7.0	9.6	6.9	6.4	7.0
3	Hardness Mg/L	1060	240	270	280	980	210	220	240
4	Basicity	950	140	190	208	1200	210	230	350
5	Conductivity μ_s/L	10.9	4.2	6.1	6.3	15.0	8.2	9.0	9.0
6	TDS mg/L	5300	1700	1900	2000	9100	3700	4000	4300
7	Cl^- mg/L	900	310	340	360	1030	340	330	350
8	SO_4^{-2} mg/L	500	180	200	220	460	180	200	220
9	COD mg/L	670	170	200	220	700	200	210	230
10	BOD mg/L	430	40	40	60	380	25	40	60
11	Color removal %	-	94	95	92	-	94	95	92

Z: zone waste water sample

AT: After treatment

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