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Rice Husk (Adsorbent) is Better Option than High Cost Adsorbent for Removal of Color from Waste Water

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Abstract- *The main objective of this experimental study was to determine the color removal efficiency from wastewater using low cost rice husk (adsorbent) than high cost adsorbent like activated charcoal. There are different renewable resources for adsorbent like Coconut husk, sugarcane Bagasse, Almond nutshells, which could be used as alternatives. Rice husk as waste material of food industry is a low cost adsorbent. It is available at huge amount from food industries. It can be more utilized as an adsorbent for removal of color, pollutants from waste of industries. Activated charcoal is high cost adsorbent. It is used in more industries for removal of color and pollutants but it is highly cost adsorbent so affect on economical process.*

Rice husk has adsorbed ability to dyestuff from aqueous solution. Rice Husk has been checked for the removal of color efficiency from waste water samples containing dyes. The experiments were conducted by packing rice husk adsorbent in an adsorption column with certain height. Then by applying a continuous down flow of wastewater through the column with overflows rates of different flow rates. Effect of various parameters such as adsorbent dose, color removal efficiency, concentration, Height of packing adsorbent, pH, temperature and time will investigate in the present study. The experiments were carried out for a certain time period. The determination of effluent from column adsorption system in terms of absorbance, percent transmittance.

Key Words- *Adsorbent, Color removal efficiency, Activated charcoal, Rice husk, Adsorption column.*

I.INTRODUCTION

1.1 Project and Justifications

Water is life before birth, much of man's life spent in water, in the sheltering membranous sac of mother's womb and water flows through the body till death. Water is vital to human life and happiness. If the quality is sufficiently degraded, it becomes unusable and the effect is the same as a qualitative loss. The control of water pollution has become overriding consideration for continued global growth, health and welfare. Water for consumption, sanitation and industrial purposes are of great social and economic importance because the effect of human's health in turn influences all other activities. In the era of liberalization, Indian industries are poised towards rapid growth mainly in the small-scale sector.

Adsorption technique has been proved to be an excellent way to treat dye effluents, offering advantages over conventional process. Adsorption is one of the most efficient methods of removing pollutants from wastewater. Also, the adsorption provides an attractive alternative treatment, especially if the adsorbent is inexpensive and readily available many studies have been made on use of different adsorbents like activated carbon, rice husk, rice hull, paddy straw, peat, coir pith, chitin, silica, fly ash, and many others like hardwood sawdust, bagasse pith, slag and various blends of these. The removal of color from wastewater can be carried out by Adsorption holds promising results in treatment of wastewater as it was inexpensive, simply designed, easy to handle and provides sludge free cleaning operations. Commercially, activated carbon has long been used as standard adsorbent for color removal, in spite of widespread use in various cleaning procedures. However search for cost-effective, efficient adsorbent is continuing. Carbon is widely used as an adsorbent for many species because of its high efficiency. In a multivariate experiment, all of the important variables are changed during each run of trials. The need for this arises because the variables often interact with each other. For example, if pH conditions are optimized at one temperature, this work may have to be repeated if it is subsequently found that a different temperature works better. The relative importance of all the factors can be evaluated simultaneously with less number of experiments. Temperature, pH, initial concentration of dye and adsorbent particle dosage are important parameters in adsorption. Thus in the present study capacity of rice husk to remove color was investigated by varying these factors at two levels. Interaction between these factors were studied and optimization done. [15

Synthetic Dyes are widely used in industries such as paper, textiles, leather, plastics, etc. to color their final products. Colored dye effluents are highly toxic to aquatic life. It reduces the photosynthetic activity and primary production. These dyes are mostly resistant to biodegradation and therefore are not removed by conventional treatment techniques. In general, there are main methods used for the treatment of dye containing effluent: adsorption, ozonation, biological treatment, flocculation, flotation, chemical coagulation, chemical oxidation and membrane processes. Dyes are widely used for coloring in textile industries, and significant losses occur during the manufacture and processing of dyes, and these lost chemicals are discharged in the effluent. Adsorption of dyes is a new technology for treatment of wastewater containing different types of dyes. The goal of this research is to develop a new and efficient adsorbent of direct dyes. [20, 14]

1.2Definition of the Keywords

Rice husk ash: a waste material of Food industries were a low cost adsorbent successfully utilized wastes of some industries for the removal of various pollutants.

Low cost adsorption: Adsorbent that require little processing, was abundant in nature, or was a by-product or waste material from another industry.

Color: Color from dyeing wastewater, which discharge into water causes pollution

Synthetic colored wastewater: Prepared by addition of dye into distill water.

Adsorption Column: Glass column 21 cm ht and internal diameter 4.8 cm.

Adsorbent: The solid media (Activated Charcoal or Rice husk ash for the removal of color from Synthetic wastewater. [17]

Removal efficiency: The percentage of colored waste water treatment ability by Rice Husk ash. [12]

$$\% \text{ Removal} = \frac{\text{Inial absorbance} - \text{final absorbance}}{\text{Initial absorbance}} \times 100$$

1.3 Adsorption

Adsorption is surface phenomenon that is defined as the taking up of molecule by external or internal surface of solids or by the surface of liquids. Adsorption occurs on these surfaces because of attractive forces of the atoms and molecules that make up the surfaces. The material being concentrated or adsorbed is adsorbate and adsorbing phase is termed the adsorbent. In discussing the fundamentals of adsorption it is useful to distinguish between physical adsorption, involving only relatively weak intermolecular forces and chemisorptions, which involve essentially the formation of chemical bond between the sorbate molecule and the surface of the adsorbent. [10]

1.4 Significance of Adsorption

Adsorption process is applied in wastewater treatment in two ways, one is tertiary treatment and the second is physico-chemical treatment. If the adsorption process is applied after the biological treatment to remove the residual organics in the effluent, it is called as “tertiary treatment”, otherwise if adsorption is applied only after primary clarifier, then it is referred as “physico-chemical treatment”. In conventional wastewater treatment methods, it is not possible to remove all the soluble compounds from the raw wastewater. Use of granular activated carbon for the adsorption of organic materials from water and wastewater has been introduced as a reliable and economical non-biological or physic-chemical process. The non-biodegradable materials like tannins, lignin, ethers, color producing organics, herbicides, pesticides like DDT etc, cannot be removed by conventional processes such as activated sludge treatment, trickling filter etc. Among the limited number of unit processes, adsorption is capable of removing the biodegradable or refractory organics. In practice, adsorption is nearly limited to the use of activated carbon for the removal of refractory organics. [9]

1.5 Application of Activated Carbon in Wastewater Treatment

Conventional treatment methods may not remove all the soluble compounds from the raw wastewater. Biologically treated effluents still contain considerable amounts of dissolved organic materials. To remove these organic materials by adsorption using granular activated carbon from water or wastewater becomes a reliable and economical non-biological or physic-chemical process. The conventional biological treatment methods such as activated sludge process, oxidation ditches, trickling filters, aerated lagoons, oxidation ponds, etc are not capable to remove non-biodegradable organic materials such as lignin, tannins, pesticides, herbicides; etc. Adsorption is capable of removing these non-biodegradable organic materials.

Rapid growth of industrialization needs large quantity of required quality of water for various industrial processes. The capacity of disposal sources to tolerate the pollution is also limited. Hence application of activated carbon in water and waste water treatment is becoming into more general for the removal of non-biodegradable organic material and heavy meats. Activated carbon was first used in water and wastewater treatment for removal of organic material, odor, tastes and viruses since long. Activated carbon which is available in granular as well as powdered form is generally used for treating various industrial wastes such as pulp and paper, textile, pharmaceutical, petrochemical, etc. particularly for the removal of color, dissolved impurities and heavy metals. (17)

1.6 Necessity for development of Low cost Adsorbents

Activated carbon is costly and is difficult to regenerate due to fragility. Because of these reasons the developing countries can't afford its use. Hence there is a need to identify some low cost but effective adsorbent materials to replace carbon. There are many raw materials which are locally available at a very low cost, which can be used in place of activated carbon or they may be used directly with some pretreatment. Among them are fly ash, bagasse, bagasse fly ash, coconut shell, coconut fiber, wood, ground nuts, agricultural wastes, human and animal bones, hair, rice husk, leaves, soil etc. These materials in fact have no market value and their disposal is also difficult and costlier. (10, 11)

1.7 Mechanisms of Adsorption

Adsorption of substances onto adsorbents takes place because there were forces that attract the adsorbate to the solid surface from surface. Alternatively, one can view this thermodynamically as a case where adsorbate has a lower free energy at surface than in solution. During equilibrium, the adsorbate was driven onto the surface to the lower energy state, which it prefers in keeping with the second law of thermodynamics. The specific forces or mechanisms by which adsorbate was attracted. (6)

1.8 Raw material used in the Production of Activated Carbon

Activated carbon is produced from a variety of carbon-rich raw materials, including wood, coal, peat, coconut shells, nut shells, bones and fruit stones. New materials under investigation as sources for new activated carbon materials. Almost any organic matter with a large percentage of carbon could theoretically be activated to enhance its sportive characteristics. The raw material from which a given activated carbon is produced often has a large effect on its porosity distribution and surface area. Activated carbons produced from different raw materials may have much different absorbent qualities. Scientist defined activated carbon, which "Includes a wide range of amorphous carbon based materials prepared to exhibit a high degree of porosity and an extended interparticulate surface area". (5, 6)

1.9 Constituents of Rice husk Ash

64-74 % volatile matter and 12-16 % fixed carbon and 15 20 % ash. The rice husk compositions are: 32.24 % cellulose, 21.34 % hemicelluloses, 21.44 % lignin, 1.82 % extractives, 8.11 % water and 15.05 % mineral ash. The mineral ash is 94.5-96.34 % SiO_2. (28)

Table 1: The Composition of Rice husk ash

Composition	Value
K_2O	1.46 wt %
CaO	0.45 wt %
Na_2O	0.09 wt %
MgO	0.17 wt %
Al_2O_3	0.42 wt %
ZnO	0.08 wt %
Fe_2O_2	0.19 wt %
MnO_2	0.10 wt %
CuO	375 ppm
TiO_2	13 ppm
SiO_2	78.44 wt %
C	18.24 wt %
Others	0.36 wt %

(30)

Table 2: Rice husk ash Analysis

Proximate analysis	**Values**
Moisture	6 %
Ash	16.92 %
Volatile	51.98 %
Fixed Carbon	25.1 %
Ultimate analysis	
Carbon	37.6%
Hydrogen	4.88%
Sulphur	0.094 %
Nitrogen	1.88 %
Oxygen	32.61 %
Ash	16.92 %
Gross Calorific Value	13.4 MJ/Kg
Physical Properties	
Diameter range	0-10 mm
Equivalent mean diameter	1.60 mm
Natural Packing density	122 kg/m^3
Real Density (Volume cavity not accounted)	500 kg/m^3

(29)

1.10 UV- Spectrophotometer

Application:

This method is applicable to portable and surface waters and to wastewaters, both domestic and industrial.

Double beam spectrophotometer

The light from the source was split into two beams of light approximately equal in intensity. One beam was termed the reference beam. The second, which passes through the sample were called the sample beam. The two beams were then recombined and pass through the detector. The beam splitter may be a simple mirror plate into which a number of holes were drilled. Light was reflected by the mirror plate and passes down the sample beam path. An equal portion of light passes through the holes in the plate and forms the reference beam.

Another convenient beam splitter was a disk with opposite quadrants removed. The disk rotates in front of the radiation beam. The mirrored surface reflected light into the reference path. The missing quadrants permit radiation to pass down the sample beam. Each beam of light is intermittent signal. Using double beam system, we can measure the ratio of the reference beam to sample beam. Because the ratio was used, any variation in intensity of radiation from the source during measurements does not introduce analytical error. [12, 14, 32]

Absorbance of solution is measure of the amount of light of specified wavelength that is absorbed by the constituents in a solution. Absorbance measured using a spectrophotometer and a fixed path length (usually 1.0 cm), is given by the following relationship:

$$A=\log (Io/I)$$

Where,

A = absorbance, absorbance units/ centimeter, a.u. /cm

Io = initial detector reading for the blank (i.e. distilled water) after passing through a solution of known depth

I = final detector reading after passing through solution containing constituents of interest

Absorbance was measured with a UV-Spectrophotometer using a specified wavelength, i.e. 455.5 nm which is maximum wavelength in this project. [12, 19]

III.EXPERIMENTS

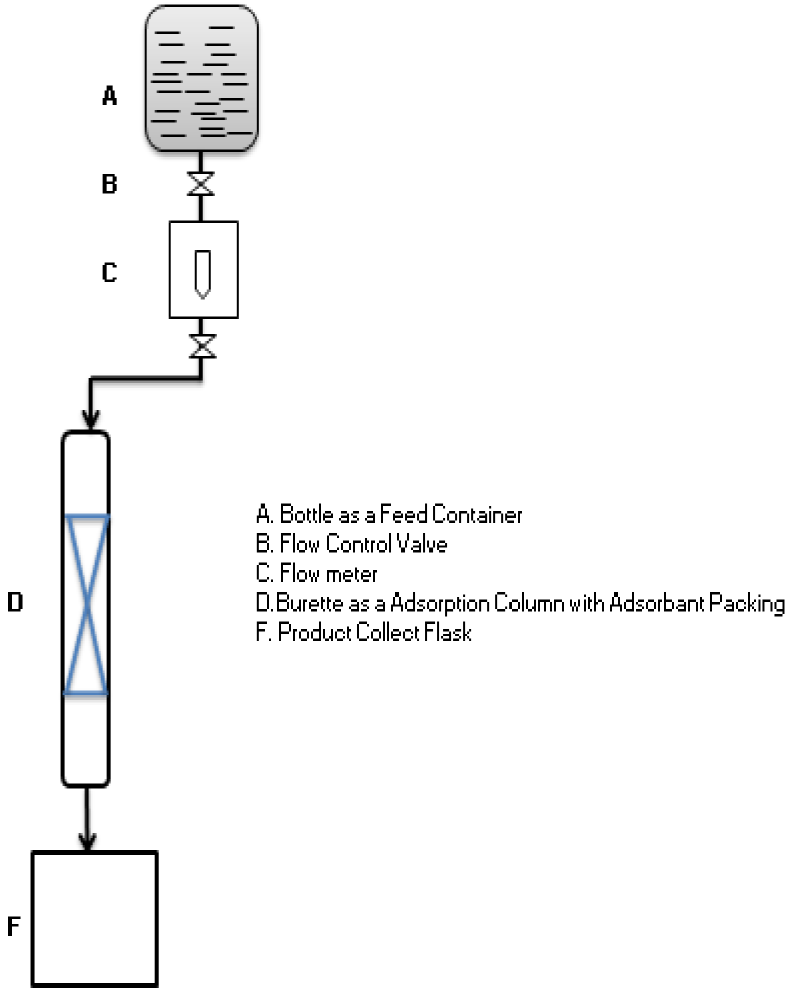

Fig 1: Experimental Set-up

3.1 Preparation of dye solution

Direct dye (Diamine fast orange) with certain color index used with several concentrations. Stock solutions of the dye were prepared in distilled water and were diluted to working concentrations stored in 2 liter volumetric flask. A stock solution of the dye was prepared by dissolving 2 gm of Direct dye in 1000 ml distilled water to make a stock solution of 2000 mg/l. The experimental solution was prepared by diluting definite volume of the stock solution to get the desired concentration. For absorbance measurements a spectrophotometer was employed. The maximum wavelength was measured in 455.55 nm. Concentrations are determined in color unit during experimental work were determined from a standard calibration curve of Pt-Co standard Vs Absorbance graph. [23, 28]

3.2Preparation of Rice Husk Ash adsorbent and preliminary screening

Rice husk Ash obtained from a nearby rice mill was screened and then washed with distilled water till the supernatant solution becomes clear. The washed ash was dried at 105°C in oven. The dried husk ash was screened and 150-200 µm mesh size particles were collected and used for the study. [14]

3.3Column Study

Column experiments were conducted using a burette as adsorption column that has internal diameter of 4.8 cm and height of 21 cm. It was packed with rice husk ash or activated charcoal.

3.4 Procedure and analytical methods

Influent and effluent wastewater was measured for pH meter. For color removal, both influent and effluent were determined as absorbance by UV-Spectrophotometer. (19)

Color removal efficiency calculated by the following formula:

$$\% \text{ Removal} = \frac{\text{Initial Pt-Co unit} - \text{Final Pt-Co unit}}{\text{Initial Pt-Co unit}} \times 100$$

3.5 Other Equipment and Apparatus

Analytical Balance (AND HR-200), pH meter, Sieves (150-200 µm), Hot Air Oven, Desiccators, Beaker (100, 250, 500, 1000 and 2000 ml.), Pipette (BOROSIL 1, 10 ml), Micro Pipette (JSGW 5 µl, 20 µl, 100 µl), Column made of Burette of 250 ml (BOROSIL internal diameter 4.8 cm, Height of 21 cm), Petri dish to weigh adsorbent (BOROSIL), Volumetric Flask (250, 1000, 2000ml), Glass Rod for stirring, Stand to hold funnel for filtration, Measuring cylinder (BOROSIL 1, 10, 250, 1000,2000 ml), Cuvettes of Quartz for sample of UV Spectrophotometer, Whatmann filter paper, Tissue paper used for cleaning cuvettes, Stop watch, Test tubes to take sample, Clinical sample collector to collect sample after filtration (100 ml).

3.6 Chemicals

Potassium Chloroplatinate, Cobaltous Chloride, HCl, Distilled water, Direct dye (Diamine fast orange), Colored water, adsorbents (Activated Charcoal, Rice husk ash)

3.7 Experimental Methods

3.7.1 Batch wise Study Procedure

1. The measured amount of adsorbent Activated Charcoal and Rice Husk Ash is taken into Petri dish weighed (0.5, 1, 2.5, 5, 10, 15, 20, 25, 30 gm) and size of 150-200 µm.
1. This adsorbent is carefully transferred into the conical flask.
2. The direct dye color solution of 150 ml was added to the conical flask and then flask was shake vigorously and Stirred at constant speed for 1 hour.
3. Allow it to settle.
4. Effluent samples were filtered by using whatmann filter paper on filter glass with help of stand.
5. The concentration of the supernatant liquid is measured by using UV-spectrophotometer.
6. The absorbance was then determined and Color removal efficiency was calculated.

3.7.2Continuous Study Procedure

1. The Glass column is prepared from Burette such that, the adsorbent was weighed and taken in column around which whatmann filter paper was placed which does not allowed the adsorbent to passed out through bottom i.e. it acts like barrier as well as filtering fine adsorbent and avoid spillage through bottom.
2. The measured colored wastewater was then taken in bottle and kept at suitable height so that flow could be constant.
3. The required flow rates were adjusted by control valve and monitored frequently during run.
4. Effluent samples were collected periodically at the bottom of column after every 20 minutes.
5. The concentration of the supernatant liquid is measured by using UV-spectrophotometer.
6. The absorbance was then determined from which the color is measured in terms of Pt-Co unit from standard graph of Pt-Co Vs Absorbance. Color removal efficiency was then found.

IV RESULTS

This Chapter presents the results from the laboratory scale experiments for the treatment of dyeing wastewater. The specific objectives of the study were to determine the operating time and removal efficiency of Direct Orange dye color from wastewater by using Rice husk ash and Activated charcoal.

Table 3: Standards were prepared of color concentration in terms of Absorbance

Pt-Co unit	Abs
240	0.023
300	0.042
350	0.056
400	0.073
500	0.100
650	0.143
700	0.159
750	0.163
950	0.224
1000	0.256
1100	0.269
1200	0.318
1300	0.347
1400	0.371
1500	0.421

Determination of Characteristics of wastewater: The absorbance of waste water ranged from 0.001 to 0.421 and the pH was found 7-7.3. Unknown samples concentration was determined using the graph shown in fig 2. Whenever the sample concentration was going beyond 1500 Pt-Co units that sample was diluted with measured amount of distilled water and reverse calculation was performed to find out the actual concentration. Table 3 shows that there is linearity in graph of Pt-Co units and respective absorbance reading. Considering linearity in graph the original color solution having 9000 Pt-Co color units.

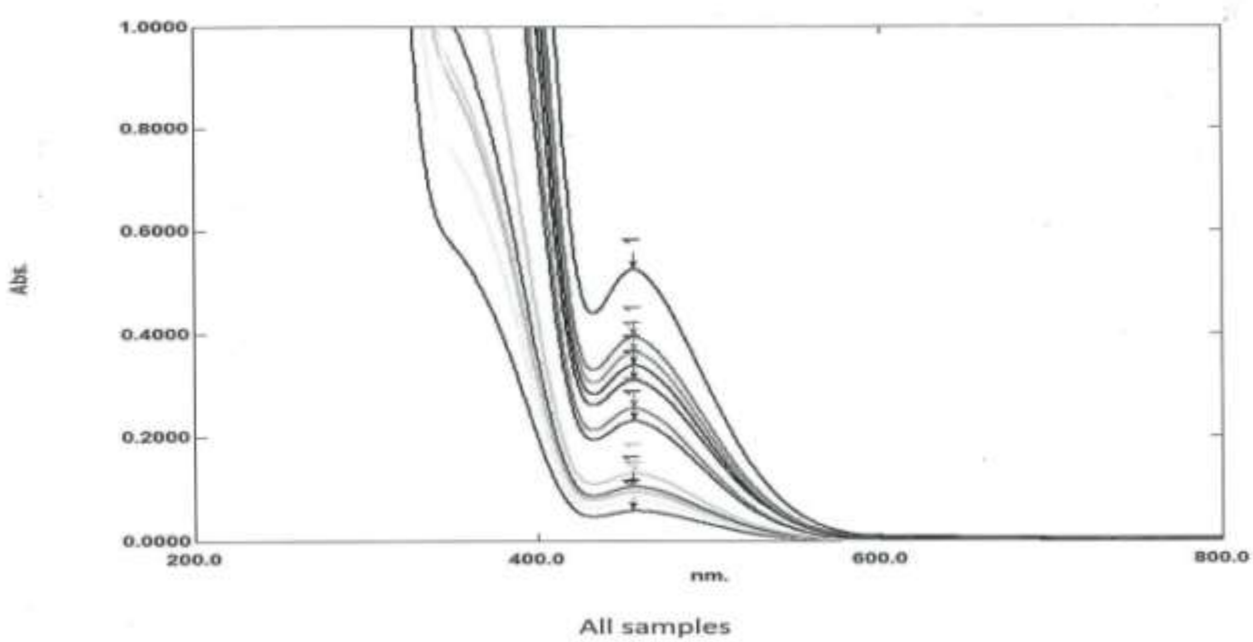

Fig 2: Graphs of Abs Vs Wavelength from UV-Spectrophotometer of Pt-Co std. solutions.

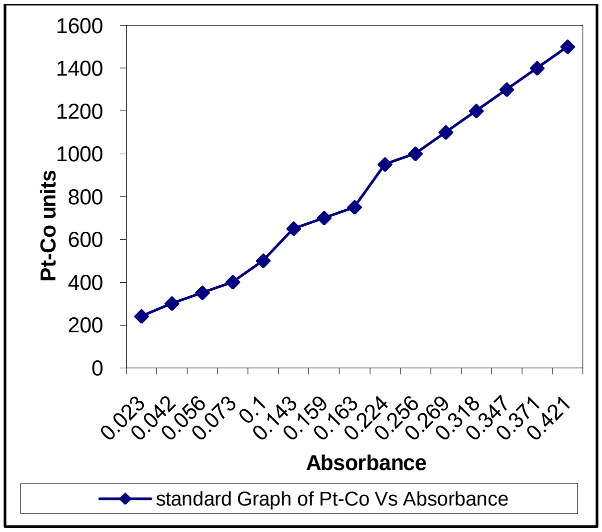

Fig 3: Relationship between std. Pt Co units Vs Abs. at max wavelength 455.55 nm.

Table 4: Batch results of Activated Charcoal

(Initial concentration of Dye color 9000 Pt-Co units, 2 gm/lit, Stirred for 1 hour)

Weight gm	Pt-Co units	Abs
Original Color	9000	2.591
0.5	1450	0.408
1	0	0
2.5	0	0

The Batch results which are carried out in 250 ml beaker with initial concentration of color solution 150 ml was having 9000 Pt-Co units the activated charcoal used as adsorbent and we found that activated charcoal as adsorbent removes the color more efficiently and with small quantity used that is why it is most popular in Industry as adsorbent.fig 3 shows that with increase in small quantity of activated charcoal the color removal efficiency increased.

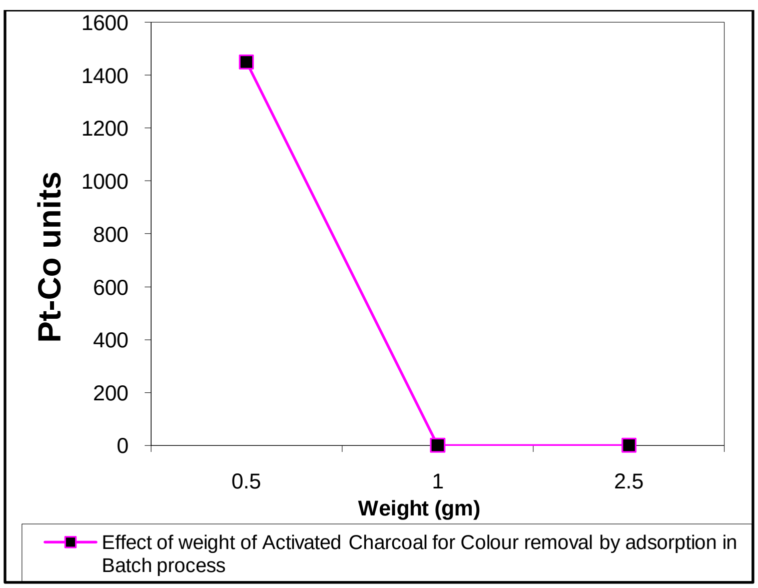

Fig 4: Effect of increased in weight of Activated Charcoal there is reduction in color with initial concentration 9000 Pt-Co units, dye 2 gm/lit, stirred for 1 hour.

Table 5: Batch result of Rice husk ash (RHA)

(Initial concentration of color 9000 Pt-Co units, dye 2 gm/lit, Stirred for 1 hour)

Weight, gm	**Pt-Co unit**	**Abs**
0.5	6898	1.936
1	6331	1.777
2.5	5109	1.434
10	1606	0.451
20	549	0.154
25	71.25	0.02
30	3.56	0.001

The Batch results which are carried out in 250 ml beaker with initial concentration of color solution 150 ml was having 9000 Pt-Co units the Rice husk ash used as adsorbent and we found that Rice husk ash as adsorbent removes the color more for longer time but it requires more amount of for complete removal. Fig 5 shows that the quantity of rice husk required was about 30 gm which is very much compare to Activated charcoal i.e it require 1 gm only.

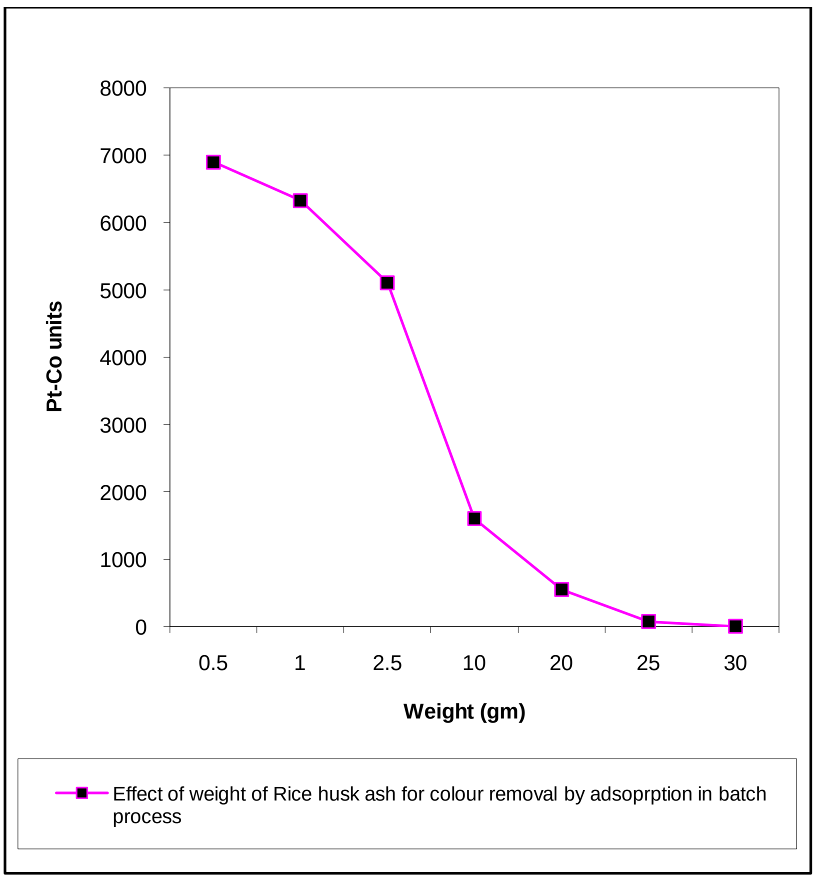

Fig 5: Effect of increased in weight of Rice Husk Ash there is reduction in color with initial concentration 9000 Pt-Co units, dye 2 gm/lit, stirred for 1 hour.

Table 6: Continuous study on effect of Contact time on adsorption with Activated charcoal (15 gm) and Rice Husk Ash (30 gm), initial concentration 9000 Pt-Co units, dye 2 gm/lit, Flow rate maintain 1 ml/min

Time (minutes)	Pt-Co unit	AC=15 gm Abs	Time (minutes)	Pt-Co unit	RHA=30 gm Abs
20	0	0	20	0	0
40	0	0	40	0	0
60	0	0	60	0	0
80	0	0	80	0	0
100	0	0	100	0	0
120	0	0	120	0	0
140	0	0	140	0	0
160	0	0	160	0	0
180	0	0	180	0	0
200	0	0	200	0	0
220	0	0	220	0	0
240	0	0	240	0	0
260	0	0	260	0	0
280	0	0	280	0	0
300	0	0	300	0	0
320	0	0	320	0	0
340	0	0	340	0	0
360	0	0	360	0	0
380	0	0	380	0	0
400	0	0	400	0	0
420	118	0.005	420	0	0
440	118	0.005	440	0	0
460	71	0.02	460	0	0
480	143	0.04	480	0	0
500 520	200 285	0.056 0.08	500 520	0 4	0 0.001
540	363	0.102	540	7	0.002
560	438	0.123	560	89	0.025
580	510	0.143	580	128	0.036
600	641	0.18	600	178	0.05
620	802	0.225	620	271	0.076
640	1019	0.286	640	289	0.081
660	1219	0.342	660	331	0.093
680	1375	0.386	680	363	0.102
700	1667	0.468	700	445	0.125

Continuous study with rice husk shows more removal of color solution since quantity required for removal of color solution was 30 gm in column which is more bulky than activated charcoal which required only 15 gm but its cost is more. Therefore the rice husk ash can be low cost adsorbent.It removes color more efficiently because time required to pass color solution through rice husk ash is more there is more contact time between the color solution and rice husk ash.Table 6 shows that there is no color found after passing through rice husk for longer time.The absorbance reading of rice husk passed color solution has less value.For 1ml/ minute there is more efficiency with rice husk ash compare with activated charcoal.

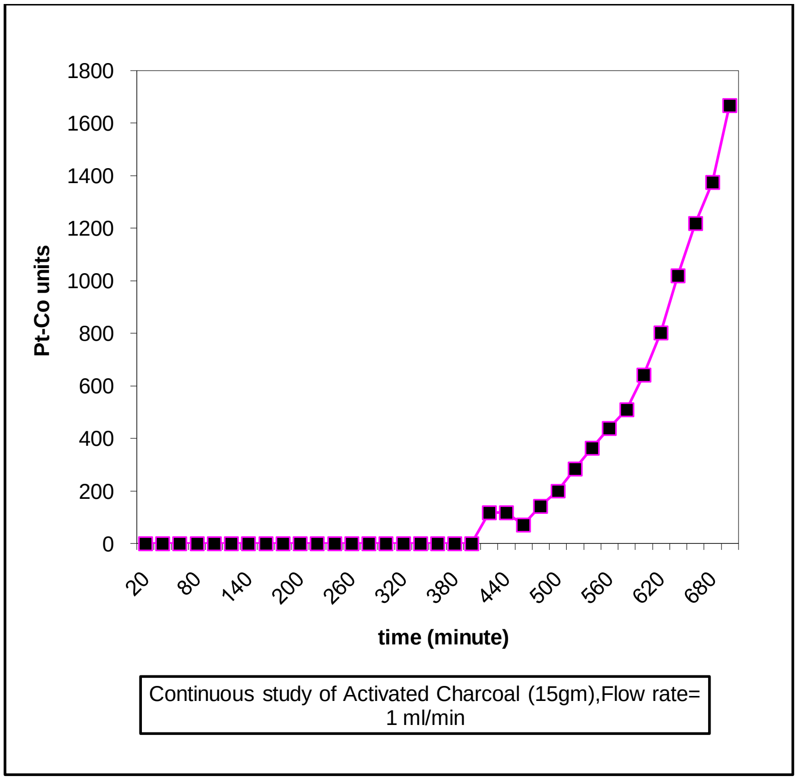

Fig 6: Continuous study on effect of Contact time on adsorption with Activated charcoal (15 gm), initial concentration 9000 Pt-Co units, Flow rate maintain 1 ml/min.

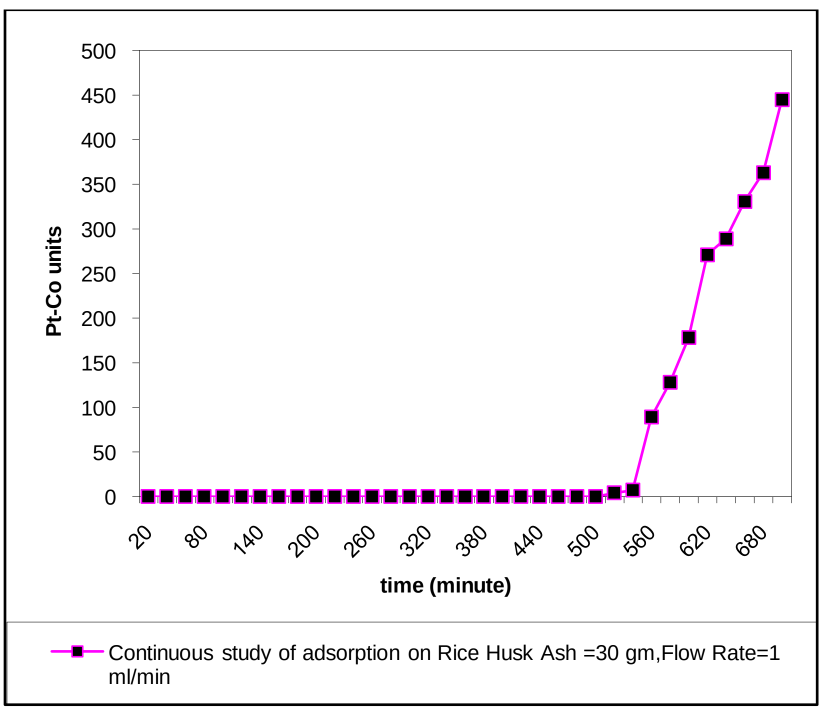

Fig 7: Continuous study on Effect of Contact time on adsorption with Rice Husk Ash (30 gm), Initial concentration 9000 Pt-Co units, Flow rate maintain 1 ml/min.

Table 7: Continuous study at flow rate 2 ml/minute

		AC=15 gm			**RHA=30 gm**
Time (minutes)	**Pt-Co unit**	**Abs**	**Time (minutes)**	**Pt-Co unit**	**Abs**
20	0	0	20	0	0
40	0	0	40	0	0
60	0	0	60	0	0
80	0	0	80	0	0
100	0	0	100	0	0
120	0	0	120	0	0
140	0	0	140	0	0
160	0	0	160	0	0
180	0	0	180	0	0
200	0	0	200	0	0
220	0	0.005	220	0	0
240	0	0.005	240	0	0
260	300	0.04	260	0	0
280	350	0.054	280	0	0
300	410	0.08	300	0	0
320	650	0.143	320	0	0
340	760	0.186	340	0	0
360	790	0.22	360	100	0.01
380	805	0.23	380	255	0.027
400	990	0.266	400	255	0.027
420	1050	0.285	420	280	0.032
440	1600	0.506	440	300	0.042
460	1625	0.54	460	325	0.05
480	1750	0.708	480	400	0.072
500	1750	0.708	500	410	0.081

Continuous study on Effect of Contact time on adsorption with Rice Husk Ash (30 gm), Initial concentration 9000 Pt-Co units, Flow rate maintain 2 ml/min then the result of rice husk ash shows much better efficiency compared with activated charcoal (15 gm).

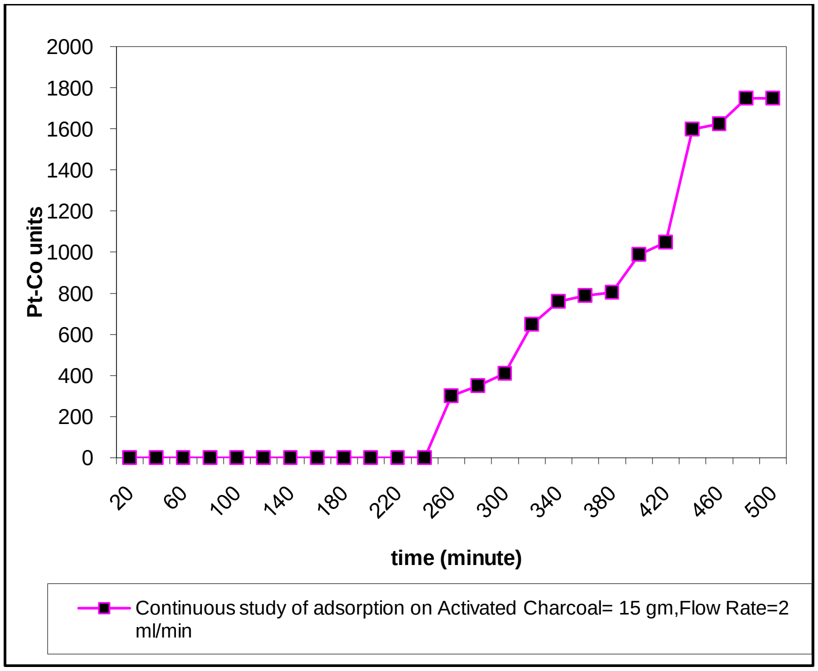

Fig 8: Continuous study on Effect of Contact time on adsorption with Activated Charcoal (30 gm), Initial concentration 9000 Pt-Co units, Flow rate maintain 2 ml/min

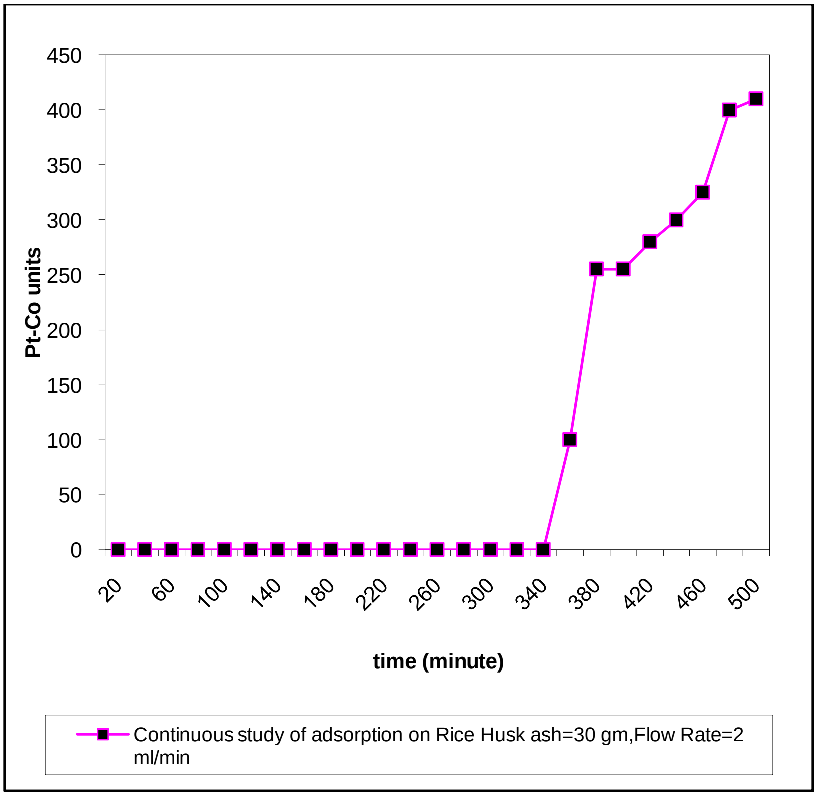

Fig 9: Continuous study on Effect of Contact time on adsorption with Rice Husk Ash (30 gm), Initial concentration 9000 Pt-Co units, Flow rate maintain 2 ml/min

Table 8: Continuous study at flow rate 3 ml/minute

Time (minutes)	Pt-Co unit	AC=15 gm	Time (minutes)	Pt-Co unit	RHA =30 gm
20	0	0	20	0	0.001
40	0	0	40	0	0.001
60	520	0.128	60	0	0.001
80	515	0.129	80	0	0.001
100	550	0.134	100	0	0.001
120	720	0.17	120	0	0.005
140	790	0.202	140	0	0.005
160	800	0.221	160	0	0.006
180	880	0.238	180	0	0.006
200	950	0.252	200	0	0.006
220	1150	0.289	220	100	0.01
240	1170	0.309	240	100	0.01
260	1200	0.34	260	100	0.01
280	1320	0.386	280	200	0.022
300	1450	0.411	300	200	0.022
320	1580	0.46	320	200	0.022
340	1600	0.501	340	200	0.022
360	1700	0.568	360	250	0.026
380	1780	0.645	380	270	0.028
400	1820	0.721	400	280	0.031

Continuous study on Effect of Contact time on adsorption with Rice Husk Ash (30 gm), Initial concentration 9000 Pt-Co units, Flow rate maintain 3 ml/min then the result of rice husk ash shows much better efficiency compared with activated charcoal because the rice husk ash has more bulky compared with activated charcoal (15 gm) therefore more contact time is required to pass through rice husk ash.

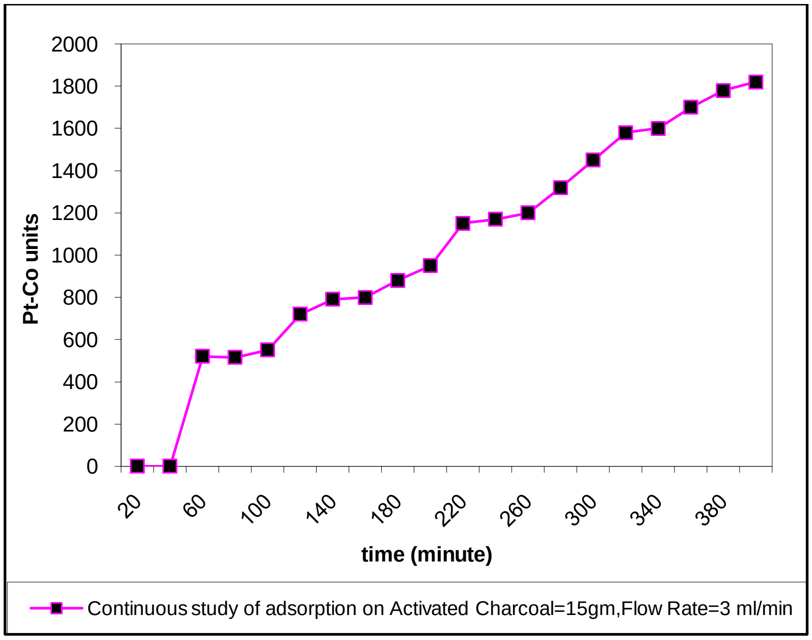

Fig 10: Continuous study on effect of Contact time on adsorption with Activated charcoal (15 gm), initial concentration 9000 Pt-Co units, Flow rate maintain 3 ml/min

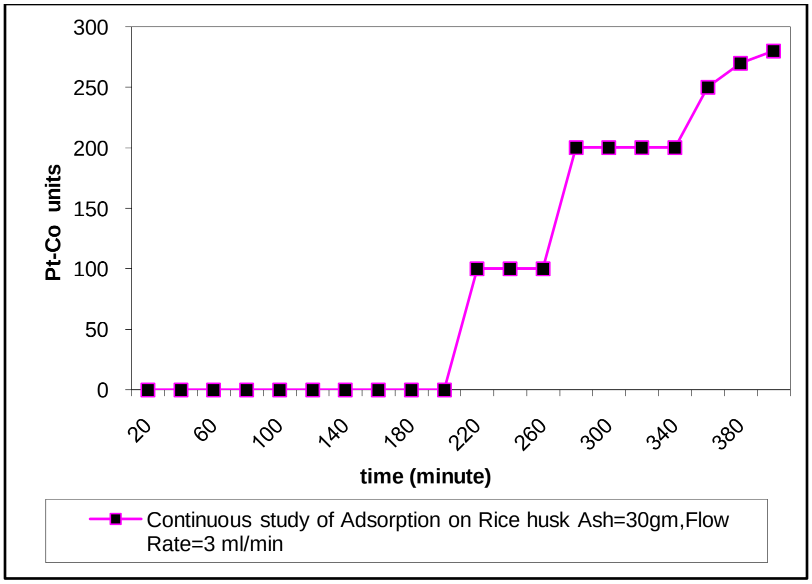

Fig 11: Continuous study on Effect of Contact time on adsorption with Rice Husk Ash (30 gm), Initial concentration 9000 Pt-Co units, Flow rate maintain 3 ml/min

Table 9: Continuous study with flow rate 4 ml/minute at constant weight.

Time (minutes)	Pt-Co unit	AC=15 gm	Time (minutes)	Pt-Co unit	RHA=15 gm
20	270	0.03	20	250	0.026
40	4293	1.207	40	295	0.038
60	6727	1.888	60	500	0.106
80	6744	1.893	80	949	0.222
100	6744	1.893	100	1600	0.51
120	6744	1.893	120	1900	0.82

Continuous study at same weight of rice husk and activated charcoal was done and it was found that the rice husk ash removes more initial color of 9000 Pt-Co unit compare with activated charcoal. But compared with slow flow rate as 1ml/min, the flow rate at 4 ml/min shows poor result therefore we can say that with increase in flow rate the removal efficiency with activated charcoal is poor compared with rice husk ash as shown in fig 12 and 13.

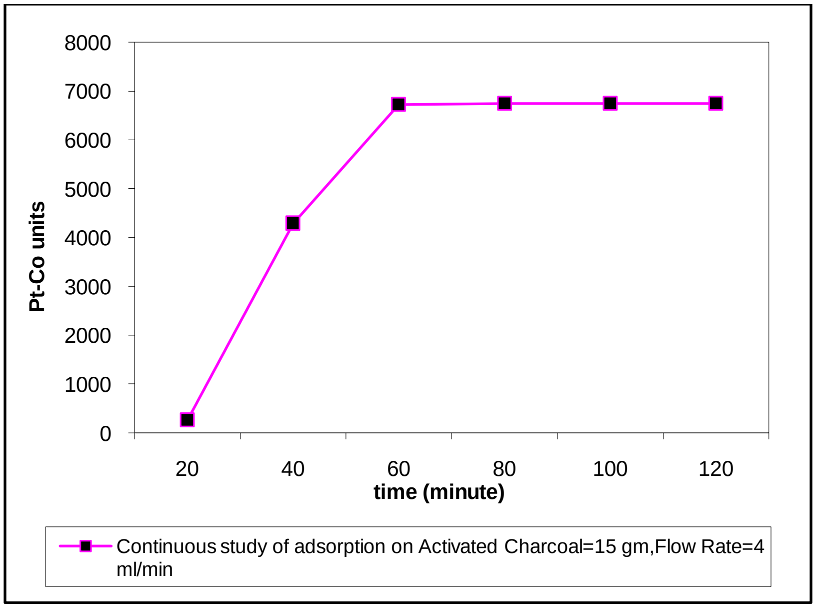

Fig 12: Continuous study on effect of Contact time on adsorption with Activated charcoal (15 gm), initial concentration 9000 Pt-Co units, Flow rate maintain 4 ml/min.

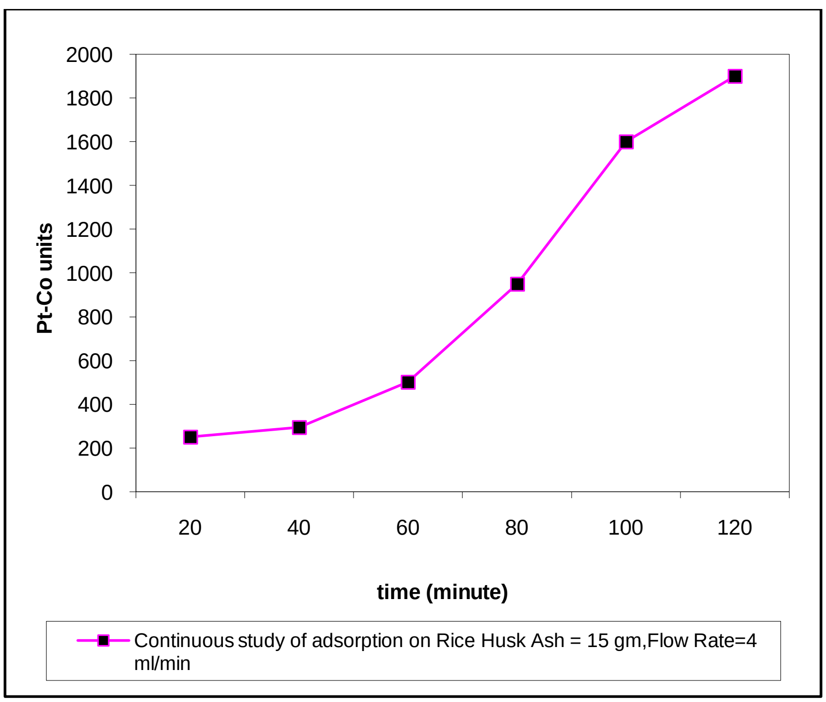

Fig 13: Continuous study on Effect of Contact time on adsorption with Rice Husk Ash (15 gm), Initial concentration 9000 Pt-Co units, Flow rate maintain 4 ml/min.

V. DISCUSSIONS

5.1Effects of Overflow rates on Removal Efficiency of color

As shown in results the flow rates of 4 ml/minute were significantly higher than those of the flow rate 1 ml/minute. This result shows that the color removal efficiency from wastewater at flow rate 1 ml/minute was higher than those of 4 ml/minute. Thus result was found color removal efficiency decreased as an increase of flow rates. It is due to fact that when color wastewater solution pass through the column, the upper portion of rice husk ash becomes saturated with color molecules and the mass transfer zone moves down the column. The mass transfer zone characterized the changes in concentration of color molecules on the rice husk ash during the continuous adsorption until reaching the outlet. When molecules of color flow through rice husk ash bed at high flow rates, causes an insufficient contact time for allowing color molecules being diffused to all adsorbing site of adsorbent. Thus the percentage of color removal efficiency was decreased.

5.2Effect of Height of Packing in column on Removal Efficiency of color

Since the rice husk is comparatively low dense with activated carbon. The height of column of rice husk is more than the activated carbon. The color removal efficiency increased when the height of packing adsorbent was increased. This phenomenon could be explained that the increased of the height of packing adsorbent will increase the large surface and longer detention time, thus result in a longer contact time of the wastewater with the adsorbent. The rice husk ash is more bulky compared with activated charcoal therefore absorbs more wastewater compared with activated charcoal. The column prepared with rice husk ash occupies more space than activated charcoal at same weight.

VI CONCLUSION AND RECOMMENDATION

6.1Conclusion:

The study was conducted to investigate the color removal efficiency from colored wastewater by using Rice husk ash as adsorbent. The conclusions drawn from the results of this experiment project are shown as followed:

1. The color removal efficiency at lower flow rates was significantly higher than those of higher flow rates of wastewater. The result of rice husk ash was comparatively better than the activated charcoal at same weight basis and considering cost.
2. The color removal efficiency at the higher packing adsorbent was significantly higher than those of the lower packing adsorbent. The rice husk ash at same weight has more bulky compared with activated charcoal therefore shows much good removal efficiency compared with activated charcoal compared considering cost.

6.2Recommendations:

For further study, the following areas should taken into consideration

1. The experiment should scale up in order to apply in the actual situation.
2. The treated Rice husk ash should be studied.
3. The effect of pH on color removal should be study further.
4. The Effect of temperature should be studied.
5.

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