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Chemistry

REMOVAL OF TOXIC POLLUTANTS FROM AQUEOUS SOLUTIONS USING ACTIVATED CARBON FROM POACEAE FAMILY

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ABSTRACT Water is called as elixir of life. Pure water is the basic requirement on the surface of the earth for the sustenance of life for humans, animals and birds. Increased contamination in the environment with toxic pollutants has been a great challenge for living organisms. There is a dire need for developing an effective strategy that can apply for environmental renewal. The major problem with conventional methods such as chemical and physical in terms of their efficiency and economy used for cleaning of pollutants is inadequacy and high economic costs. The biological processes for treating toxic effluents are better than chemical and physical methods in terms of their efficiency and economy and the potential of biofilm communities for bioremediation processes. Though biofilms are recognized to cause troubles in several areas of human health and the industry, bio-films are very vital in a number of engineering applications including wastewater management, bio-production of valued chemicals and bioremediation. Intriguingly, the use of biofilms is efficient for bioremediation as bio-films absorb, immobilize and degrade many environmental contaminants. Bioremediation is a developing technology having a progressive potential of cleaning pollutants. Therefore biofilm produced by many microorganisms will probably offer an appropriate microenvironment for effective bioremediation activities.

KEYWORDS :

INTRODUCTION

Water quality issues are looming large as the one of major challenges that the humanity is facing tooth and nail in the twenty-first century. Fresh water is vital source to human life and economic well-being and societies extract vast quantities of water from lakes and ponds, streams, reservoirs, rivers and groundwater. They amply provide the majority of water resources for drinking, agriculture, industry, sanitation as well as food including fish and shellfish. Advances in the field of science and technology have brought remarkable improvement in many areas of development. Nevertheless, during the process, it also contributed copiously frightful conditions to the environment such as polluting the water resources by unethical discharge of abnormal quantities toxic metals. These toxic metals in turn increase the great demand for cost effective techniques with proper treatment facilities for discharging wastewater into the environment. The increasing demand of freshwater resources for the future will exert simmering pressure, particularly in waterless regions of the world, for protecting the available surface water resources from pollution.

Toxic metals lead to several health problems in animals, plants and human beings such as cancer, kidney failure, metabolic acidosis, oral ulcer, renal failure and damage in for stomach of the rodent. As a sequel, the degree of the problems caused by heavy metals pollution and removal of heavy metals from Industrial waste is important. An efficient removal of toxic metals from wastewater is an important matter and it is being studied. Several technologies have been developed over the years for removing toxic metal from wastewater. Physical treatment can also be used to remove small concentrations of hazardous substances dissolved in water that never settles out. The current physico-chemical processes for heavy metal removal like precipitation, reduction, ion-exchange etc. are expensive and inefficient in treating large quantities. Untreated effluent containing toxic pollutants released from various industries represents an environmental threat and imbalances the ecological equilibrium.

REVIEW OF LITERATURE

Malairajan Singanan et. al [1] have reported toxic heavy metal removal from synthetic waste water using a novel bio carbon technology. The base reported removal of Pb (II) and Cr (III) ions is depend on the pH and adsorbent dose (Biocarbon). The predominant mechanisms are ionic interaction, ion exchange and weak surface adsorption were employed on the adsorbent material.

Xiaonan Tang et. al [2] investigated removal of Cu (II) by loofah fibres as a natural and low cost adsorbent from aqueous solution. Adsorption of Cu (II) was increased in the presence of Humic acid (HA) at pH <8.0 but decreased at pH >8.0. The adsorption process was examined in various pH, foreign ions, humic acid and temperature. Humic substances were proved to be a clear enhancing effect on Cu(II) at low pH while decrease at high pH.

A.O.Jorgetto et. al [3] have reported Cu(II) removal from natural river water using cassava root husks powder as green adsorbent. The adsorbent was characterized by FTIR and NMR technique. It shows that adsorbent have alcohol, amine, carboxylic acid, methionine and thiamine. The existence of carboxyl, amine and other functional group at materials surface is the main responsible for its adsorption capacity.

Vaishali Tomar et. al [4] have reported Adsorptive removal of fluoride from aqueous media using citrus limonum leaf. The adsorption of F^- ion was affected by pH, contact time, adsorbent dose. The factors are optimized and reported, it indicates the adsorption of F^- ion is directly proportional to the contact time and adsorbent dose. The maximum removal of F^- was achieved at pH 2.0

V.Coman et. al [5] investigated Nickel removal/recovery from industrial wastes, Nickel removal performed by the following methods such as Chemical precipitation, Ion floatation, Ion exchange, membrane filtration, Adsorption and Electrochemical treatment. Nickel recovery was done from batteries, catalysts, electrical and electronic equipment by using reagents such as H_2SO_4, HNO_3, citric acid and EDTA. The recovery is based on the precipitation of nickel by acids and chelating effect by EDTA.

Ali. A. Homaidan et. al [6] have reported bio-sorption of copper ions from aqueous solutions by Spirulina platensis biomass. The dried algae biomass was very efficient to remove copper ions (90.6%) from aqueous solution containing metal waste. He has reported maximum removal rate of copper ions has achieved within 90 minutes contact time. Capabalities were influenced by pH, initial concentration and contact time.

Nilton F.G.M. Cimirro et al [7] in their work employed lovegrass (Cpa), an abundant grass of the Poaceae family, as feedstock for the production of activated carbon in a conventional furnace using ZnCl2 as a chemical activator. The prepared material (Cpa-AC) was characterized by pH of the point of zero charges (pHpzc), Boehm's titration method, CHN/O elemental analysis, ATR-FTIR, N2 adsorption/ desorption curves and SEM. This carbon material was used for adsorption of acetylsalicylic acid (ASA) and sodium diclofenac (DFC). FTIR analysis identified the presence of O-H, N-H, O-C=O), C-O, and aromatic ring bulk and surface of (Cpa-AC) adsorbent. The isotherms of adsorption and desorption of N2 confirm that the Cpa-AC adsorbent is mesopore material with a large surface area of 1040 m2 g−1 . SEM results showed that the surface of Cpa-AC is rugous. The kinetic study indicates that the system followed the pseudo-second-order model (pH 4.0). The equilibrium time was achieved at 45 (ASA) and 60 min (DCF). The Liu isotherm model best fitted the experimental data. The maxima sorption capacities (Qmax) for ASA and DFC at 25 °C were 221.7 mg g−1 and 312.4 mg g−1. The primary mechanism of ASA and DFC adsorption was justified

considering electrostatic interactions and π-π interactions between the Cpa-AC and the adsorbate from the solution.

METHODOLOGY

The root of maize belong to *poaceae* family is dried, powdered, treated with conc sulphuric acid and kept the mixture of them for 24 h to get Activated carbon (AC). This AC is thoroughly washed with distilled water for removing acid content in it. The washed AC is dried in the oven to remove moisture at 105 -110 □ C temperature. The SEM Analysis has been conducted for Biomass before and after Batch experiments of adsorption by using spectroscopy. This study is carried out to find adsorption efficiency of AC through measuring the effect of different parameters such as pH, dosage, temperature, Hg concentration and contact time.

RESULTS AND DISCUSSION

The EDX report of Fig 1, 2 and 3, 4 have indicated that the AC of biomass has adsorbed Hg on it.

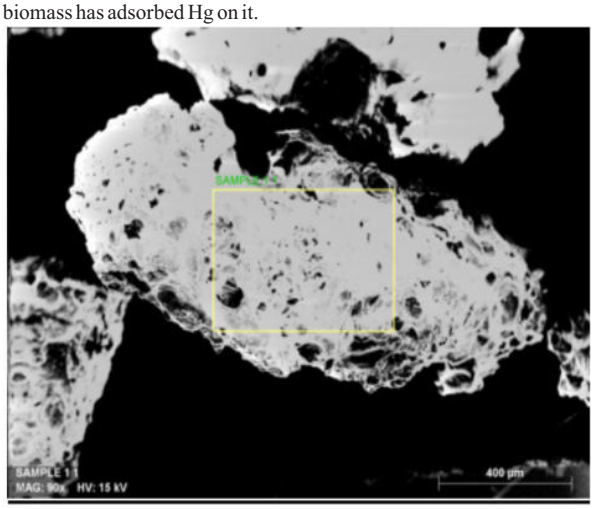
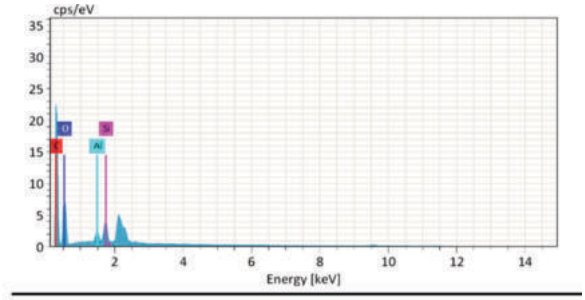


Fig.1 Sem Of Carbon Before Treatment



Spectrum	C	O	Al	Si
SAMPLE 1 1	55.80	38.94	1.68	3.57

Fig. 2 EDX of Activated Carbon before Batch Experiment

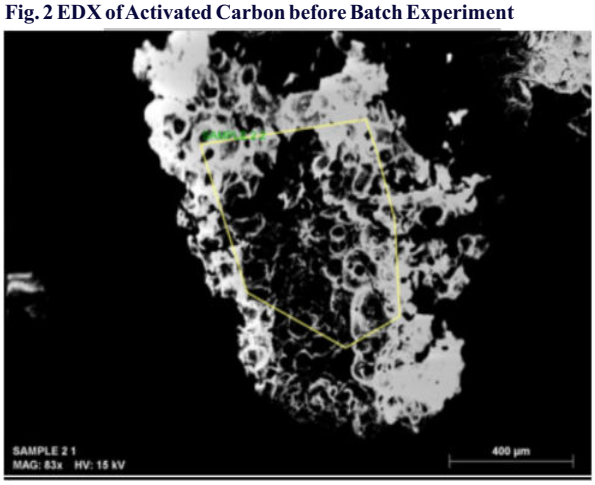
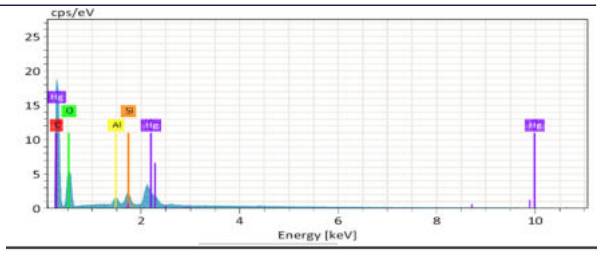


Fig.3 SEM report After Batch Experiment



Spectrum	C	O	Al	Si	Hg
SAMPLE 2 2	48.08	28.58	2.00	3.39	17.95

Fig.4. EDX of Activated Carbon after Batch Experiment

Table 1 EDX Spectrum Report

Element	EDX before Batch Experiment	EDX after Batch Experiment
C	55.80	48.08
O	38.94	28.58
Al	1.68	2.00
Si	3.57	3.39
Hg	NIL	17.95

Effect of pH

Hydrogen Ion Concentration has effects on the adsorption of different toxic pollutants. The table 2 and Fig.5 show the effect of pH on adsorption of Hg is higher at pH of than the pH of---- The adsorption of is high at pH of 4.5 – 5.5 due to negatively charged surface of AC.

Table 2 Effect of pH

Sl. No.	pH Value	Removal (%)
1	2.0	60.021
2	2.5	60.987
3	3.0	70.546
4	3.5	85.657
5	4.0	95.243
6	4.5	99.123
7	5.0	99.564
8	5.5	99.321
9	6.0	90.765
10	6.5	85.234
11	7.0	75.313
12	7.5	70.548
13	8.0	60.986
14	8.5	60.765
15	9.0	60.521
16	9.5	60.043

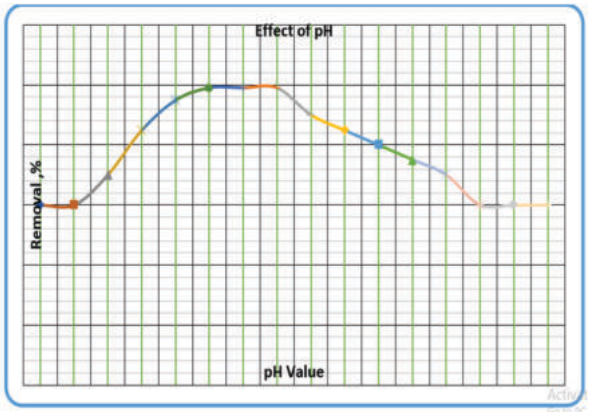


Fig.5 Effect of pH

Effect of Temperature

The temperature has effects on the adsorption of different toxic pollutants (Table 3). Adsorption of Hg with a variation of temperature range from 45 to55° C is shown in Fig .6.The optimum temperature to exhibit high adsorption capacity of Hg is 50° C to 60° C.

Table 3 Effect of Temperature

Sl. No.	Temperature (°C)	Removal (%)
1	25	55.43
2	30	60.67
3	35	70.74
4	40	80.76
5	45	90.71
6	50	98.56
7	55	99.21
8	60	99.68
9	65	92.44
10	70	90.12
11	75	88.99
12	80	87.65
13	85	85.36
14	90	80.56
15	95	80.24
16	100	78.03

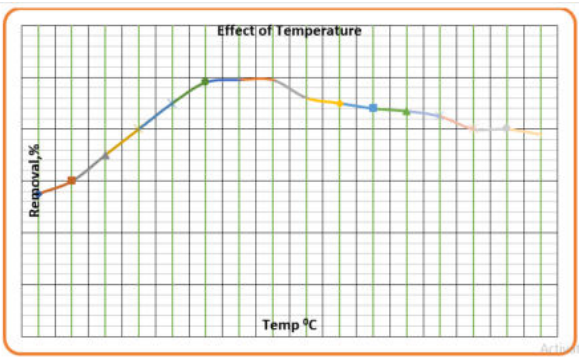


Fig.6 Effect of Temperature

Effect of Adsorbent Dosage

The adsorption of Hg enhancement is notified with increase AC dosage from 1g to 15g. Further, it has shown no much effect of dosage on adsorption due to either agglomeration of carbon particles which reduces the availability of surface area AC. The optimum dosage of AC for a betterment adsorption is 10 gms as shown in Fig.7.

Table 4 Effect of Adsorbent Dosage

Sl. No.	Dosage (gms.)	Removal (%)
1	1	10.32
2	2	21.26
3	3	33.45
4	4	42.63
5	5	52.81
6	6	61.31
7	7	73.42
8	8	80.74
9	9	91.65
10	10	99.02
11	11	99.03
12	12	99.43
13	13	99.67
14	14	99.71
15	15	99.73

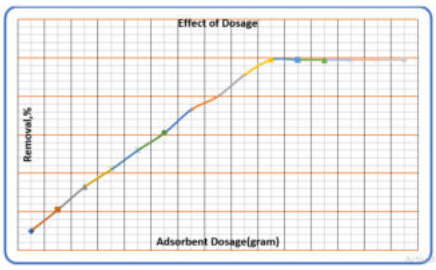


Fig.7 Effect of Adsorbent Dosage

Effect of Contact Time

The adsorption of Hg enhancement is notified with increase of Contact Time from 10 mins to 90 mins (Table 4). Further, it has shown no much effect of 60 mins onwards. The optimum contact time is 10 min and is shown in Fig.8.

Table 4 Effect of Contact Time

Sl. No.	Contact time (min.)	Removal %
1	10	70.75
2	20	80.56
3	30	90.47
4	40	95.36
5	50	98.65
6	60	99.43
7	70	99.76
8	80	99.78
9	90	99.81

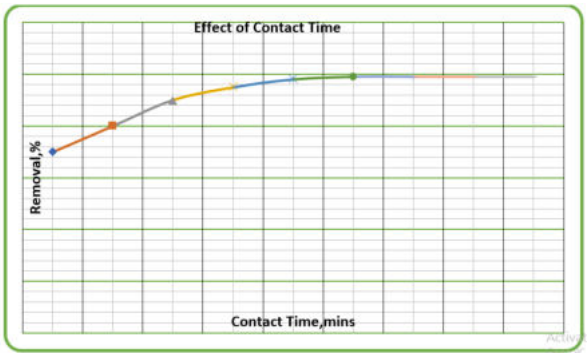


Fig.8 Effect of Contact Time

COCNLUSION

The tremendous increase of using heavy metals over the past few decades has resulted in an increase of metallic substances in the aquatic environment. Mine drainage, industrial and domestic effluents, agricultural run-off etc. have all contributed to some extent to the heavy metal loads into the water bodies. The heavy metals are of copious concern as they are non-degradable and thus they are persistent for quite long time in the nature and can cause harm or death to animals, humans and plants even at very lower concentration. An abundant grass of the Poaceae family, was employed as feedstock for the production of activated carbon in a conventional furnace. The adsorption of is high at pH of 4.5 – 5.5 due to negatively charged surface of AC. The optimum temperature to exhibit high adsorption capacity of Hg is 50° C to 60° C. There is no much effect of dosage on adsorption due to either agglomeration of carbon particles which reduces the availability of surface area AC. The optimum contact time is 10g. Thus, the present work collaborates in developing new adsorbent materials harnessed for the removal of contaminants from aqueous solutions.

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