ISSN: 2277-9655
Impact Factor: 1.852

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY
TECHNOLOGY

Waste Water Treatment by Adsorption and Coagulation

Ms. S. K. Waghmare
Department of Chemical Engineering, Government Polytechnic, Yavatmal, Maharashtra, India
seema1203@gmail.com

Abstract

A physicochemical study for the treatment of paper mill wastewater was performed. This effluent is treated with coagulation and adsorption. The composite of wastewater treatment was carried out using Saw Dust Carbon and Rice Husk Carbon as adsorbent and Alum to remove TSS, TDS, color. The paper industry wastewater was treated with different doses of coagulants like alum, at constant contact duration (4 hours) and room temperature (300C). Alum was found to be more effective coagulant and reduce TSS & TDS 58.94% and 59.52% A comparative analysis is done with the two adsorbents saw dust husk and rice husk .It was found that as compare with rice husk by using saw dust husk gives maximum removal (80.88% and 80%),of TSS, TDS and color.

Keywords: TDS, TSS, Paper industry wastewater, Adsorption, Coagulation

Introduction

Rapid industrialization, over the past 40 to50 years, has resulted in the generation of increasing quantities of wastes and wastewaters containing high level of organic and inorganic pollutants. Manufacturers of new products, particularly pulp, have greatly increased the waste treatment and disposal problems. Wastewaters from operations in the paper industry are generally high in both color and organic content. The wastewater from the paper industry is known to be strongly colored, presence of large amount of suspended and dissolved solids, broadly fluctuating pH, amount of dissolved solids. Color is the first contamination to be recognized in this wastewater [2][3]. There are several methods for color removal like adsorption, coagulation/ flocculation/ precipitation, polyelectrolyte, biological process, ionizing/gamma radiation. However, many of these technologies are cost prohibitive, especially when applied for treating large waste streams. Consequently, adsorption techniques seem to have the most potential for future use in industrial wastewater treatment because of their proven efficiency in the removal of organic and mineral pollutants and for economic considerations. Practically process requires the following potential advantages for the adsorbent: (1) a large accessible pore volume, (2) hydrophobicity, (3) high thermal and hydrothermal stability, (4) no catalytic activity, and (5) easy regeneration. New approaches based on the use of natural, inexpensive sorbent materials for effluent treatment have been reported However, the use of these materials is still limited, although they show good adsorption capacity relative to that of the other expensive treatment processes Activated carbon is the most widely used adsorbent for this purpose because of its extended surface area, micro porous structure, high adsorption capacity and high degree of surface reactivity. However, commercially available activated carbons are very expensive. In addition, the laboratory preparation of activated carbons have been accompanied by a number of problems such as combustion at high temperature, pore blocking, and hygroscopicity. This has led to search for cheaper and simplest substituent. Rice husk, an undesirable agriculture mass residue. Traditionally, rice husks have been used in manufacturing block employed in civil construction as panels and was used by the rice industry itself as a source of energy for boilers. However, the amounts of rice husk available are so far in excess of any local uses and have posed disposal problems. It was chosen because of its granular structure, chemical stability and its local availability at very low cost and there is no need to regenerate them due to their low production costs. The purpose of this work was to investigate the adsorption capacity of activated carbons, prepared from low-cost mahogany sawdust and rice husk. [5]

The present study deals with the physicochemical characteristics of composite wastewater of paper industry which recycle the cardboard by using Saw Dust carbon and Rice Husk carbon as adsorbent and coagulant such as alum. The different parameters were studied such as TSS, TDS & color.

ISSN: 2277-9655
Impact Factor: 1.852

Materials and Methods

Preparation methods of adsorbents [7]

Saw dust husk:

The sawdust was collected from local saw-mill respectively. It was washed with hot distilled water to remove dust like impurities and dried in sun. The resulting material was carbonised by heating in muffle furnace at a temperature ranging from 150-200 C for an hour. Activation was applied by grounding and washing it with the distilled water. All samples were grounded and dried at (100±5) C for overnight before the determination of their chemical properties. Before utilisation, the carbon was thoroughly washed with distilled water for several times by decantation and subsequently filtered and then dried in hot air oven at (100±5) C.

Rice Husk:

Rice husk was obtained from local rice mills and was washed several times with distilled water followed by filtration. The cleaned rice husk was oven dried completely at 105°C, then cooled and sieved to 250-500 µm size, which was used without further treatment. Another part of same size fraction of rice husk was exposed to activation using

Citric acid which was reported as follows: 100 g of rice husk were soaked in 0.6M citric acid for 2 h at 20°C. The acid- repeatedly with distilled water (200 ml per g of husk) to remove any excess of citric acid followed by oven drying overnight at 100°C.

Experimental

This study was carried out in two steps. The first step consisted of the characterization of the Composite wastewater samples. The analyzed parameters were the pH, TSS, TDS, and color. In the second step physicochemical treatments like adsorption and coagulation were applied to combined wastewater in order to reduce TSS, TDS and color.

Characteristic of waste water

The wastewater samples were collected from Navrang Paper Mill located at Chausala Road, Yavatmal (Maharashtra). Samples were collected in sampling bottles and placed at cool place to preserve for analysis. The individual and its composites samples were analysed for TSS, TDS, pH and colour as per standard method.

Table: 1 Initial characteristic of waste water

Sample (ml)	Initial pH	Initial TDS (mg/l)	Initial TSS (mg/l)	Observed colour
10	4-5	23	19	Blackish

***Coagulation* [1][2]**

The alum directly added to the effluent as per the ratio of 10gm/1000ml of effluent. Placed it for settling of suspended solid of effluent for 4 hour.

Table: 2 Characteristics of wastewater after coagulation

Sample (ml)	pH	TDS (mg/l)	TSS (mg/l)	Observed colour
10	4	9.31	7.8	Yellowish

***Adsorption* [1][6]**

Batch Adsorption Process:

Batch adsorption process was carried out for the removal of TSS and TDS, and determination of pH. This process was carried out for two adsorbents are as follows.

Saw dust:

- Take 10gm of saw dust per 100ml of coagulated effluent and stirrer it for the time interval of 10 min each at room temperature.
- Then the mixture was passed through porous medium.
- The carbon was separate out on the porous medium and we got water from the bottom.
- The drain water and its TSS, TDS and pH are found to be as shown in table below.

Rice Husk:

- Take 10gm of rice husk carbon per 100ml of coagulated effluent and stirrer it for the time interval of 10 min each at room temperature.
- Then the mixture was passed through porous medium.
- The rice husk carbon was separate out on the porous medium and we got water from the bottom.
- The drain water and its TSS, TDS and pH are found to be as shown in table below.

Calculate suspended solids (mg/l) using the following formula:

Suspended Solids (mg/l or ppm) =
[Wt. of Solids (g)] x [1,000,000] /
Volume of Sample filtered (ml)

Result and Discussion

Comparative Study between two Adsorbents:

Comparative study was taken with the results obtained for TSS, PH and TDS on both adsorption processes by the using Saw Dust Carbon and Rice Husk Carbon with respect to time.

ISSN: 2277-9655
Impact Factor: 1.852

Table: 3 Result of adsorption by using Saw Dust Husk

Sample (ml)	pH	TSS (mg/l)	% Removal of TSS	TDS (mg/l)	% Removal of TDS
10	4.29	4.25	45.50	6.80	**26.90**
20	4.82	4.03	48.33	6.31	32.20
30	4.93	3.61	53.71	5.84	37.27
40	5.16	3.24	58.46	4.28	54.02
50	5.43	2.71	65.25	3.73	60.04
60	5.87	2.28	70.76	2.86	69.28
70	6.18	1.93	75.25	2.47	73.46
80	6.32	1.56	80.00	1.78	80.88

Table: 4Result of adsorption by using Rice husk

Sample (ml)	pH	TSS (mg/l)	% Removal of TSS	TDS (mg/l)	% Removal of TDS
10	4.31	5.60	28.20	6.95	25.34
20	4.83	5.25	33.33	6.20	34.40
30	4.98	4.83	38.46	5.78	37.91
40	5.20	4.16	47.43	5.13	44.89
50	5.50	3.54	54.61	4.61	48.22
60	5.79	3.09	61.53	3.72	60.04
70	5.94	2.40	69.23	2.55	72.61
80	6.03	1.71	78.02	2.01	78.41

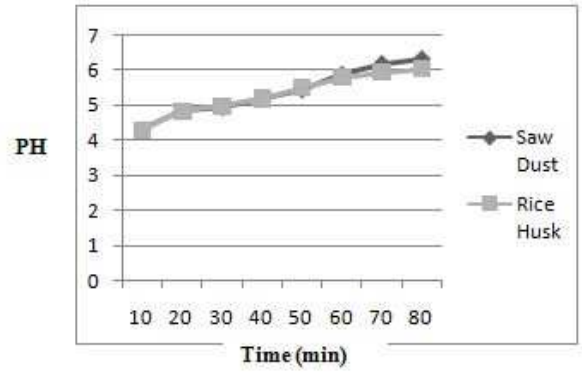

Fig: 1 Comparison of pH value of effluent v/s time on Saw dust and Rice Husk as adsorbents

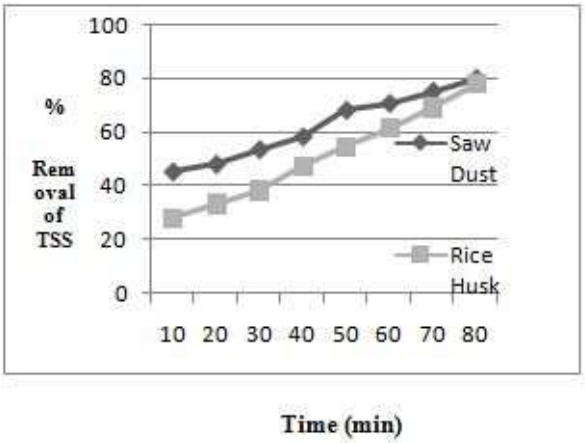

Fig: 2Comparison of TSS value of effluent v/s time on Saw dust and Rice Husk as adsorbents

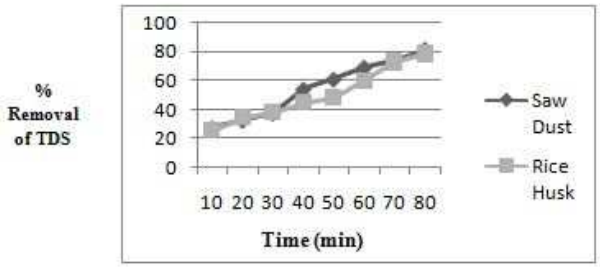

Fig: 3Comparison of TDS value of effluent v/s time on Saw dust and Rice Husk as adsorbents

Observation of Colour:

- Initial colour of the effluent was blackish in colour. This colour is due to the presence of lining compounds which are not easily biodegradable.
- After coagulation the colour has been changed from blackish to yellowish colour.
- After batch process of adsorption by using Saw dust carbon and Rice husk carbon was observed that the colour has changed from yellowish to colourless which is near to standard water colour.

ISSN: 2277-9655
Impact Factor: 1.852

Method	Observation
Original Effluent from mill	Blackish
After coagulation	Yellowish
After Batch Adsorption Process (Saw Dust & Rice Husk)	Colourless (nearer to soft water)

Conclusion

Wastewater was treated with coagulant like alum. Alum was found to be more effective coagulant and reduce TSS & TDS 58.94% and 59.52% respectively. The Eight individual samples of effluent were analyzed with respect to constant time interval. The various parameters, wherein TDS, TSS and Color were in elevated limits and coveted to remove it. The adsorption process using Saw Dust carbon and Rice Husk carbon is effectively applicable for removal of TDS, TDS and Color from paper mill effluent. The process parameters like adsorbents, time interval were exploited in this study. The highest percentage removal of TDS and TSS was found to be 80.88 and 80.00% respectively using Saw Dust carbon of 10gm/200ml for time intervals of 10 min each at a room temperature. Also the highest percentage removal of TDS and TSS was found to be 78.41% and 78.02% respectively using Rice Husk carbon of 10gm/200ml for time intervals of 10 min each at a room temperature. It is observed that the Saw Dust carbon is more effective adsorbent for waste water treatment on paper mill effluent rather than Rice Husk carbon adsorbent for the removal of TDS, TSS and the color. It was concluded that the suggested treatment scheme is suitable to bring the effluent quality up to the water quality standards.

References

[1] Himanshu Patel and R.T. Vashi, Treatment of Textile Wastewater by Adsorption and Coagulation, *E-Journal of Chemistry*, 7(4), 2010, 1468-1476.

[2] Pradeep Kumar, Tjoon Tow Teng, Shri Chand, and Kailas L. Wasewar, Treatment of Paper and Pulp Mill Effluent by Coagulation, *International Journal of Civil and Environmental Engineering*, 2011,222-227

[3] Stephenson RJ and Duff SJB, Coagulation and precipitation of a mechanical pulping effluent – I. Removal of carbon, colour and turbidity. Wat Res. 30: 781-792 (1996).

[4] Dilek FB and Bese S, Treatment of pulping effluents by using alum and clay-Color removal and sludge characteristics. *Water SA* 27: 361-366 (2001).

[5] Ola Abdelwahab, Ahmed El Nemr, Amany El Sikaily, Azza Khaled, Use Of Rice Husk For Adsorption Of Direct Dyes From Aqueous Solution: A Case Study Of Direct F. Scarlet, *Egyptian Journal Of Aquatic Research*, Vol. 31, No.1 2005, 1110-0354.

[6] P.K. Malik, Use of Activated Carbons Prepared from Sawdust and Rice-Husk for Adsorption of Acid Dyes: A Case Study Of Acid Yellow 36, *Elsevier Science direct*, 56 (2003) 239–249.

[7] Sarita Yadav,D. K. Tyagiand O. P. Yadav, Equilibrium And Kinetic Studies On Adsorption Of Congo-Red Dye From Aqueous Solution Onto Rice Husk Carbon, *Nature Environment and Pollution Technology An International Quarterly Scientific Journal*, Vol. 10 No. 4, 2011, 551-558.