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DOMESTIC WASTEWATER TREATMENT USING FLYASH

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Abstract
Wastewater treatment and disposal are major issues nowadays that require attention in order to safeguard the environment. Fly ash has been tested as an adsorbent for waste water treatment facilities in recent years. A locally produced filter bed was created that might take the place of pricey treatment facilities like granulated activated carbon (GAC) beds and reverse osmosis (RO). The treatment bed is made up of three distinct pebble, river sand, and fly ash layers of varying thickness. It is used to remove contaminants from wastewater effluent, including turbidity, pH, total suspended solids (TSS), total dissolved solids (TDS), and chemical oxygen demand (COD). Turbidity is reported to decrease from 200 NTU to 116–37 NTU. TDS is lowered from 2200 to 1200 parts per million. TSS levels are reduced from 3000 ppm to 900 ppm. The pH is reduced from 8.41 to 7.57. It is also reported that for efficient wastewater treatment, filter medium thickness of 10mm-20mm is advised.

Key words: Fly ash, filter bed, turbidity, chemical oxygen demand, total dissolved solids, total suspended solids, wastewater, treatment and disposal, adsorbent.

1.INTRODUCTION
Water is one of the ecosystem's most abundant natural resources [1]. The Earth has 79% water [1]. Wastewater treatment is a crucial process designed to remove contaminants and pollutants from water generated by various human activities. Wastewater from households and companies has become a major issue for our environment, and it also has a negative impact on humans [2]. As urbanization and industrialization continue to grow, the volume and complexity of wastewater also increase, making effective treatment essential for protecting ecosystems and public health. Water is mostly polluted by the discharge of various effluents from home and industrial trash [3]. The primary goal of wastewater treatment is to eliminate or reduce harmful substances, such as organic matter, nutrients, pathogens, and chemicals, from wastewater to ensure that the discharged water meets environmental standards. This process involves a series of physical, chemical, and biological treatments, each tailored to target specific contaminants and enhance the overall quality of the effluent.

Fig.1 Thermal fly ash

Fly ash is a pulverized fuel ash [4]. It is a coal combustion product that is composed of the particulates that are driven out of coal-fired boilers together with the flue gases. Ash that falls to the bottom of the boiler is called bottom ash. Fly ash contains high carbon content with specific surface area between 2000 to 6800 cm2. It is examined that the fly ash in wastewater treatment is used to remove COD, reduce turbidity, TSS, TDS and pH level.

2.LITERTURE REVIEW

2.1 Dr. Pankaj Singh et al (2014) He researched home wastewater treatment with fly ash. According to the findings of this study, the use of flyash alone or combined in the treatment of residential laundry waste water effluent [4]. Then he got some results. BOD is reduced from 250 mg/l to 10-20 mg/l, TSS is reduced from 350 mg/l to 15-20 mg/l, and pH is reduced from very alkaline to 8.5-9.5 [11].

2.2 Sandeep Thakur et al (2013) He has demonstrated the ability to reduce the amount of surface and ground water consumed for all uses while also replacing fresh water with other sources. According to the author, grey water recycling is a versatile option that can be quite beneficial in water-stressed areas.

2.3 V K Singh et al extracted malathion from aqueous solutions using flyash from a thermal power plant. The amount of malathion eliminated increased as the temperature climbed, indicating an endothermic elimination mechanism. The fly ash exhibited first order rate kinetics and obeyed both the Langmuir and Freundlich isotherm models. The growing Langmuir and Frisch constant values with temperature provided more evidence of the adsorption process's endothermic nature. When the adsorption capacity of fly ash is compared to that of other adsorbents, it can be used to remove malathion from aqueous solutions.

3. METHODOLOGY

3.1 COLLECTION OF MATERIALS AND EFFLUENT

3.1.1 EFFLUENT COLLECTION [5]

Grey water is gathered from several domestic sources. Here, we periodically collected the wastewater from the washing machines and kitchen sinks twice a week for a month.

Fig.2 Washing machine water

Fig.3 Kitchen water

3.1.2 MATERIALS

A. FLY ASH

Fly ash was collected from Rayalaseema Thermal Power Plant [5]. To prepare the filter media, the fly ash was collected and sieved through a 90micron sieve.

B. PEBBLES

The current assumption is that pebbles are smaller than cobbles and larger than granules. Small pebbles, no larger than 10 mm, were employed as the filter material in this investigation. After being cleaned with distilled water, the stones were dried.

C. SAND

Sand is a granular substance that occurs naturally and is made up of finely divided rock and mineral particles. In this investigation, the filtration tank's sand bed was prepared using river sand. just before application, the river sand was filtered using a 2.36 mm sieve.

Fig.4 Pebbles

Fig.5 River Sand

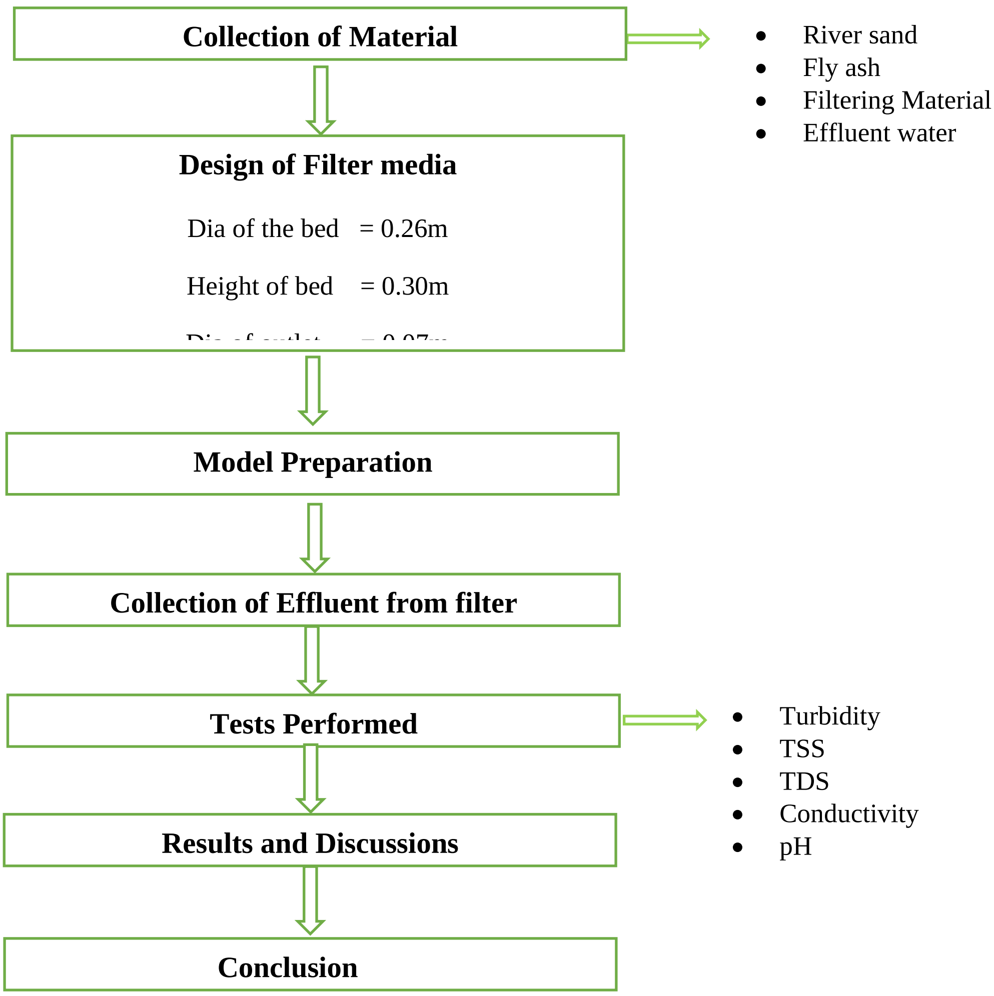

Fig.6 flow chart describes the methodology

4. MODLE PREPARATION

In the laboratory, wastewater treatment plant was made with two drinking water cans assembled on top of one another with 0.0001micron filter paper. Following that, we maintained a metal plate with holes inside the tank to hold the stones and let water in. To treat the grey water, fly ash, pebbles, and river sand are added to the filter medium. Fly ash from thermal power stations was utilized as a low-cost adsorbent to remove pollutants from wastewater [6].

Fig.6 Filter Media

4.1 DESIGN OF FILTER MEDIA

The bed constructions' requirements are as follows:

Dia of the bed = 0.26m
Height of bed = 0.30m
Dia of outlet = 0.07m

4.2 PROCESS OF FILTERATION

The filter bed cleaned effectively at first. Using a 90 micron sieve, fly ash is collected. Fly ash is made up of small, powdery particles that are generally spherical in shape, either solid or hollow, and mostly glassy (amorphous) [7]. The bottom layer's pebbles should be washed well with distilled water and let to dry for a short while in the sun. 2.36 mm size sieve is used as a screen for the river sand. It is necessary to test an untreated effluent to obtain initial Turbidity, TSS, TDS, and pH measurements. Fly ash was utilized as the adsorbent in this investigation because some types of this material have a high adsorptive ability. It is also inexpensive and widely available in most industrial regions [8]. The 10 mm thick bed is first constructed, and the bottom layer is covered with pebbles. Next comes a layer of fly ash, and finally, the top layer is covered in river sand. After that, the bed is filled with the wastewater. It has been tried after a full night has passed. The tests include measuring pH, TDS, TSS, Turbidity, and COD. This process is repeated for the subsequent layers (20, 30, and 40 mm). Lastly, it's important to find out a true thickness where the fly ash will perform effectively.

Fig .7 During Filteration

Fig. 8 Wastewater After Treatment

Table.1 characteristics of waste water before treatment [2]

SI. NO	PARAMETERS	BATHROOM	KITCHEN
1.	pH	8.41	4.83
2.	Turbidity	200 NTU	186 NTU
3.	Total Suspended Solids	2200 mg/l	3000 mg/l
4.	Total Dissolved Solids	3400 mg/l	1900 mg/l
5.	COD	500 mg/l	700 mg/l
6	Conductivity	3.8 mS	3.2 mS

To determine the sample's physical and chemical characteristics, the following tests were carried out on it:

5. TESTS CONDUCTED

5.1 TDS

Calibrate your conductivity meter with standard solutions of known TDS levels. Collect a representative water sample. Ensure the conductivity meter is clean and in good working condition. Calibrate the meter using the standard solutions according to the manufacturer's instructions. Immerse the conductivity probe into the water sample. Allow the reading to stabilize. Use the calibration curve or factor provided by the manufacturer to convert conductivity readings to TDS measurements. Record the TDS measurement along with relevant details such as sample location and date.

5.2 TSS

Collect a representative water sample using a clean container, avoiding contamination. Filter the sample through a pre-weighed glass fibre filter to capture suspended solids. Dry the filter and solids in an oven at a specified temperature until a constant weight is achieved. Weigh the filter and dried solids to determine the mass of suspended solids. Calculate TSS concentration using the formula

5.3 TURBIDITY

Turbidity is based on the comparison of the intensity of light scattered by the sample under defined conditions with the intensity of the light scattered by a standard reference suspension under the same conditions. The turbidity of the sample is thus measured from the amount of light scattered by the sample taking a reference with standard turbidity suspension. The higher the intensity of scattered light the higher is the turbidity. Formazin polymer is used as the primary standard reference suspension.

5.4 pH

Ensure your pH meter is calibrated using buffer solutions of known pH values. Prepare the sample you want to test. It should be at room temperature for accurate results. Rinse the pH electrode with distilled water and gently blot it with a clean tissue to remove any contaminants. Immerse the clean electrode into the sample without touching the container walls. Allow the reading to stabilize, usually within a few seconds. Stir gently if needed. Once stabilized, record the pH reading from the meter display. Rinse the electrode with distilled water between measurements to avoid cross-contamination. After use, store the electrode in a storage solution recommended by the manufacturer.

5.5 CONDUCTIVITY

Ensure the conductivity meter is calibrated and in good working condition. Prepare a representative sample of the substance or solution to be tested. Calibrate the conductivity meter using standard calibration solutions of known conductivity. Immerse the conductivity probe into the sample, ensuring good contact. Record the conductivity reading once it stabilizes. If necessary, repeat the measurements for accuracy, especially if dealing with variable samples. Clean the conductivity probe between measurements to prevent cross-contamination. Analyse the results and compare them to standards or specifications.

6.RESULT&DISCUSSION

Table.2 characteristics of waste water before treatment & After treatment

Parameter	Before Treatment	After Treatment			
		10 mm	20 mm	30 mm	40 mm
Turbidity	200	116	37	55	78
TSS	3400	200	350	800	1600
TDS	2000	999	1165	1332	1665
pH	8.41	7.94	7.57	7.54	7.63

6.1

TURBIDITY

The cloudiness or haziness of a fluid caused by the presence of suspended particles such as sediment, silt, or other fine particles is referred to as turbidity. It is a measure of the reduction in a liquid's cleanliness or transparency caused by light reflected or absorbed by these particles. Turbidity is 200 NTU before treatment. The turbidity value is reduced to 37 NTU in a thickness of 10mm after treatment. It is apparent that the true thickness is 10-20mm.

6.2 TOTAL SUSPENDED SOLIDS

A measurement of the number of solid particles suspended in water is called total suspended solids, or TSS. Among those particles are silt, organic debris, sediment, and other fine particles that float in the water instead of dissolving. TSS is 3400 mg/l before treatment. The TSS value is reduced to 200 mg/l in a thickness of 10mm after treatment. It is apparent that the true thickness is 10-20mm.

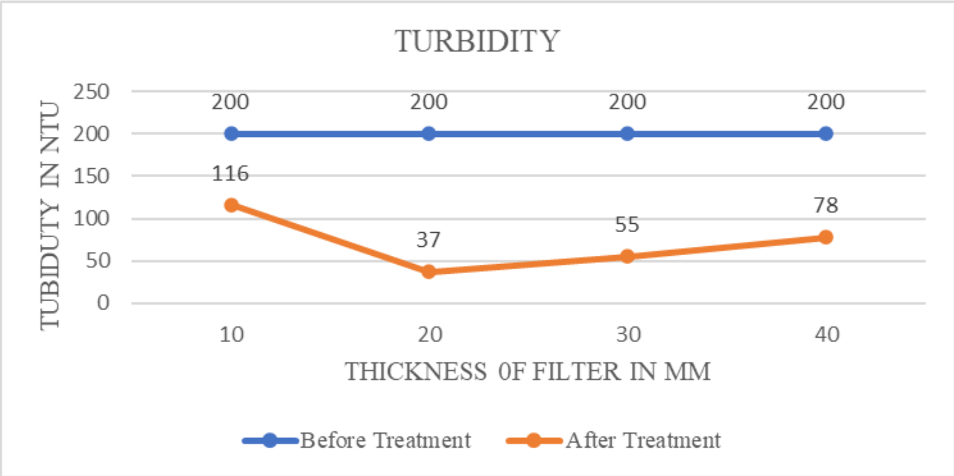

Fig.9 Quantity of Turbidity before and after treatment

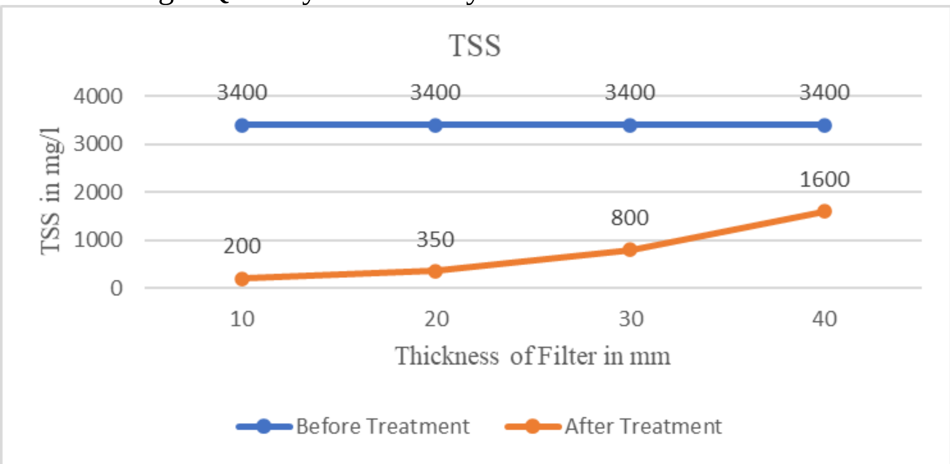

Fig.10 Quantity of TSS before and after treatment

6.3 TOTAL DISSOLVED SOLIDS

The total amount of all inorganic and organic materials in a liquid that have dissolved is known as total dissolved solids. These materials may consist of dissolved chemical compounds, metals, salts, minerals, cations, and anions. TDS is 2000 mg/l before treatment. The TDS value is reduced to 999 mg/l in a thickness of 10mm after treatment. It is apparent that the true thickness is 10-20mm.

6.4 pH

The concentration of hydrogen ions (H^+) in a solution is indicated by the pH scale, which measures the acidity or alkalinity of a solution. Generally speaking, the pH scale has a range of 0 to 14, with **7** regarded as neutral. Acidity is shown by values below 7, where lower numbers denote stronger acidity, while alkalinity is indicated by values above 7, where higher numbers denote greater alkalinity. Because the pH scale is logarithmic, a tenfold change in acidity or alkalinity is represented by each unit change. The pH level reductions in the subsequent layers are listed in the table below.

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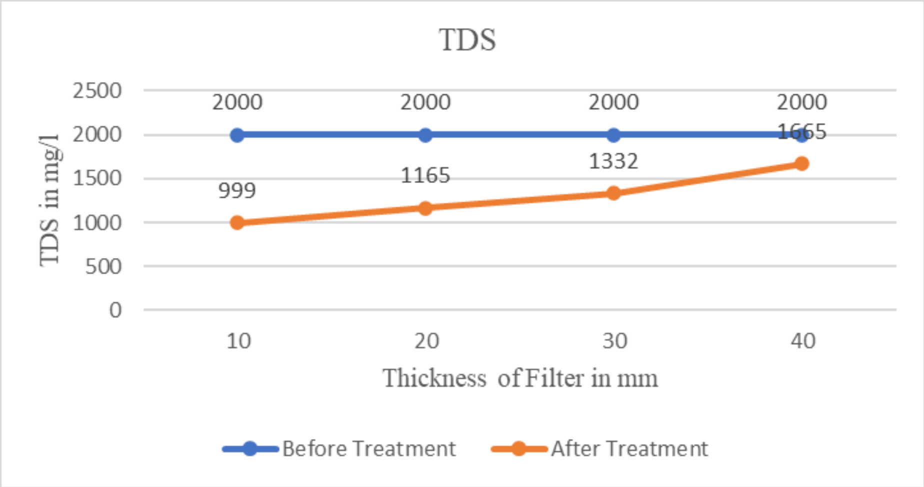

Fig.11 Quantity of TSS before and after treatment

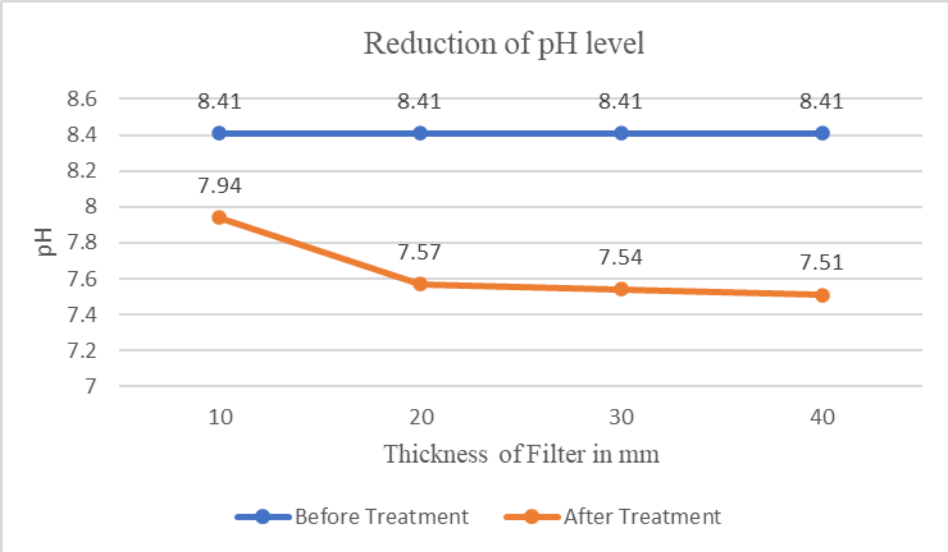

Fig. 12 pH level before and after treatment

7.The characteristics of effluent after a week of treatment

We conducted a waste water treatment experiment in which we converted waste water into pure water. The cleansed water was next tested and the report was obtained. We tested the same water after one week and received the report.

Table 3 Physio- chemical properties of the effluent

Sl.NO	First day Treatment	After week Treatment
Turbidity	116 NTU	132 NTU
TSS	200 mg/l	250 mg/l
TDS	999 mg/l	1050 mg/l
pH	7.94	7.34

8.CONCLUSION

Based on the experimental data, the following conclusion is obtained. Because of its high porosity and adsorption capacity, coal fly ash bed is a low-cost and effective method for removing turbidity, TSS, TDS, and pH. It is widely available. Here We did a wastewater experiment in which we transformed waste water into pure water using coal fly ash particles. The cleansed water was treated with a fly ash layer with thicknesses ranging from 10 mm to 20 mm, 30 mm to 40 mm. Some experiments yielded the best results at 10mm thickness, while others yielded the best results at 20mm thickness. As a result, we believe that accurate results can be produced in the 10-20 mm thickness range. Here on we conclude that the treated water can be used for a week . After a week this water is not that effective for reusing in activities like watering gardens, fire hydrants, field irrigation, etc.

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