COMPARISON OF DYE REMOVAL EFFICIENCY FROM TEXTILE EFFLUENT USING COIR PITH AND MODIFIED COIR PITH

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Abstract

The removal of color from wastewater containing dyes requires an effective method to treat the effluent. Adsorption is quite popular due to its simplicity and effective for removal of dyes. As an agricultural waste, coir pith has gained wide attention as effective biosorbents due to the significant adsorption potential for the removal of various aquatic pollutants. In this paper, the removal of dye from textile effluent is performed by batch adsorption and column adsorption with a modified form of coconut coir pith developed using combination of coir pith, Eggshell powder and kokum rind as adsorbent is carried out. A comparative study is between coir pith and this modified form is done to find out the colour removal efficiency and change of other physicochemical parameters before and after treatment.Study revealed that the modified form of coir pith is efficient in colour removal with maximum percentage removal of 97% through column adsorption studies.

Index Term-*Dye removal[1] –Adsorption [2] textile effluent[3]- coir pith[4] –Egg shell powder[5]Kokum rind[6]-Batch -column adsorption studies[7]*

I.INTRODUCTION

Clothing and textiles, after agriculture, is the basic requirement of human being.Large quantities of water is needed for textile processing, dyeing and printing. Among these various processes, dyeing process includes fixing dyes on fabrics, washing etc requires more water and it consumes 16% of total water usage depending on the type of dyes used. Textile waste water may include many types of dyes, detergents, insecticides, pesticides, grease and oils, sulfide compounds, solvents, heavy metals, inorganic salts and fibers, in amounts depending on the processing system. Colored matter discharged from textile industries is not only aesthetically displeasing, but also affect aquatic ecosystems by inhibiting sunlight penetration and posing certain hazards and environmental problems. Thus color removal of effluent from the textile dyeing and finishing operation is becoming important because of aesthetic as well as environmental concerns.Various methods and biological techniques can be employed to remove various pollutant from textile effluent but they are effective only when low concentration of organic compounds are present in it. The adsorption process provides an attractive alternative to the processes because of inexpensive and availability to control the various pollutants from the water and wastewater. Many investigators have examined a wide variety of absorbents like fly-ash, peat, sawdust, brown coal, bagasse, activated carbon to remove colourfrom textile industry wastewater rather than removal of other pollutants in the textile industry wastewater. Present study deals with finding out the removal efficiency of coir pith and modified form of coir pith developed usingcombination of kokum rind (Garciniaindica) and eggshell powder.

II.MATERIALS AND METHODS

1. Textile Effluent

The **T**extile effluent sample is collected from the textile industry at AvinisseriKhadi Dyeing unit ,Kerala. Large quantity of textile effluent iscollected for the experiment studies and stored in refrigerator

Fig.1 Textile effluent

2. Coir pith

The coconut coir pith is collected from locality, driedand sieved through 0.60 µm sieve. Powdered form of coconut coir pith powder was taken for conducting the experiments and the remaining quantity is kept in the refrigerator to avoid the decomposition of powder, because the coconut coir pith powder is an agro-based product.

Fig 2.Coir pith powder

3. Kokum rind

Activated Garciniaindica or commonly known as Kokum, one of several species of Garcinia is distributed mainly in peninsular India. Kokum is grown in tropical rain forest of Western ghats in konkan, Goa, South Karnataka and Kerala. The extract of the fruit has both antifungal and antibacterial properties .Kokum is usually preserved after sun drying since it is a seasonal fruit. Preserved Kokum fruit is powdered, sieved and used for studies.

Fig 3. Black dried and powdered kokum

4. Eggshell Powder

Chicken eggshell is a waste material discarded from domestic sources such as poultries, homes, foodmanufacturers and restaurants .The porous nature of eggshell makes it an attractive material to be employed as an adsorbent. It was estimated each eggshell contain between 7000 and 17000 pores.Locally available collected eggshell is washed powdered and sieved for adsorption studies.

5. METHODOLOGY

The effluent sample was collected in cleaned plastic container and it was subjected to study physico-chemical parameters by using standard procedures.

A. Batch adsorption studies

Batch adsorption studies were performed to determine the optimum condition and to study the adsorbent dose and contact time on the test solution. In order to reduce colour in a textile industry effluent, the experimental setup were examined for a period of 150 min. with an increment of 10 min. using different adsorbent dosages 2gm,4gm,6gm,and 8gm. The adsorption removal percentage of various parameters by each adsorbent was calculated by using the following formula:

$$\text{Percentage Removal} = \frac{Ci - Cf}{Ci} * 100\%$$

in which Ci is the concentration of colour before treatment with coconut coir pith powder and Cfthe concentration of colour after treatment with adsorbent. At the end of the desired contact time, the samples were filtered using Whatman no. 42 filter paper and the filtrate was analyzed for residual dye concentration by standard method by spectrophotometer. Characteristics of effluent before treating and after treating are also analyzed. The parameters were selected based on the influence of dyes and other chemicals.

Fig 4.Batch adsorption studies on textile effluent

B. Column adsorption studies

Theadsorptionexperimentswerecarried out in columns that were equipped with a stopper for controlling the column flow rate. Glass columns of 3 and 6 cm inside diameter and height of 1.5 m was used. This experiment is useful in understanding and predicting behaviorofthe process.

Fig5. Column Setup

III. RESULTS AND DISCUSSION

The aim of the study is the comparison of application of Coir pith and modification of coir pith using kokum rind and ESP in removal of dye from textile effluent. Most of the adsorption studies have been focused on low cost adsorbents. Some of the advantages of using natural material wastes for waste water treatment include involvement of simple techniques requirement of good adsorption capacity, very little processing, low cost, free availability etc. In this work batch studies and column studies were carried out using coir pith and modified coir pith. The effluent characteristics before treatment and after treatment were analyzed.

1. BATCH ADSORPTION STUDIES

A. Effect of adsorbent dosage

The adsorption of dye increased with the adsorbent dosage for coconut coir pith adsorbent, andreached equilibrium after an adsorbent dosage of 2gm .The optimum dosage was found as 6gm/250 ml for coir pith as adsorbent. For ESP the adsorption of dye increased with the adsorbent dosage, after an adsorbent dosage of 4gm.Optimum dosage of ESP was found as 8gm/250ml.For Kokum rind powder the adsorption of dye adsorbent dosage above 6gm/250ml reached equilibrium.The modified coir pith was developed in such as way that optimum dosages of selected adsorbents individually were take and mixed together.Thus coir pith of 6 gm, ESP of 8gm and kokum rind of 6 gm were taken and mixed to form Modified coir pith. For modified coir pith adsorption of dye with increased with increase in dosage.

The percentage of dye removal increased with the increasing amount of biomass. Further increment in adsorbent dose did not affect significant improvement in adsorption. This is due to the binding of adsorbate to the adsorbent and equilibrium is reached between the adsorbate bound to the adsorbent and those remaining unadsorbed in the solution. The minimum removal at low dosage is due to insufficient quantity of dosage for the removal colour and at high dosage is to there is a competition between the adsorbent particles such a way each particles are not opened fully to adsorb the colour intensity in a textile industry wastewater

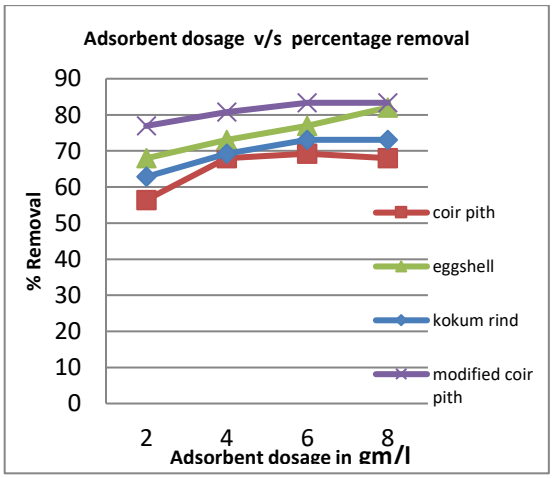

Fig 6.Asorbent dosage V/s Percentage colour removal

B. Effect of contact time

Contact time plays a very important role in adsorption dynamics. The effects of contact time on adsorption of dye onto coir pith,ESP,kokum rind and modification of coir pith is shown below

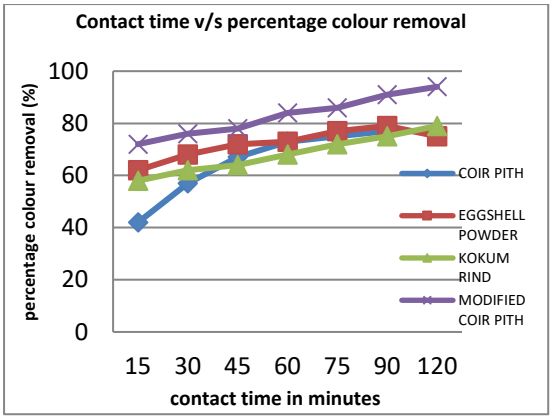

Fig 7. Contact time V/s Percentage colour removal

Here different contact time of effluent added with coconut coir pith, of adsorption dose 4 mg/250ml,egg shell powder of adsorption dose 4 mg/250ml,kokum rind of adsorption dose 6 mg/250ml and 6mg/250ml is considered, because this dosage is considered as optimum dosage above this dosage equilibrium is obtained. In adsorption experiment, dye solution was added with adsorbent in shaking jars at room temperature and the blend stirred on a rotary orbital shaker at different rpms. The sample withdrawn from the shaker at the fixed time intervals, then agitated samples from the shaker are tested for its adsorption in UV spectrophotometer to know colour removal efficiency of the adsorbent. The colour removal efficiencies of the adsorbents have a breakthrough at 120minutes duration, in which there is no further considerable colour removal takes place. It is observed that after 75 minutes there is no change in adsorbance for coir pith as adsorbent, whereas eggshell powder shows a decrease in colour removal after 90 minutes, kokum rind shows slight increase in percentage removal whereas modified coir pith shows contionus increase in percentage removal contact time increases.

C .Colour removal efficiency

Here the percentage of colour removal is about 77% in case of coir pith ,79% in case of eggshell powder ,79% for kokum rind powder and 94% modified coir pith as adsorbent.From the figure below

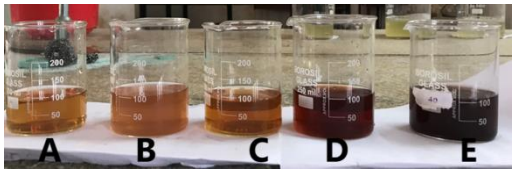

Fig 8.Textile effluent after and before treatment
A: Effluent treated with modified coir pith,
B: Effluent treated with Egg shell powder,
C: Effluent treated with kokum rind
D:Effluent treated with Coir pith,
E:Effluent before treatment.

2. COLUMN ADSORPTION STUDIES

A. Effect of adsorbent depth

When column adsorption test where done at varying adsorbent depths of 10,20,30 and 45cm the percentage colour removal was obtained at higher depth.coir pith exhibited a increasing percentage of colour removal where 45 cm depth was optimum depth whereas for eggshell powder no icrease in percentage colour removal is seen beyond the depth of 30cm.Kokum rind and modified coir pith exhibited increased percentage removal at 45 cm depth.the observations are graphicaly represented as below.

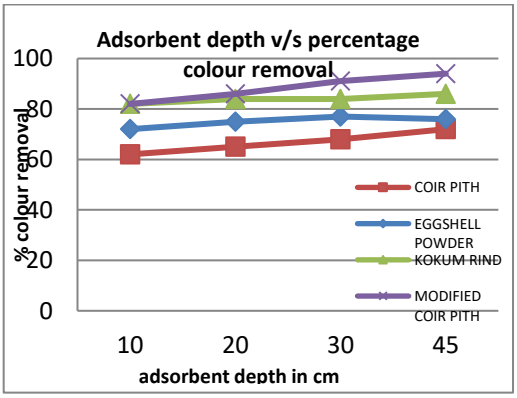

Fig 9. Adsorbent depth v/s percentage colour removal

B . Effect of retention time

When column adsorption test where done at varying retention time the percentage colour removal was obtained at more retention time .Coir pith exhibited an increasing percentage of colour removal on a retention time of 90 minutes whereas

for eggshell powder and kokum rind there was further increase in percentage colour removal after a time of 60 minutes but modified coir pith exhibited increased percentage removal while increasing the retention time upto 120 minutes the observations are graphicaly represented as below

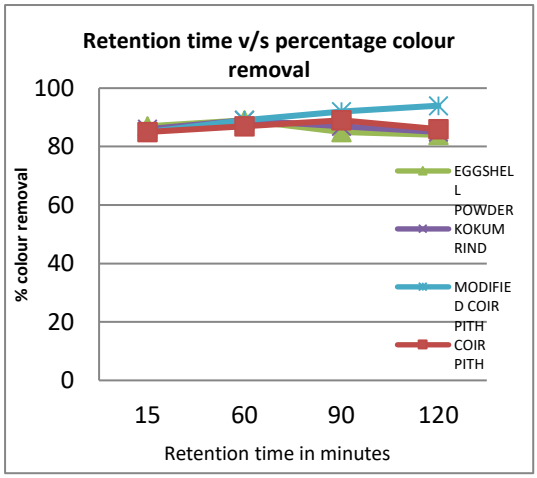

Fig 10.Retention time v/s Percentage colour removal

C .Colour removal Efficiency

Here the percentage of colour removal is about 89% in case of coir pith ,89% in case of eggshell powder ,87% for kokum rind powder and 94% modified coir pith as adsorbent.From the figure below

Fig 11. Textile effluent after and before treatment

A:Effluent treated with modified coir pith
B:Effluent treated with ESP
C: Effluent treated with kokum rind
D:Effluent treated with Coir pith,
E:Effluent before treatment

3. EFFLUENT CHARACHTERISTICS BEFORE AND AFTER TREATMENT

Effluent characteristics before and after treatment with adsorbents selected and modification carried were checked so as to study the impact chosen adsorbents in reducing the textile effluent characteristics to BIS limits.It was found that almost all major characters such as BOD ,COD TDS, TSS etc brought within BIS limits

IV .CONCLUSION

In my study, the aim is to find the suitabilityof coir pith and modified coconut coir pith powder as adsorbent in colour removal of textile industry effluent. The efficiencyof modified coconut coir pith powder developed by combination of coir pith , eggshell powder and kokum rind for removing colour in a textile industry effluent by various adsorbent dosages and contact time was found out by batch and column experiments. The maximum percentage reduction of colour in a textile industry wastewater by coconut coir pith powder was obtained at an optimum adsorption dosage of 4mg/250ml and contact time of 90 minutes in batch adsorption studies withpercentage colour removal of 77% whereas modified coir pith showed a percentage removal of , 94% at a an optimum dosage of 6gm and contact time of 120 minutes.From the batch experiments it was found that modified coir pith exhibits maximum colour removal (%) than the colour removal by individual adsorbents such as coir pith ,eggshell powder and kokum rind. In the column adsorption studies also, more efficiency was observed in colour removal by modified coir pith shows higher colour removal (94%) at an optimum adsorbent depth of 45 cm and retention time of 120 minutes .Whereas the percentage colour removal ofcoir pith (72%)was at an optimum adsorbent depth of 45 cm and retention time 90 minutes.it was found that colour removal during the column adsorption studies shows more variations than the batch adsorption studies due to the higher retention time and bed depth. Moreover the Phyicochemcial analysis of treated and untreated Textile effluent exhibited a reduction of parametric values to an extent within BIS Limits.

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