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GRAPHENE OXIDE SYNTHESIS FROM SUGARCANE BAGASSE & ITS APPLICATION FOR REMOVAL OF PB (II) IN WASTEWATER

Vishakha Wagh[1]* and Pravin Nalawade[2]

Department of Environmental Science and Research Centre, K.T.H.M. College, Gangapur Road, Nashik-422002, India.

Abstract

Water is an important source of earth. But nowadays wastewater increasing rapidly due to rapid development industrialization. Treatment of wastewater is very costly and some cost-effective methods also available. Sugarcane bagasse is also one of the cost-effective methods. It contains fibre with versatile properties. Graphene oxide synthesis by oxidized graphite with sugarcane bagasse under muffle furnace method. Confirmed that structure by different techniques like XRD, SEM, FTIR and TEM. This material used for the treatment of Lead removal, it contains a high amount of adsorption capacity. It takes minimum 3hrs period removal of lead. Basic PH shows high adsorption rate as compare to other PH ranges. Comparative study of both samples done by t-Test method and ANOVA method.

Key words : Graphene oxide, Sugarcane bagasse, adsorption, contact time, pH, t-Test.

Introduction

Water is an important source of life which support to sustain. Major developmental projects, civilization & villages are settled near water bodies. All these things arise the problem of wastewater. Wastewater is contained domestic sewage discharge, industrial discharge, and agricultural runoff etc. change water quality. Industrial discharge is mainly containing heavy metals like lead, arsenic, cadmium, chromium, mercury, zinc, nickel. Among the toxic heavy metals in that lead is also common contaminants in water from industries. Lead is mix in water through anthropogenic activities and when it exposed to longer period then affect the humans & animals.

Lead shows adverse effects in human, high exposure includes the neurological, reproductive, renal and hematological effects and more precaution should take small children. Blood lead level is always below the CDC recommended level of 10µg/dL. Various techniques are available removal of heavy metal but adsorption technology currently used which is cheaper, cleaner and easily remove heavy metals. The adsorption technology is done by Batch operations because it is a small amount of treatment or experiment-based. The Batch operations equilibrium distribution depends on contact time then it determines the effect of contact time, initial pH, the adsorbent size on the removal of Lead. The main aim of this study prepare a sugarcane bagasse waste material into valuable Graphene Oxide material and study its Adsorption capacity of Pb(II) removal. Sample adsorption comparative study is done by statistical methods.

***Author for correspondence :** E-mail: waghvishakha007@gmail.com

Materials and Methods

Preparation of adsorbent

Sugarcane bagasse is a type of agricultural waste. After a process of juice extraction, collect that fiber. The fiber was crushed & make it powder. The above process repeated several times to obtain a powder. Take a crucible put 0.5 gm sugarcane bagasse powder and 0.1 gm ferrocene mixed it. After that put crucible into muffle furnace for 10 min with 300°C a black solid produced & collect it.

Characterization of go by XRD, FESEM+EDX, FTIR and TEM Techniques

Prepare a 1000 ppm stock solution of lead and add

1.8gm of lead powder in 1000ml distilled water, dissolved it. Then prepare different concentration of sample solution into a stock. Adsorption efficiency of lead ions on adsorbent was carried out by batch adsorption method. In this method observed the effects of agitation time, size of the particle and different pH of a lead solution. Take a 500ml conical flask add into it 50ml sample and 1.5gm adsorbent with various particle sizes. This sample is shaken on a shaking incubator at room temperature for 1 hr. the sample was prepared and placed the on shaker for agitation with different time intervals like 5min, 10min, 20min, 30min, 40min, 50min, 60 min, 120min,180min and 240min. after the sample filtered by Whatman filter paper and examined by the titration method.

Results and Discussion

X-Ray diffraction method: I have presented the XRD pattern of synthesis graphene oxide from sugarcane bagasse in given figure. The peak at 2u= 31.2° indicate grapheme oxide material was fully oxidized. This peak of Graphene Oxide is obtain by single-step oxidation of sugarcane bagasse and shows two dimensional structure.

FT-IR Spectroscopy

Sample 1 shows the carboxylic acid & carbonyl group C=O was increasing wave mode at strong band 1593 cm^{-1}. The epoxy group C-O contained band at 1045 cm^{-1} and other bands were at 1111 cm^{-1}, 1184 cm^{-1}. An unoxidized graphitic was showing a peak at 1381 cm^{-1}. mainly O-H & C-OH group showed a sharp peak at 3500-4000 cm^{-1}.

Sample 2 shows the carboxylic acid & carbonyl group C=O was stretching vibration mode at strong band 1710 cm^{-1} . The epoxy group C-O was contain band at 1114 cm^{-1}, 1226 cm^{-1} & 1369 cm^{-1}. The O-H & C-OH group were shows strong peak at 3500-4000 cm^{-1}.

FESEM and HRTEM Analysis

The graphene oxide surface formation of sugarcane bagasse oxidation was identified by FESEM. The FESEM image shows flake and sheet like structures which is similar to reference research.

The micrograph of Graphene oxide done by HRTEM technique. This techniques shows detail micro structure of graphene oxide contain edges, Nano sheets, flakes and wrinkle structure. It shows polycrystalline structure and confirmation of graphene oxide by HRTEM analysis.

Adsorption process done by graphene oxide synthesis from sugarcane bagasse

The adsorption method was done here, this method shows

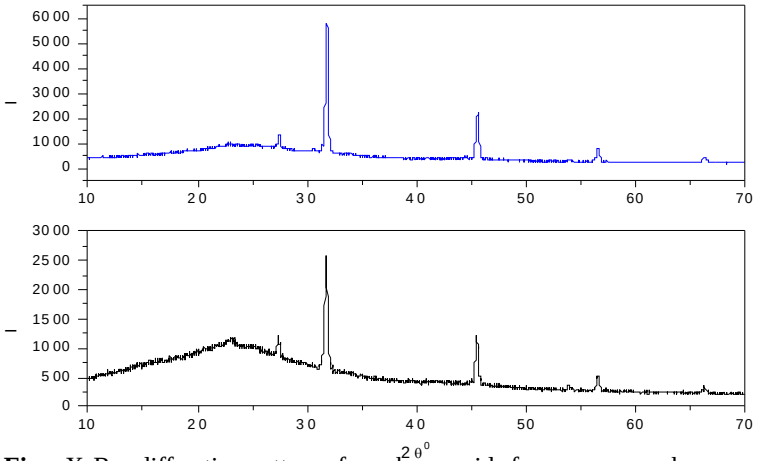
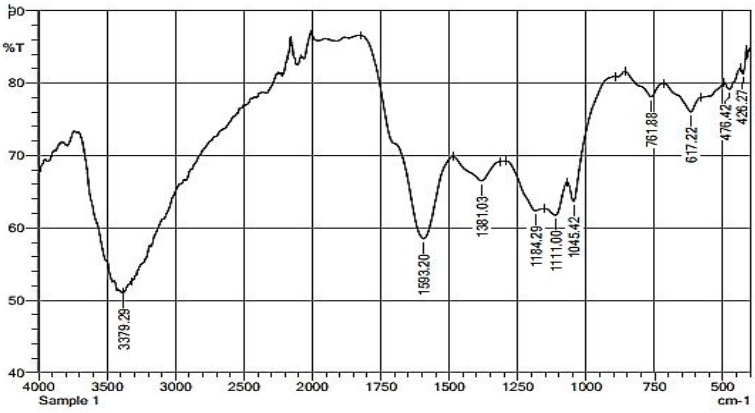
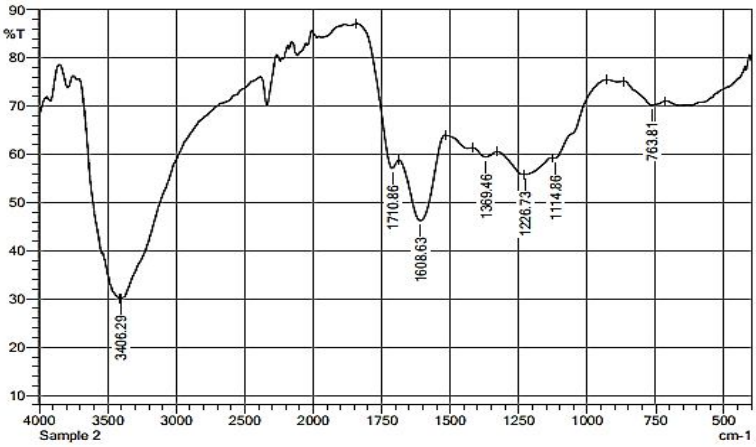


Fig. : X-Ray diffraction pattern of graphene oxide from sugarcane bagasse.



Sample 1: Fourier Transform infrared spectroscopy (FT-IR) spectrum Graphene Oxide.



Sample 2: Fourier Transform infrared spectroscopy (FT-IR) spectrum of Graphene Oxide.

Statistical Analysis

t-Test: Two-Sample Assuming Equal Variances		
	Variable 1	**Variable 2**
Mean	9.6000	9.1833
Variance	13.7073	14.5361
Observations	12.0000	12.0000
Pooled Variance	14.1217	
Hypothesized Mean Difference	0.0000	
Df	22.0000	
t Stat	0.2716	
P(T<=t) one-tail	0.3942	
t Critical one-tail	1.7171	
P(T<=t) two-tail	0.7885	
t Critical two-tail	2.0739	

ANOVA for time						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Between Groups	3.217802	1	3.217802	0.319854	0.578678	4.413873
Within Groups	181.084	18	10.06022			
Total	184.3019	19				

ANOVA for pH						
Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**	**F crit**
Between Groups	2.896022	1	2.896022	2.791788	0.11419	4.493998
Within Groups	16.59738	16	1.037336			
Total	19.4934	17				

t-Test and ANOVA both statistical method shows sample 2 was more efficient than sample 1.

adsorb lead ions by graphene oxide from the sample. The forces were between lead and graphene oxide due to attraction. In this study, I have studied the adsorption capacity of graphene oxide material which synthesis from sugarcane bagasse and adsorb lead material concerning time and pH. As the pH increases the removal of lead also increases gradually. Here I have used two adsorbate materials like sample 1 and sample 2. Comparison of both adsorbate material study with Time and initial pH. The above-investigated study showed sample 2 maximum capability at an initial pH 11. Lead ion adsorption did within three hours.

Conclusions

This method is simple, cost-effective and environment-friendly. Sugarcane bagasse waste material is converted into valuable material like Graphene Oxide. This Graphene Oxide material is useful for the removal of Pb (II) from wastewater. Graphene Oxide material is also effective for other heavy metal removals.

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