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Domestic Wastewater Treatment Using Fly Ash

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Abstract*: Wastewater treatment and disposal is the serious issue and need attention for protecting the environment. Management of coal fly ash (class C ashes) as a particulate by-product of coal burning has become an issue to be solved right away due to environmental concerns related to soil, water, and air pollution. Over the recent years, fly ash has been experimented as an adsorbent for the waste water treatment plants. Many attempts have been made by researchers for the conversion of coal fly ash. Wastewater treatment using coal fly ash is one such attempt solving water quality issues. The abundant availability, high carbon content and adsorption characteristics of fly ash lead to application in waste water treatment method. In this study, experiments were carried out using fly ash as adsorbent. A batch study was conducted to check the removal efficiency of wastewater The chemical properties of wastewater before and after treatment were examined. The experimental results showed significant reduction in the values of BOD from (178mg/l to 96mg/l), COD from (110 mg/l to 40mg/l), pH from (8.2 to 7.2) and TDS from (880mg/lt 110 mg/l) after treatment. A scanning electron microscope (SEM) scans a focused electron beam over a surface to create an image. Beneficial effects of fly ash utilization as adsorbent was observed for removing various impurities present in wastewater. Sludge conditioning is a use for fly ash, but suitable mixing and feeding equipment for fly ash is required. It is understood from the review that fly ash has demonstrated good removal capabilities for various organic compounds.

***Keywords*: Coal fly ash, abundant, low-cost filter media, adsorbent, waste water treatment, high carbon content, SEM test.**

1. Introduction

Water is mainly polluted by the discharge of various effluents from domestic waste and industrial waste. Water pollution occurs when pollutants are discharged directly or indirectly into water bodies without adequate treatment. Water covers about 70 percent of earth surface, and is a valuable resource of the earth. There is earth is composed of approximately 30% of the world's fresh water is in liquid form. Waste water treatment is the process of converting waste water into bilge water that can be discharged into the environment.

Waste water includes black water and grey water. Black water accounts 32.6 percent of domestic waste water, while grey water accounts for 67.5 percent. Heavy metals from industrial processes are also among the most important pollutants in source and treated water. Domestic waste water is categorized as organic pollutant.

Fly ash is an industrial by-product from thermal power plants which is majorly composed of fine particles. Fly ash is one of the residues generated in combustion and comprises of fine particles, rise with the flue gases. Fly ash which has been widely studied for its Adsorbtion properties and is available in plenty in India from thermal power plants can be employed for the purpose of treatment of domestic waste water.

Fly ash resulting from coal burning is a mixture of oxides with unburnt carbon, with a predominant negative surface charge, having thus a good affinity for cations or polar pollutants. Although fly ash presents low Adsorbtion capacity and to enhance the Adsorbtion capacity, it is necessary to modify the properties of fly ash. Adsorbtion, which is the surface phenomenon, that depends on the higher specific surface area, narrow particle size distribution and the porosity of an adsorbent where also investigated for the fly ash absorbed that the larger the specific surface area, the higher the carbon content and the finer the Particle size of the fly ash the greater its adsorbtion capacity.

2. Materials

A. Effluent Collection

Waste water was collected from college waste water treatment plant. The sample were collected periodically thrice in a week for a month for the study. It has high concentration of COD, TDS, TSS, PH and the dissolved oxygen level would be very low.

B. Fly Ash

Fly ash was collected from cement factory, Coimbatore. The collected fly ash was sieved through 90 microns sieve before preparing filter bed.

C. Pebbels

Pebbles are generally considered larger than granules and smaller than cobbles. In this study small size (maximum 15mm) pebble were used in the filter media. The pebbles were washed with distilled water and dried.

D. Sand

River sand was used in this study to prepare the sand bed in the filtration tank. The river sand was sieved through 2.36 mm sieve before application.

3. Characteristics of Fly Ash

Fly ash is typically finer than portland cement and lime. Fly ash consists of silt-sized particles which are generally spherical, typically ranging in size between 10 and 100 microns. The

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major constituents of fly ash are silica(SiO_2), Alumina(Al_2O_3), Ferric Oxide(Fe_2O_3), Calcium Oxide(CaO). The other minor constituent of fly ash are MgO, Na_2O, K_2O, SO_3, MnO, TiO_2 and unburnt carbon. There is wide range of variation in the principle constitutes – Silica (25-60%), Alumina(10-30%) and Ferric Oxide (5-25%).

Class C ashes are generally derived from sub - bituminous coals and consist primarily of calcium alumino-sulfate glass, as well as quartz, tricalcium aluminate, and free lime(CaO). Class C ash is also referred to as high calcium fly ash because it typically contains more than 20 percent CaO. Fly ash can be tan to dark gray, depending on its chemical and mineral constituents. Tan and light colors are typically associated with high lime content. A brownish color is typically associated with the iron content.

4. Methodology

A certain amount of waste water is get collected from the domestic area. Then the materials is to be collected. The collected materials are like coal fly ash, pebbles and sand. The river sand is sieved with 2.45mm sieve. The waste water is get tested in the laboratory before filtration. By using the above materials the waste water is get treated. Then the treated waste water is get tested in laboratory. The filter bed of five layers is get separated for conducting the treatment. These five layers consists of pebbles at the bottom and fly ash & sand over it, followed by pebbles and the waste water at the top. The treated water is get obtained by the outlet present at the bottom of the filter bed. Finally, the comparisons is get made for the untreated and treated waste water.

Table 1
Tests performed in the laboratory

S. No.	Test	Before Treatment	After Treatment
1.	pH	8.2	7.2
2.	TDS	880mg/l	110 mg/l
3.	DO	2.25mg/l	5.56mg/l
4.	BOD	178mg/l	96mg/l
5.	COD	110 mg/l	40mg/l
6.	TURBIDITY	27.6 NTU	8.3 NTU

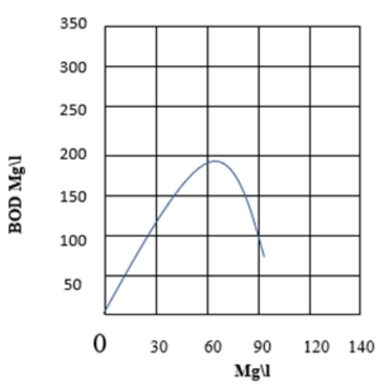

Fig. 1. BioChemical Oxygen Demand (BOD)

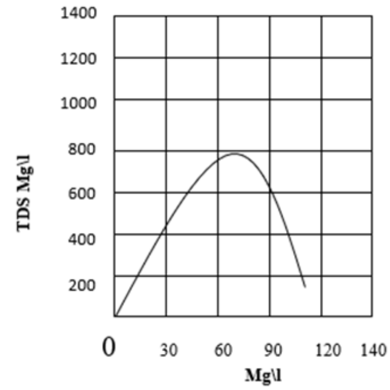

Fig. 2. Total Dissolved Solids (TDS)

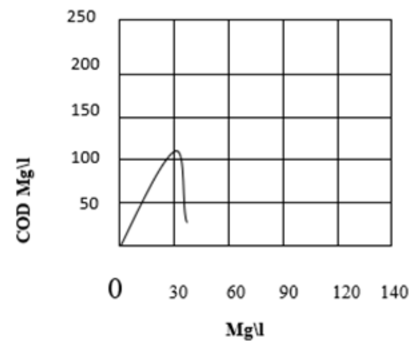

Fig. 3. Chemical Oxygen Demand (COD)

5. Conclusion and Discussion

A. Removal of COD from the Waste Water

Chemical oxygen demand is a measurement of the oxygen required to oxidize soluble and particulate organic matter in water. The COD measurement for the domestic waste water was taken before and after passing through the filter beds. The initial level of COD was measured as 110mg/l.

B. Removal of BOD from the Waste Water

Biological oxygen demand is a measure of, the amount of oxygen that requires for the bacteria to degrade the organic components present in water / waste water. Before treatment the level of BOD is 178 mg/l. After filtration through Flyash bed, the BOD value was decreased to 96mg/l. Higher efficiency attained in the filter bed having least thickness (10mm).

C. Removal of TDS from the Waste Water

A total dissolved solids (TDS) is an important parameter which decides the usage of water. Depends on the TDS value the water can be used for various purposes like agriculture, industrial and drinking. The term total dissolved solids refer to materials that are completely dissolved in water. These solids are filterable in nature. Estimation of total dissolved solids is useful to determine whether water is suitable for drinking purpose, agriculture and industrial purpose. There was a significant fall in TDS concentration before and after the treatment process. Due to the presence of high carbon in flyash the solids present in the wastewater was absorbed. The initial level of TDS was measured and found as 880mg/l. After passing through the filter media, the TDS value was found to be decreased to the range of 110mg/l.

D. pH of Waste Water

The pH value is an important parameter in the operation of biological units. In domestic waste water, organic matters decomposition affected the pH value by lowering it. Generally, the pH of raw sewage is in the range 5.5 to 8.5. The pH value of the untreated sewage wastewater was found as 8.2 which was slightly higher than the water supplied to the community. After filtration process the pH value was reduced upto 7.2.

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