Adsorption Studies on Treatment of Dye Effluent Using Sugarcane Bagasse Ash

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ABSTRACT

In this paper, a study of the treatment of dye removal efficiencies from dye wastewater using sugarcane bagasse ash. As water quality is a precious commodity and available in the world, it has become highly imperative to treat wastewater for removal of pollutants. Sugarcane bagasse ash is an agricultural byproduct, act as an effective adsorbent for removal of dyes from dye wastewater. Sugarcane bagasse ash could reduce the higher concentration of COD from dye effluent. The initial COD concentration of collected dyes effluent sample was 3200mg/l. The removal of dye was carried out by the adsorption process under the optimized conditions of adsorbent dose and contact time were studied for this work. Experimental results for 100ml of sample indicates that with an increase in adsorbent dose upto 0.6g. The optimum contact time and initial concentration, pH were found to be 5hr and 3200mg/l, 8.64. BOD_5 of the collected dye effluent sample was taken as 20ml at 30°c is 37.5mg/l. The paper covers effluent treatment process limitations and scope for further improvements.

Keywords : *Adsorption, Dye effluent, Sugarcane bagasse ash, Wastewater, Water pollution, COD removal*

1. INTRODUCTION

Dye industries are one of the problematic groups since they dispose highly toxic effluent which creates harmful effect on environment and may directly or indirectly destroys the ecosystem. Dye production industries which use dyes and pigments and generate wastewater, characteristically high in colour and organic matter. These compounds are highly visible and undesirable because they alter the natural appearance of rivers and lakes which impact on aquatic life. Dye effluent contains high range of color, chemical oxygen demand (COD), biological oxygen demand (BOD), turbidity. The removal of dyes from dye containing wastewater has serious restriction such as high cost and intensive energy requirement.

Furthermore, regeneration using solution produces small additional effluent while regeneration by refractory technique results in a 10-15% loss of adsorbents. Nowadays, there is numerous numbers of low cost, economically available adsorbents which had been used for dye removal. Hence sugarcane bagasse ash is a suitable for reduce the colour and organic matter.

Sugarcane bagasse ash is a byproduct of sugar factories found after burning sugarcane bagasse which itself is found after the extraction of all economical sugar from sugarcane.

One of the most effective techniques for removal of color and organic pollutant from dye effluent is adsorption. Adsorption is the adhesion of atoms, ions or molecules from a gas, liquid or dissolved solids to a surface. This process creates a film of the adsorbate on the surface of the adsorbent. Adsorption is a low cost and important physical process for the treatment and regeneration of wastewater.

This paper presents the experimental investigations of adsorption process for removal of organic matter using sugarcane bagasse ash from dye effluent. The effect of various parameters like adsorbent dosages, initial concentration and contact time on chemical oxygen demand and biological oxygen demand were also reported with their optimum values.

2. MATERIALS AND METHODS

2.1 REAGENTS:

The reagents used in the study were sulfuric acid [H_2SO_4]98%, Manganeous sulphate [$MnSO_4H_2O$], Standard Potassium dichromate [$K_2Cr_2O_7$], Alkali-iodide-azide, Ferrous ammonium sulfate[FAS].

2.2 INSTRUMENT

Flocculator , COD block digester, pH meter, BOD incubator were used.

2.3 COLLECTION OF MATERIAL

The wastewater samples were collected from the main disposal point of dyes manufacturing industry and collected samples were kept in laboratory for analysis. Low cost adsorbents were prepared from collected fly ash samples and were utilized for the treatment of industrial dyes effluent for an effective reduction of organic pollutants.

Sugarcane bagasse ash was collected from a local mill, it was sieved through desired particle size of 600µ and used for adsorption studies and was stored in laboratory for analysis.

3. EXPERIMENTAL STUDIES

In the present study of sugarcane bagasse ash have been utilized for the treatment of dye effluent. The following parameters were optimized during the study dilution factor, contact time, adsorbent dosage, pH, COD.

For all the above parameters 100 ml of dye effluent was taken into 500 ml conical flasks and various adsorbents take such as 0.1g, 0.2g, 0.3g, 0.4g, 0.5g, 0.6g was added. The flasks were kept on flocculator for various contact time such as 1hr, 2 hr, 3hr, 4 hr, 5hr the samples were filtered and collected for analysis as shown below figure..,

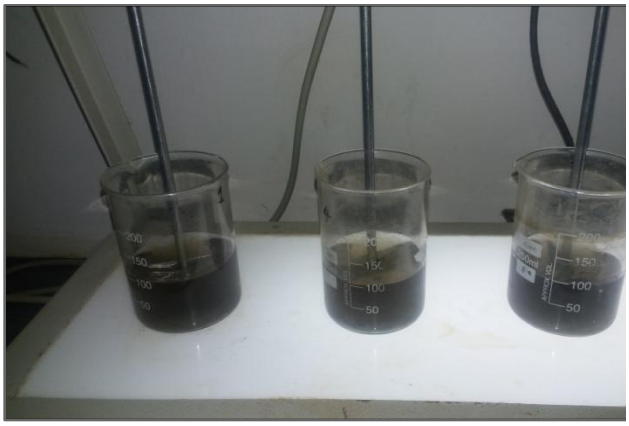


fig. flocculator

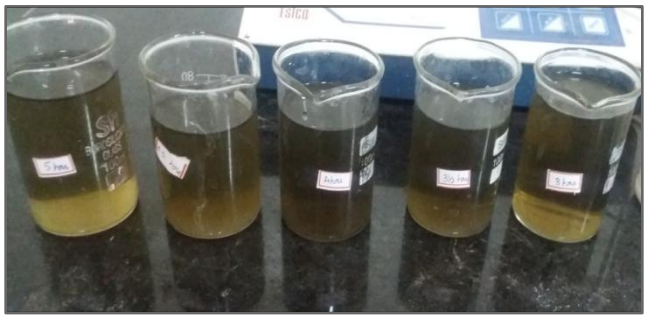
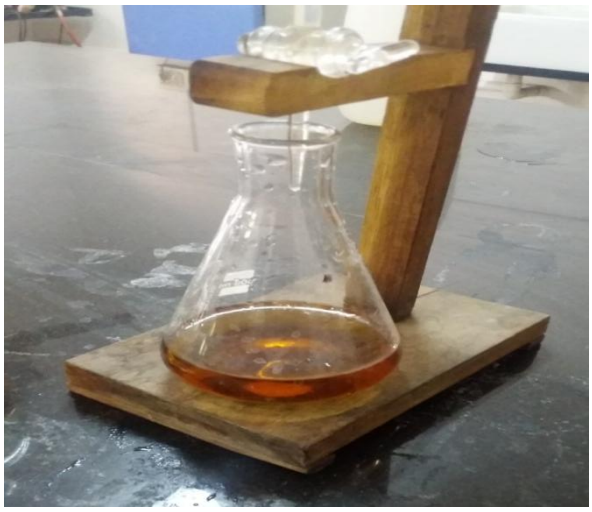


Fig. various contact time of 100ml sample with adsorbent

The COD of the effluent were measured for each run.

For the measurement of COD, the wastewater containing known amount of potassium dichromate with normality 0.01N was kept at 150°c on COD digester for 2hrs. From the literature and the available data, 2hrs are sufficient for the decomposition of organic matter. The blank containing distilled water instead of wastewater in the sample tube is also kept at same temperature and for the same duration. Silver sulphate is used to fasten the process of decomposition. After two hours the sample were cooled and titrated with FAS of known concentration using ferrion indicator. The difference in the burette reading for blank and the sample is measured. The COD is estimated by calculating the equivalent concentration of organic matter required for the consumption of potassium dichromate.



For the measurement of BOD, the wastewater sample was taken as 5ml, 10ml, 20ml for initial BOD value and for final BOD value the sample was taken in BOD bottle, add aerated water for dilution. The alkali-iodide-azide filled with stopper air tight without air bubbles entrapped and titrated with sodium thio-sulphate of known concentration using starch indicator. The difference in the burette reading for the sample is measured.

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final BOD test bottle was kept into BOD incubator at 20°c for 5 days and the initial BOD bottle of sample with known amount of manganous sulphate and

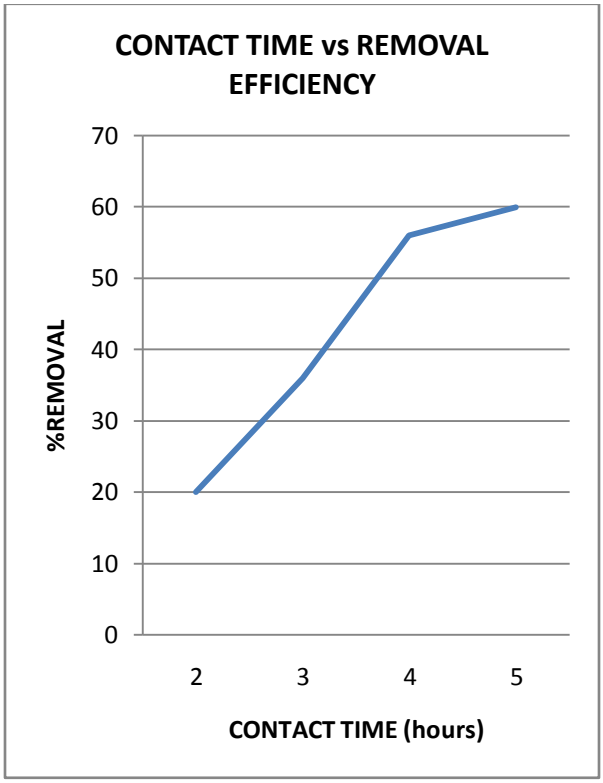
4. RESULTS AND DISCUSSION

4.1 FIXATION OF DILUTION FACTOR

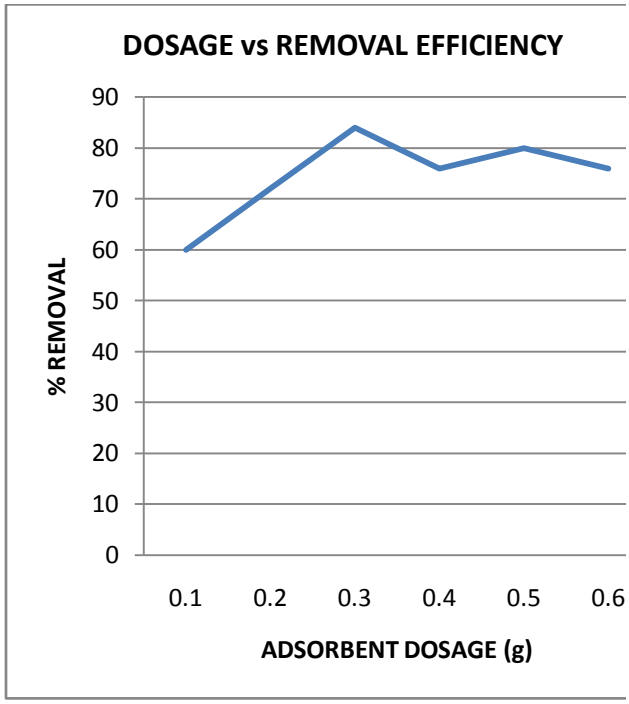
The dilution factor of sample was taken as 1ml, 1.5ml, 2ml, 2.5ml, 3ml, 3.5ml, 4ml for 0.1g adsorbent dose. From these dilution factor the Fixed value is 2.5ml have high removal efficiency

4.2 EFFECT OF CONTACT TIME

The contact time has taken as 2hr, 3hr, 4hr, 5hr for o.1g adsorbent dose of bagasse ash with dilution factor of 2.5ml sample. From these contact periods, the optimum time has to be fixed as 5hrs have maximum removal efficiency of COD as shown below



4.3 EFFECT OF ADSORBENT DOSAGE



4.4 OTHER PARAMETERS

The total amount of the hardness of the dye effluent is 2750 mg/l.

The amount of calcium hardness and magnesium hardness present in the dye sample was obtained as 680 mg/l and 2070 mg/l.

The chloride present in dye effluent is 93.05 mg/l.

5.ADVANTAGES AND APPLICATION

- The cost of adsorbent is low since they are often made from locally, abundantly and easily available material.
- It can be used in raw form for adsorption.
- It is eco-friendly low cost adsorbent.
- Application of the advance treatment of BOD technologies and process while reducing.

6. CONCLUSION

Dye industry effluent is mostly treated by use of chemical and biological treatment process. The bagasse ash is found to be effective adsorbent to removal of pollutants from dye effluent. The sugarcane bagasse ash, an agricultural by-product, acts as an effective adsorbent for the removal of dye from dye effluent. The result shows the detailed analysis carried out on the dye effluent has various parameters. The pH values were slightly alkaline was found to be 8.64. The total amount of hardness in the sample was 2750mg/l. The biochemical oxygen demand in the dye effluent were quite higher than the standards given by the world health organization (WHO). The maximum removal efficiency of chemical oxygen demand in the dye effluent was determined as 0.3g of adsorbent dose without thermal activation contact time of 300minutes has obtained was 84%. Thus, the sugarcane bagasse ash has good removal efficiency.

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