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REMOVAL OF COD FROM RICE MILL EFFLUENT USING RICE HUSK ASH

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Abstract - *The effluents from rice industries induce environmental pollution. The effluents discharged from rice mills do not contain toxic compounds, but contain more amounts of COD and continuous discharge of this effluent into soil or surrounding water bodies cause adverse environmental effects. Among various available technologies for removal of COD from waste water, 'adsorption' process is considered better as compared to other methods, because of convenience, easy operation and simplicity of design. Further, this process can remove/minimize different type of pollutants and thus it has a wider applicability in water pollution control. Many materials that can be removing COD by adsorption are available. Among the various adsorbent materials my scope of the project deals with comparison of adsorption capacity of waste materials and by products from industries. The adsorbent materials selected are rice husk ash (by product from rice mills). The sample rice mill effluent was collected from the rice mill industry located at Pudhuvayal, Karaikudi. The collected sample was first analyzed in the laboratory to determine its initial characteristics. Then, the experimental studies were carried out to find out the optimum dosage of adsorbent and the effect of pH and stirring speed on the adsorption process. In my project, optimum dosage of adsorbent 5g/l at a contact time 90 mins and Removal of COD from rice mill effluent the removal efficiency was 93.97% at stirring speed 160rpm.*

Key Words: Rice mill effluent, adsorbent, rice husk ash, optimum dosage.

1. INTRODUCTION

Water is a vital source, at present a worrisome scarcity in recent years. In the developing countries, 90% of all wastewater still goes untreated into local water bodies like rivers and streams. Among the various known forms of pollution, water is one of the great concern since water is the prime necessity of life and extremely essential for the survival of all living organisms. Indeed, it is parts of life itself, since the protoplasm of the most living cells contain about 80% of water. It is worthy nothing that only 0.02% of the total available water on the earth is immediately available for use in the rivers, lakes and streams. However, years of increased industrial and domestic activities have resulted in the generation of large amount of waste water containing a number of toxic pollutants, which are polluting the available fresh water continuously. With the realization that pollutants present in water adversely affect human and animal life, domestic and industrial activities, pollution control and management is now a high priority area. The availability of the clean water for various activities is becoming the most challenging task for researchers and practitioners worldwide. So, the recycling and reuse of the waste water are having vital role in the day to day life. In the recycling process of waste water, Adsorption is the one of the simplest, economic operation. This project aims to remove/minimize the various pollutants, and toxic elements from the waste water, which makes the water safe for reuse or disposal.

Objective of the work

1. To analysis the Characteristics of rice mill effluent.
2. To determine the optimum dosage of rice husk ash.
3. To investigate the performance of the selected adsorbent under diff pH, stirring speed.

Applications of adsorption

1. Separation and purification of liquid and gas mixtures, bulk chemicals, isomers and air;
2. Drying gases and liquids before loading them into industrial systems;
3. Removal of impurities from liquid and gas media;
4. Recovery of chemicals from industrial and vent gases; and Water purification.

Industrial wastes as adsorbents

Widespread industrial activities are producing large amount of solid waste materials. Some of these materials are being put to use while others find no proper utilization and are damped elsewhere. The industrial waste material is available almost free of cost and causes major disposal problem. If the solid wastes could be used as low cost adsorbents, it will provide a twofold advantage in reducing the pollution. Firstly, the volume of the waste material could be partly reduced and secondly the developed low cost adsorbent can reduce the pollution of the waste water at a reasonable cost. In the view of the low cost of such adsorbents, it would not be necessary to regenerate the spent materials. some of the waste materials used as a adsorbents are fly ash, rice husk ash, Granulated Blast Furnace Slag, Blast furnace flue dust, Red mud,…etc., Among the various adsorbents mentioned above one were chosen that are rice husk ash(RHA).

About rice husk ash

The major solid by product of the rice mill industry is rice husk ash (RHA). The amount of rice husk produced is 16-25% of weight of the paddy. Then, the produced rice husk is use to boil the water for preboiling of paddy. After the combustion the ash is dumped on the land. Thus may cause severe land contamination and air pollution also. The amount of RHA production in India during year 2011 was 24

million tonnes respectively (According to CEA and Ministry of Food and Agriculture reports). So, this project works mainly concern with the COD removal capacities of rice husk ash.

MATERIALS AND METHODS

Collection of Sample Water

The sample rice mill waste water was collected from the Jothi Rice Mill Industry located at Pudhuvayal, Karaikudi, Sivagangai District, Tamil nadu, India. The collected waste water was kept as stock solution in the refrigerator and the sample used for studies was prepared by diluting the stock solution for avoiding fault results. The type of sampling dopted was Grab sampling.

Collection of Adsorbent

Table No.1 Collection of Adsorbent

Details	Rice Husk Ash
Source	Rice mill
Industry name	Jothi Rice Mill
Location	Pudhuvayal, Sivagangai dist
Price	Free of Cost

Fig.1 Rice husk ash

EXPERIMENTAL STUDIES

The sample rice mill effluent water was collected from the Rice mill. The collected sample was first analyzed in the laboratory to determine the initial Characteristics of the sample water. Three experimental studies were carried out in a batch mode. First experimental Study was carried out to determine the optimum adsorbent dosage for the removal of COD form Rice mill effluent using rice husk ash (RHA). Second experimental study was carried out to optimize the parameter which affects the performance of the removal of the COD. Third study was carried out to determine the reaction rate of the adsorption process for adsorbent. The experimental studies to achieve the formulated objectives were carried out in different phases and the same was described below.

CHARACTERIZATION OF SAMPLE WASTE WATER

Determination of pH

The pH of the rice mill effluent waste water sample was determined using portable pen type pH meter at room temperature. The principle used in the test was potentiometric method. The pH is determined by measurement of the EMF of a cell comprising of an indicator electrode(an electrode responsive to hydrogen ion such as glass electrode) immersed in the test solution and a reference electrode(usually a calomel electrode).The pH meter was calibrated as per the standard procedure. The meter is switched on and the pH electrode about 2 to 3cm was dipped into the pH standards buffer solution. pH calibration mode was activated by pressing CAL/MEAS key. The CAL icon appeared in the LCD. The upper display shows the default (uncalibrated) pH measurement of pH electrode while the lower display indicates the pH standard buffer solution which was automatically recognized by the meter. The solution was swirled gently and the meter reading was allowed to stabilize. The upper displays value is calibrated to the pH standard buffer solution. The lower display toggles between next two standard calibration points. The electrode was rinsed in tap water before dipping into next standard buffer. Then the electrode was dipped about 2 to 3 cm into the solution. The test solution was stirred gently and the meter reading was allowed to stabilize till the display shows "ready". Then the readings on the display were noted as pH of the test solution.

Determination of Turbidity

The turbidity of the sample was determined using nephelometric turbidity meter which follows the principle "Scattering of light". The turbidity meter was first calibrated with the standard solution of 800NTU, 100NTU, 20NTU, 0.2NTU. After calibration, the sample was taken in the sample bottle provided with the turbidity meter up to the mark level. Then the same was inserted in the hole provided and the read button in the turbidity meter was pressed. After pressing the button, the turbidity value of the sample was display in LCD display in the same was noted as the turbidity of the sample.

Determination of Acidity

Acids contribute to corrosiveness and influence chemical reaction rates, chemical speciation and biological processes. Acidity of the sample is its quantitative capacity to react with a strong base to a designated pH. The measured value may

vary significantly with the end point pH used in the deter mination. The acidity of the sample was determined by titrimetric method. In this test, the phenolphthalein and methyl orange were used as indicators. The NaOH (0.02N) was taken in the burette. Take 50ml of the sample in the conical flask and add 2- 3 drops of methyl orange indicator and titrate it with the NaOH taken in the burette till the colour of the solution just changes to faint orange colour indicating the end point. Note the reading as V1. Then add 2-3 drops of phenolphthalein indicator to the same sample continue the titration till the faint pink colour develops in the

solution. Note the reading as V2.

Mineral Acidity = (V1 x N x 50 x 1000)/(50)

Total Acidity = (V2 x N x 50 x 1000)/(50)

Determination of COD

To determine the COD of the sample Open reflux method was adopted. The organic matter present in sample gets oxidized completely by K2Cr2O7 in the presence of SULPHURIC ACID to produce CO2 and H2O. The excess K2Cr2O7 remaining after the reaction is titrated with Fe(NH4)2(SO4)2. The dichromate consumed gives the O2 required to oxidation of the organic matter. Add a pinch of HgSO4 in the reflux flask. Add 2ml of sample and add 1ml of 0.025N potassium dichromate solution and add slowly 3ml of SULPHURIC ACID

containing Ag2SO4 and mix thoroughly. Place the flask in the COD digester, reflux for a minimum period of 2 hours at 150 0C. After 2hrs, Cool and wash down the condenser with distilled water. Titrate digested sample with 0.1N Fe(NH4)2(SO4)2using ferroin indicator. The end point was sharp colour change from blue green to wine red. Reflux the blank in the same manner using distilled water instead of sample. The reading were noted as A and B for sample and blank respectively.

COD in mg/l= ((A-B) x 0.025 x 8 x 1000) / (Quantity of sample taken)

Determination of sulphate

The sulphate content in the sample was determined by gravimetric method. Sulphates ions are precipitated in a hydrochloric acid medium as barium sulphates by the addition of barium chloride. The precipitation carried out near the boiling temperature, after a period of digestion the precipitate is filtered, washed with water until free of chlorides, dried and weighed as barium sulphate. The samples are acidified to eliminate the possibility of precipitation of barium carbonate, which might occur in highly alkaline water maintained near boiling temperature. Excess barium chloride is used to produce sufficient common ion to precipitate sulphate ion as completely as possible. Because of the high insolubility of barium sulphate there is considerable tendency for much of the precipitate to form a colloidal condition that cannot be removed by ordinary filtration process. Find the empty weight of the china dish(W1)mg. take 25ml of sample in the china dish. Add 2.5ml of 1:1 hydro chloric acid with the sample and allow it to boil. Then add 2.5ml of barium chloride solution in the sample. Allow china dish to cool in a desiccators and final weight of china dish (W2) was noted down. Repeat step 4&5 till the difference between consecutive weighting is less than 5%.

Sulphate content = (W2-W1)*(1000*96)/ (V*411.5) mg/l

Determination of Ammonia Nitrogen

Ammonium ion reacts with Nessler's reagent (K2HgI4) to form a brown colour substance, and can be determined calorimetrically. Most of the natural waters and wastewaters have interfering substances; therefore, the steam distillation of ammonia becomes essential. Take 200ml of the sample in a conical flask. Add 20ml of phosphate buffer solution and 50 ml of boric acid solution. Distillate this solution in distillation unit. Take 100ml of distillate and add 3 -5 drop of methyl orange indicator and titrate it against 0.02N of sulphuric acid

till the end point is changes from orange to yellow. Note the reading as V1 (ml).

Ammonia Nitrogen in ml = (V1 x 0.02 x 1000) / (100)

Determination of Optimum Adsorbent Dosage

This experimental study was carried out to determine the optimum dosage of adsorbent. This study was carried out in a 250ml conical flask. 100ml of the sample was taken in the five different conical flasks. The adsorbent was added in 1g/l, 2g/l, 3g/l, 4g/l, 5g/l. the five conical flasks were subjected to agitation at a stirring speed of 120rpm for 15mins in the rotary shaker. After 15mins mixing the samples were collected at each 15mins intervals of 15, 30, 45, 60, 75, 90, 105, 120, 135,150 mins. The collected samples were subjected to COD test by open reflux method. This study was carried out for adsorbent rice husk ash.

PERFORMANCE EVALUATION STUDIES

Effect of pH

This batch study was carried out analyze the performance of the adsorbent by varying pH of the sample. The pH was varied as 2, 4, 6, 8, 10. Then the adsorption process was carried out as per standard procedure described in the optimum dosage test. This study was carried out in a 250ml conical flask. 100ml of the sample was taken in the conical flask. The adsorbent was added in optimum dosage found out in the optimization studies. The conical flask was subjected Agitati on at a stirring speed of 120rpm for 15mins in the rotary shaker. After 15mins mixing the samples were collected at each 15mins intervals of 15, 30, 45, 60, 75, 90, 105, 120, 135,150 mins. The collected samples were subjected to COD test by open reflux method to find out the residual COD. This study was carried out for adsorbent rice husk ash.

Effect of Stirring Speed

This batch study was carried out analyse the performance of the adsorbent by varying stirring speed of the sample. The pH was maintained at the limit found out from first study. The stirring speed was varied as 100, 120, 140, 160, 180rpm. Then the adsorption process was carried out as per standard procedure described in the optimum dosage test. This study was carried out in a five 250ml conical flasks. 100ml of the sample was taken in each of the conical flasks. The adsorbent was added in optimum dosage found out in the optimization studies. Then the each conical flask was agitated to various speeds. After 15mins mixing the samples were collected at each 15mins intervals of 15, 30, 45, 60, 75, 90, 105, 120, 135,150 mins. The collected samples were subjected to COD test by open reflux method to find out the residual COD. This study was carried out for adsorbent rice husk ash.

RESULTS AND DISCUSSIONS

Characterization of Sample Waste Water

Table No.2 Characterization of Rice Mill Effluent

S.No	Parameters	Value
1.	PH	7.7
2.	Turbidity	18.87NTU
3.	Acidity	36mg/l
4.	COD	5800mg/l
5.	Sulphates	460mg/l
6.	Ammonia Nitrogen	5.6mg/l

Determination of Optimum Adsorbent Dosage

This experimental study was carried out to determine the optimum dosage of adsorbent. This study was carried out in a 250 ml conical flask. 100 ml of the sample was taken in the five different conical flasks. The adsorbent was added in 1g/l, 2g/l, 3g/l, 4g/l, 5g/l. the five conical flasks were subjected to agitation at a stirring speed of 120rpm for 15mins in the rotary shaker. After 15mins mixing the samples were collected at each 15mins intervals of 15, 30, 45, 60, 75, 90, 105, 120, 135,150 mins. The collected samples were subjected to COD test by open reflux method. This study was carried out for adsorbent rice husk ash.

Determination of Optimum Dosage of RHA

The results were plotted in an ordinary graph with time on X-axis and percentage removal of turbidity on Y-axis. The plotted graph was shown in Fig.2.

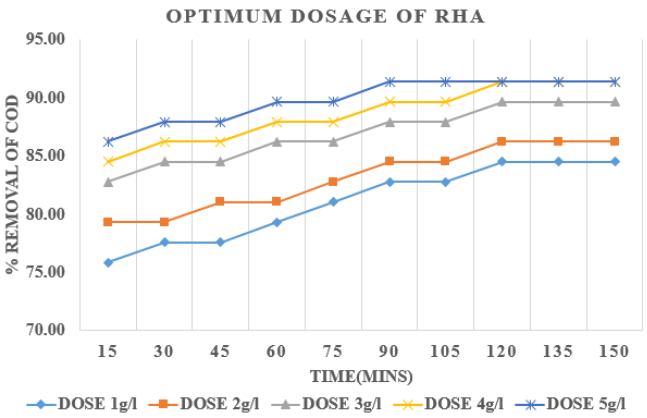

Fig .2 Optimum Dosage of RHA

From above graph, Removal of COD from rice mill effluent the removal efficiency was 91.38% at adsorbent dosage 5g/l.

PERFORMANCE EVALUATION STUDIES

Effect of pH on RHA Adsorbent

The results were plotted in an ordinary graph with pH on X-axis and percentage removal of turbidity on Y-axis. The plotted graph was shown in Fig 3.

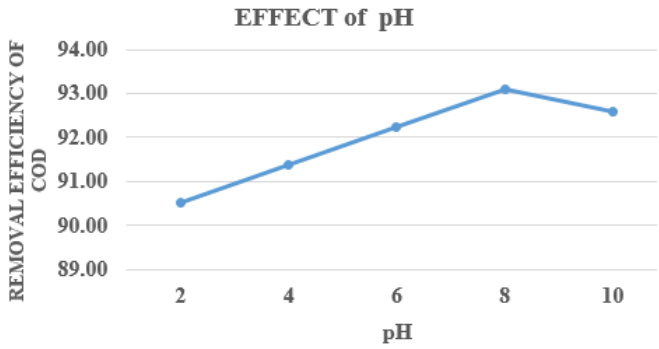

Fig.3 pH on RHA Adsorbent

Effect of Stirring speed on RHA Adsorbent

The results were plotted in an ordinary graph with Stirring Speed on X-axis and percentage removal of turbidity on Y-axis. The plotted graph was shown in Fig 4.

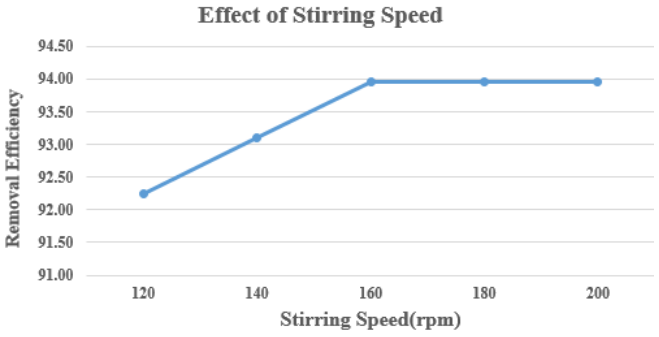

Fig.4 Stirring Speed on RHA Adsorbent

From above graph, by using RHA as an adsorbent in the Removal of COD from rice mill effluent the removal efficiency was 93.97% at stirring speed 160rpm.

CONCLUSIONS

- From the experimental study 1, it may be concluded that the percentage removal efficiency of the adsorbent increases with increasing their dosage.
- For RHA, it reaches its maximum removal efficiency of 91.38% at RHA dosage of 5g/l.
- From the experimental study II, the effect of pH and Stirring speed was analyzed.
- For RHA, the maximum removal efficiency of 93.97% may be obtained when the pH was maintained at 8, stirring speed as 160 rpm and Contact time as 90 mins. By this work I would like to complete by project.
- The material chosen for adsorption is rice husk ash which is easily obtainable and it is economical. Rice husk ash is obtained from rice mill residue, it is a waste material but it has the capacity for the removal of COD in waste water. Initiate the rice husk material for efficient removal of COD in future research.

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