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Silver nanoparticles loaded pomegranate peels adsorbent for waste water treatment

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Abstract- **The main goal of this study is to prepare a low cost activated carbon using waste pomegranate peels. It was new research no one can directly use silver chloride loading on pomegranate peels adsorbent. Carbon will be modified by loading with silver nanoparticle for waste water treatment. Activated carbons were prepared from and pomegranate peel (Punica granatum) using sodium hydroxide (alkali) as the activating agent. Loading of silver nanoparticle was confirmed by atomic spectrometry (AAS) .The silver nanoparticle loaded pomegranate peels has been studied for chemical oxygen demand (COD) and biochemical oxygen demand (BOD).The adsorption of microbes as well as other organics will be tested for waste water.**

Index Terms- **Chemical oxygen demand, biochemical oxygen demand, Punica granatum, Silver nanoparticle, Inactivation.**

I. INTRODUCTION

Biosorption is a physiochemical process that occurs naturally in certain biomass which allows it to passively concentrate and bind contaminants onto it cellular structure. Biosorption can be defined as the ability of biological material to accumulate heavy metal from waste water through metabolically mediated or physiochemical pathways of uptake. Though using biomass in environmental cleanup has been in practice for a while, scientist and engineers are hoping this phenomenon will provide an economical alternative for removing toxic heavy meals from industrial waste water and aid in environmental remediation[4].

Pomegranate, is a fruit-bearing, deciduous shrub or small tree growing between five and eight meters tall. It is native to the Iranian Plateau, the Himalayas in North Pakistan, Northern India, Russia, Azerbaijan, Afghanistan and Mediterranean region. For centuries, the barks, leaves, flowers, fruits and seeds of its have been widely used to cure diseases and it is mostly consumed fresh and in processed forms as juice, jams, wine and sauce for salads. Turkey is the third major producer of pomegranate in the world and its annual production is approximately 127,760 tons .P. granatum L. peel is a by-product of the pomegranate juice factories and it is used as an antioxidant, ant mutagenic and a skin care agent to treat diarrhea and dysentery.

Safe drinking water is necessary for every living organism on earth. It is known that from among the total amount of water, only 2.5% is fresh water and 98.8% of that water is either groundwater or is in the form of ice. Of this small amount of freshwater, < 0.3% is in lakes, rivers, and atmosphere and provides the useable sources. Water plays a vital role in the world economy. It is widely used in agriculture and in industry as a solvent and helps for transportation and cooling [7].

The scope of this work is to prepare low cost biosorbent using pomegranates peel waste for treatment of waste water. The prepare biosorbent is use to modify by chemical and physical treatment. The biosorbent has been also modify by loading silver nanoparticle. We also check the COD and BOD with or without coated solution. Loading of silver nano particle was confirmed by atomic absorption spectrometry (AAS). The adsorption of microbes as well as other organics will be tested for waste water [1] .

II. MATERIALS AND METHODS

2.1 Material

Analytical grade sodium hydroxide, methanol, aqueous ammonia solution used by SRICT Gujarat, India. Pomegranates peel was obtained from the local market in Gujarat, India. The untreated secondary waste water were collected form ETL Ankleshwar, Gujarat, India.

2.2 Preparation of activated pomegranate peel

Pomegranate peel was collected from local market of Ankleshwar and sun dried for 3 to 4 days . the pomegranate peels was washed with boiling water, and dried in an oven at 60°C for 24 hr . The dried Pomegranate peel pieces were pulverized and sieved to 1.5 mm size. Pomegranate peel powder (50 g) was activated by alkali in 5: 1 ratio (10 g NaOH) and refluxed at 100°C for 8 h then filtered, washed with distilled water until the solution attained a pH of 7. The oven dried (80° C for 12 h) adsorbent was stored in an airtight container.

Figure 2.2.1 Refluxed of adsorbent with alkali water

2.3 Preparation of silver nanoparticle loaded pomegranate peel adsorbent

Once the adsorbent is prepared we directly take waste AgCl powder which is extracted from mixture of metal. It was new research no one can directly use silver chloride loading on pomegranate peels adsorbent. Waste AgCl powder (0.310 g) mixed with 100 ml aqueous ammonia solution stirred at 400 RPM for 1 hr for better mixing AgCl powder is soluble in aqueous ammonia solution. From stirred solution add adsorbent (pomegranate peel) powder 5g. The reaction mixture was continuously stirred for 2 h and the resultant adsorbent was filtered and washed with deionized water. AgCl loaded adsorbent powder was dry in oven for 1hr. AgCl loaded adsorbent (pomegranate peel) powder was successfully prepared. This AgCl loaded adsorbent powder is use for treatment of waste water for COD and BOD reduction.

Figure 2.3.1 AgCl loaded in adsorbent stirring

2.4 Characterization of silver nanoparticle loaded pomegranate peel adsorbent.

The quantitative analyses of silver nanoparticle loaded pomegranate peel powder were performed using AAS in BEIL , Ankleshwar. The sample was digested using 70% nitric acid overnight, filtered and quantified by (Perkin - Elmer optima 5300 DV) . For AAS anlysis the sample was dissolved in 69% nitric acid and measured in 5% HNO3 matrix on a Perkins - Elmer analyst 300 AAS mounted with a silver lumina cathode lamp [1].

2.5 Waste water sampling and Characterization

The secondary waste water were collected form Enviro technology Ltd (ETL) plant ,Ankleshwar in 10 liter plastic container. Untreated waste water from ETL was grey red in colour with a moderate smell. The Chemical oxygen demand (COD) by open reflux method, biological oxygen demand (BOD_3) ,before and after treatment with silver nanoparticles loaded pomegranate was calculated using standard method.We take 100 ml waste water add different dosage of silver chloride loaded adsorbent stirred at different time interval filtered it and collect filtrate for COD and BOD testing.

III. RESULT AND DISCUSSION

3.1 Quantification of silver nanoparticles in the prepared adsorbent

The AAS results of the prepared silver nanoparticle loaded pomegranate peels powder in varying silver nanoparticle concentration was observed with the increasing silver content with the increment of silver nanoparticle concentration up to 0.340 mg/L.the maximum loading of silver nanoparticle on pomegranate peels powder was found to be 90% (±0.5%) loading of silver nanoparticle on adsorbent.

3.2 waste water characterization and treatment

The untreated secondary waste water were treated with silver nanoparticle loaded and without loaded pomegranate peels adsorbent after 150 min , their efficiency for reduction of physicochemical parameter were observed.the initial COD and BOD of secondary waste water is 1380 mg/L And BOD is 45mg/L.The treated effluent was observed with significant reduction of COD and BOD as shown in table 1 to 4.

3.3 effect of adsorbent dosage

Adsorbent dosage is an important factor for COD and BOD removal. 0.310 g silver chloride loaded adsorbent in different amount of dosage is used to treat the 100 ml secondary waste water . the initial COD and BOD is 1380 &45 (mg\L). Table 1 shows the COD & BOD removal efficiency of pomegranate peels.the increased in amount of adsorbent the value of COD and BOD is also remove. Similarly table 2 shows without silver chloride loaded adsorbent is use in different amount of dosage to treat 100 ml secondary waste water. If we increased amount of adsorbent dosage COD and BOD value is less decreased as compared to silver chloride loaded adsorbent dosage.the maximum COD and BOD removal achieved at 20 g absorbent dosage.

Sr. No.	Amt. Of adsorbent (g)	Stirring Time (min.)	Waste water (ml)	COD /BOD (mg/L)
1	Initial			1380/45
2	2	30	100	1200/23
3	5	30	100	1040/18
4	10	30	100	944/10
5	15	30	100	864/8
6	20	30	100	742/5

Table 1 : Result of COD and BOD with 0.310 g silver chloride loaded adsorbent in different dosage

Sr. No.	Amt. Of adsorbent (g)	Stirring Time (min.)	Waste water	COD /BOD (mg/L)
1	Initial			1380/45
2	2	30	100	1216/24
3	5	30	100	1056/19
4	10	30	100	960/12
5	15	30	100	880/9
6	20	30	100	776/6

Table 2: Result of COD and BOD without silver chloride loaded adsorbent in different dosage

3.4 effect of contact time

The COD and BOD removal capability of silver chloride loaded adsorbent was increase with the increase in time 30 to 150 min .table 3 shows the result of COD and BOD with 0.310 g silver chloride loaded adsorbent in two different dosage with varying stirring time. In 2g adsorbent dosage has highest COD and BOD removal compared to 1 g adsorbent dosage.similarly table 4 show the result of without silver chloride loaded adsorbent in different stirring time.2g adsorbent dosage remove highest COD and BOD value as compared to 1g adsorbent dosage.this means that if the amount of adsorbent dosage increase with increase in stirring time of COD and BOD value also increased.

Sr. No.	Stirring time (min.)	Amt. of ads. (g)		Waste water	COD/BOD (mg/L)	
1	Initial				1380/45	
2	30	1	2	100	1240/25	1220/24
3	60	1	2	100	1020/16	1000/15
4	90	1	2	100	960/12	940/10
5	120	1	2	100	920/9	860/8
6	150	1	2	100	800/6	770/5

Table 3 : Result of COD and BOD with 0.310 g silver chloride loaded adsorbent in different stirring time

Sr. No.	Stirring time (min.)	Amt. of ads. (g)		Waste water	COD/BOD (mg/L)	
1	Initial				1380/45	
2	30	1	2	100	1280/26	1240/25
3	60	1	2	100	1060/20	1040/18
4	90	1	2	100	940/10	920/9

5	120	1	2	100	900/9	880/8
6	150	1	2	100	820/5	740/4

Table 4 : Result of COD and BOD without silver chloride loaded adsorbent in different stirring time

IV. CONCLUSION

In the present study , a novel adsorbent - silver nanoparticles loaded on pomegranate peels was successfully prepared. The result of secondary waste water ETL were effective for the removal of pollutants (COD ,BOD).The AAS method shows 90% silver chloride was loaded into pomegranate peels powder. The overall studies revealed that silver chloride loaded pomegranate peels powder is a promising low cost adsorbent for waste water treatment.

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