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ASSESSMENT AND COMPARATIVE ANALYSIS OF TREATMENT OF SULLAGE WATER USING FLYASH, ZEOLITE AND PEBBLES

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ABSTRACT
The organic pollutant present in the water is the major concern in the society due to their toxcity and human hazards which is very big threat to human life as well as the environment. It is true that these pollutants can damage our sense organs and could retard the functioning of essential enzymes. We can improve the quality of water with the help of effective adsorbents with larger surface area, high porosity and more specific adsorption sites.Thus we can purify the sullage water with major prospective agents by analysing and comparing the impurities present in the water with the help of two fillter beds:One is a combination of fly ash along with pebbles in which fly ash is plentiful and available in the form of trashes in thermal power plant and pebbles as low cost filter bed: And the other filter media which contains pebbles and zeolite in which Zeolite is a microporous aluminosilicate minerals and very good absorbents that removes the permanent hardness in the sullage water and can convert into portable water by removing all toxicants present in it.

1. INTRODUCTION
Sullage water is known as the grey water which contains all organic,inorganic and heavy metal waste except the night soil . Water pollution occurs when pollutants are discharged directly or indirectly into water bodies without proper treatment. Grey water or foul water is all waste water generated in households or office building from streams without fecal contamination. **Fly ash** is one of the residues generated in combustion from thermal power plant that comprises of fine particles that helps in better filtration by the low cost filter media set up.Fly ash particles are generally spherical in shape. The fly ash in waste water treatment is used to remove organics, colour and heavy metals. **Zeolite** mined by Ida Ore can be used for water **filtration** and softening and Pebble's physical properties make it among the finest available in the world for water filtration applications.

2.PREPARATION OF FLYASH FILTER MEDIA

The filter media consists of three parts such as bottom layer consists of filter paper above that angular pebbles are placed for 5cm thickness and toplayer consists of 30 μ m sieved fly ash filled for 10cm thickness in the container.The pH,TDS,DO,COD,BOD etc can be reduced by increasing the thickness of fly ash layer.Due to high carbon content fly ash act as powerful adsorbent.

3.PREPARATION OF ZEOLITE FILTER MEDIA

The clinoptilolite zeolite in the form of crumbles are compacted well with compaction rod into a fine powder .The filter media consists of three layers.The bottom most layer consists of filter paper accompanied by pebbles placed for 5cm thickness,above the pebbles 30 μ m zeolite bed filled for 5cm thickness. The filter bed consists of clinoptilolite zeolite that appear as cation exchangers will help in ionisation reaction to occur in sullage water for the best purification to occur due to its aluminosilicate tetra hydra structure.
The filter bed consists of adequate inlet and outlet for proper filtration and penetration of sullage water through the three layers.

4. OBJECTIVE AND SCOPE OF THE REVIEW

OBJECTIVE

- To reduce the organic,inorganic and heavy metals impurities from sullage water by fly ash and zeolites used as filter media.
- To prepare and analyse low cost filter media removal of impurities.
- To compare the properties of treated sullage water.
- To convert the sullage water into portable water with improved quality of water.

SCOPE

- The fly ash reduces toxicity and heavy metals in waste water effluent
- The quality of water improves and can be used as portable water
- Zeolites reduce the permanent hardness of the sullage water effectively due to its micro porous structure.

5.STANDARDS OF PORTABLE WATER

PARAMETERS	DESIRABLE	MAXIMUM
Colour	5	25
Odour	Unobjectionable	------
Taste	Agreeable	------
Turbidity	5	10

pH value	6.5	7.5
Total hardness	300	600
Chlorides	250	1000
Sulphates	200	400
Iron	0.3	1.0
Total dissolved solids	<	300
BOD	3	5
COD	<	5

6.STANDARDS OF SULLAGE WATER

PARAMETERS	DESIRABLE	MAXIMUM
pH value	7.75	8.75
Turbidity	56.30	195.00
BOD	50	100
COD	60	200
Total hardness	104.00	320.00
Chlorides	175.23	234.10
Sulphates	59.30	68.23
Oil and greese	1000	2309.00
Iron	--------	3
Total dissolved solids	500	800

7.MATERIAL COLLECTION

7.1FLY ASH : Fly ash is a pulverized fuel ash. Fly ash contains high carbon content with specific surface area between 2000 to 6800 cm2. It is examined that the fly ash in waste water treatment is used to remove COD, reduce TSS, TDS and pH level.

FIG.1 FLY ASH

7.2CLINOPTILOLITE ZEOLITE: Natural zeolites are environmentally and economically acceptable hydrated aluminosilicate materials with exceptional ion-exchange and sorption properties. The unique three dimensional porous structure gives natural zeolites various application possibilities. Because of the excess of the negative charge on the surface of zeolite, which results from isomorphic replacement of silicon by aluminum in the primary structural units, natural zeolites belong to the group of cationic exchangers. The use of natural zeolites in wastewater treatment is one of the oldest and the most perspective areas of their application. The presence of heavy metals (Zn, Cr, Pb, Cd, Cu, Mn, Fe, etc.) in wastewater is a serious environmental problem and their removal by natural zeolites have been extensively studied along with other technologies, including chemical precipitation, ion exchange, adsorption, membrane filtration, coagulation flocculation, flotation and electrochemical method.

FIG.2 CLINOPTILOLITE ZEOLITE

7.3PEBBLES:
Pebbles are used in various water treatment and filtration applications. Natural pebbles can be provided in various sizes as per requirement.Water filter pebbles is composed of sub-angular, hard, durable, and dense grains of
predominately siliceous material.

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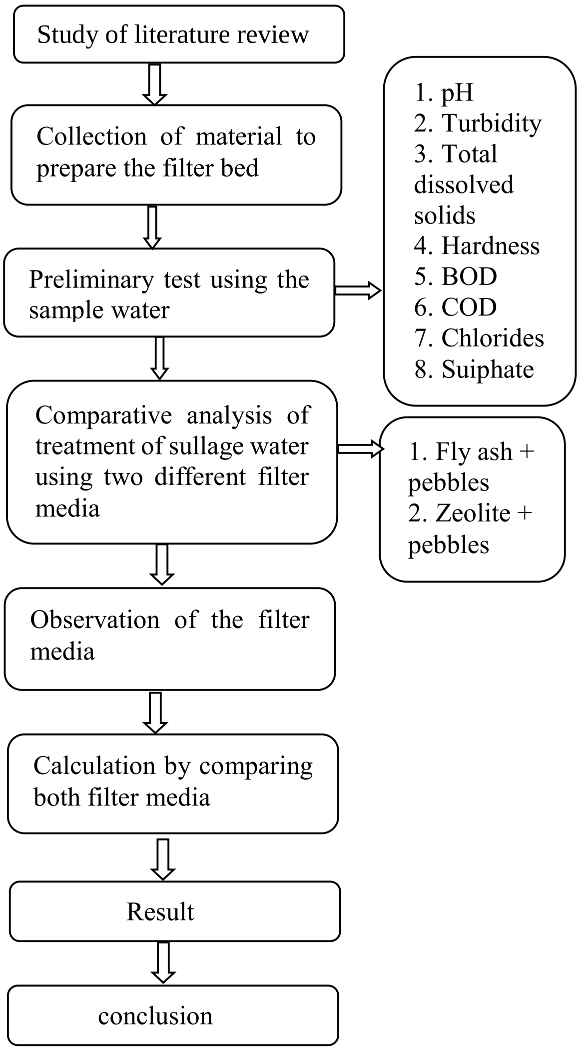
FIG.3 PEBBLES

8.METHODOLOGY



9.EXPERIMENTAL METHODS

9.1 Determination of pH

pH is measured by a meter using a glass electrode which generates a potential varying linearly with the pH of the solution in which is immersed. The basic principle of electrometric pH measurement is determined of acidity of hydrogen electrode of a reference electrode.

The pH value is determined also by using litmus paper and it is found by dipping the litmus paper in the sample and allowed them to dry for 2 minutes. This method may used to find the obsolute value of the sample. This litmus paper may show the changes of colour variation when the paper dipped in the acidic or basic samples. For the determination of pH value the litmus paper is immersed in the sample and allowed to dried the paper and obtained colour variation is compared with the limus colour chart and obsolute value of the pH can be determined. The obtained pH value of raw tannery effluent is 9 it shows the greenish blue colour appearence.

FIG.4: pH METER

9.2 Determination of Turbidity

When light is passed to a sample having suspended particles, the scattering of the light are absorption of light is generally proportional to the turbidity. The turbidity of the sample is thus measured from the amount of light is scattered by the sample taking a reference with standard turbidity suspension.

FIG.5: TURBIDITY METER

9.3 Determination of Hardness

Take the sample of 20ml in a conical flask and add 2ml of ammonia buffer solution. Adding Erichrome Black T indicator followed by buffer solution and the solution becomes wine red in colour. Titrate the above solution against EDTA Solution taken in a Burette. The end point is the appearance of blue colour. If there is no blue colour present after titrating then the sample is free from Hardness.

9.4 Determination of Sulphate

Take the sample of 100ml in a conical flask and add 1ml of concentrated hydrochloric acid and 1ml of distilled water in the sample. Mix the sample well and boil the sample until it gets to 50ml. After the sample gets cooled add 2ml of Barium chloride in it .Then the sample is filtered with the filter paper. Take the residue in the filter paper is place in the dish, and then dish is placed in the muffle furnace and heated to 550° temperature at 30 min. Take out the dish and cool the dish at room temperature then weight the dish as W2. Then weight the dish as (W2-W1).

9.5Determination of Chlorides

Take the sample of 50ml of sample is pipetted out into a clean conical flask. One or two drops of potassium chromate indicator is added to it. The solution turns in yellow in colour and it is titrated against silver nitrate taken in the burette. The end point is the change of yellow into reddish brown colour. The titration is repeated to get the concordant value.

9.6 Determination of BOD

The dissolved oxygen content of the sample is determined before and after 5 days incubation. The amount of oxygen depleted is calculated as BOD. Sample devoid of oxygen are containing less amount of oxygen is diluted several times with a special type of oxygen dilution water saturated with oxygen, in order to provide sufficient amount of oxidation.

Take the sample, dilute it with dilution water. Take the diluted samples in 2 BOD bottles. Immediately find DO of the diluted waste water sample and dilution water. Incubate the other 2 BOD bottles for 5 days. They are to be tightly stopper to prevent any air entry into the bottles. Determine the dissolved oxygen content the bottles at the end of 5 days.

9.7 Determination of COD

After dilution of 10ml of sample in a COD bottle and add 1 pinch of mercury sulphate and 1 pinch of silver nitrate into it. Add 5 ml of potassium dichromate solution to the above solution. Add 5 ml of conc. Sulphuric acid in it. Allow the solution in the room temperature for some time. Heat the solution for 2 hours in the COD apparatus. After cooling add 40ml of distilled water into it. Titrate the solution against the ferrous ammonium sulphate as indicator. The end point is the appearance of wine red colour. Repeat the same procedure for blank solution.

9.8 Determination of total dissolved solids

In the initial stage of the process is to taken the dry weight of the crucible which is available in the labarotory, then filter the sample by using the filter paper and then take the 20ml of the sample in the crucible, it should be kept it in muffle furnace (103 to 105°C) temperature after that kept the sample in the dessicator for cooling, finally measure the final weight of the dish.

Total dissolved solid (mg/l) =

(final weight of dish – initial weight of the dish)× 1000×1000 /volume of the sample taken

10. RESULT AND DISCUSSION

The following tables explains the values obtained from the treatment of sullage effluent by using fly ash, pebbles as filter media 1 and zeolites and pebbles as filter media 2.

Comparative analysis and Characteristics of treatment of sullage water using two filter media shown in table 3:

Table 3: Treated values of sample 1

S.NO	Parameter	RS	TF	TZ
1	pH	8.0	7.5	6.5
2	Turbidity (NTU)	67.9	5.62	5.1
3	Hardness (mg/l)	735	453	256
5	TDS (mg/l)	567.56	256	157.6
6	BOD (mg/l)	80.2	3.26	2.5
7	COD (mg/l)	53.6	4.26	3.32
8	Chloride (mg/l)	935	500.3	309
9	Sulphate (mg/l)	518.8	316.5	250

RS-Raw sample,TF-Treated with Fly ash, TZ-Treated with zeolite

Table 4: Treated values of sample 2

S.NO	Parameter	RS	TF	TZ
1	pH	8.0	7.0	7.0
2	Turbidity (NTU)	65.0	5.40	5.09
3	Hardness (mg/l)	809	430	236
5	TDS (mg/l)	616.9	270.5	142
6	BOD (mg/l)	87.6	3.52	2.26
7	COD (mg/l)	65.47	5.03	4.99
8	Chloride (mg/l)	986	499.7	286
9	Sulphate (mg/l)	521.8	318.5	235

RS-Raw sample,TF-Treated with Fly ash, TZ-Treated with zeolite

Table 5: Treated values of sample 3

S.NO	Parameter	RS	TF	TZ
1	pH	9.5	8.5	7.0
2	Turbidity (NTU)	65.0	5.45	5.0
3	Hardness (mg/l)	795	420	231
5	TDS (mg/l)	655	275.3	145
6	BOD (mg/l)	76.6	3.46	3.1

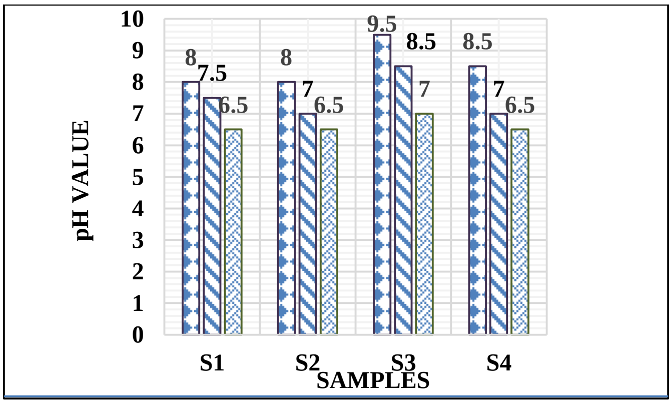
7	COD (mg/l)	55.9	4.15	2.9
8	Chloride (mg/l)	969	490.73	302
9	Sulphate (mg/l)	515	313.5	230

RS-Raw sample,TF-Treated with Fly ash, TZ-Treated with zeolite

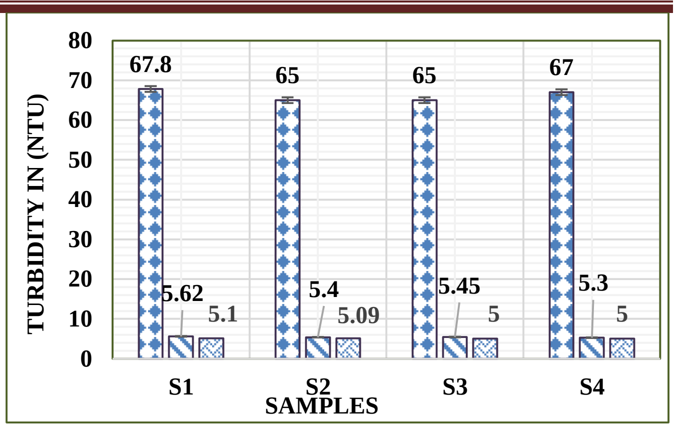
Table 6: Treated values of sample 4

S.NO	Parameter	RS	TF	TZ
1	pH	8.5	7.5	6.5
2	Turbidity (NTU)	67.0	5.30	5.0
3	Hardness (mg/l)	751	509	309
5	TDS (mg/l)	689.15	285.3	190.3
6	BOD (mg/l)	78.30	3.47	2.9
7	COD (mg/l)	61.36	4.7	2.65
8	Chloride (mg/l)	909.5	494.1	299
9	Sulphate (mg/l)	525.80	319.2	226

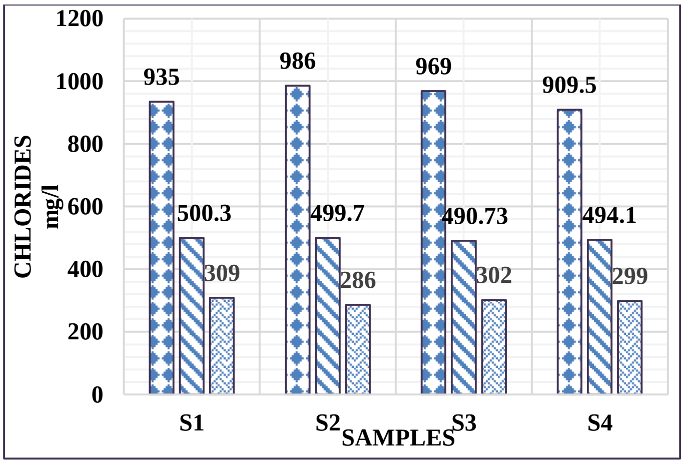
RS-Raw sample,TF-Treated with Fly ash, TZ-Treated with zeolite



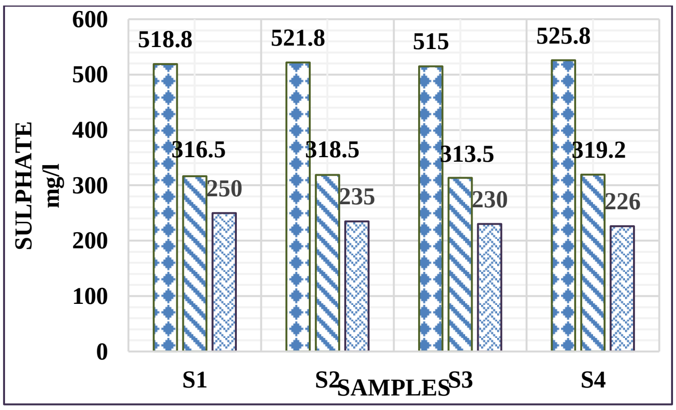
Graph No. 1 Determination of pH



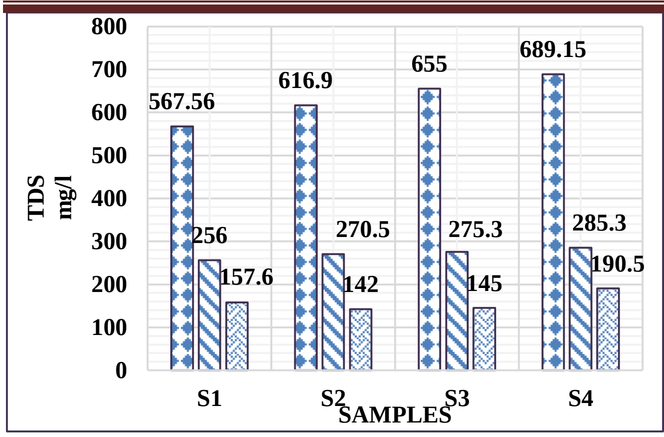
Graph No. 2 Determination of turbidity



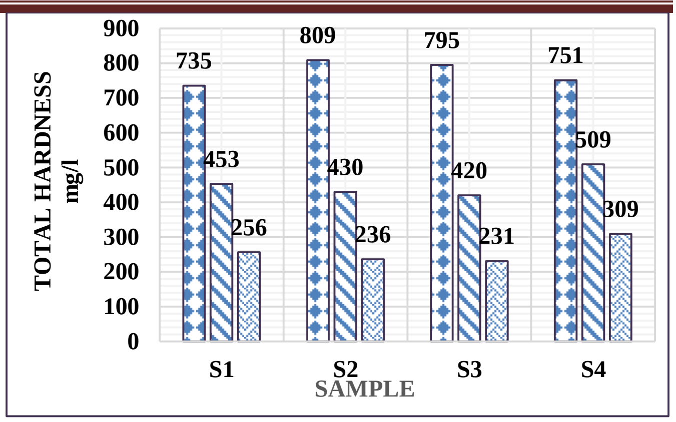
Graph No. 3 Determination of chloride



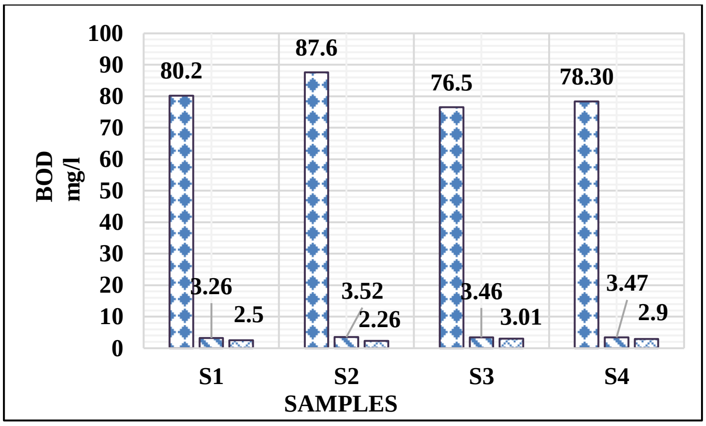
Graph No. 4 Determination of Sulphate



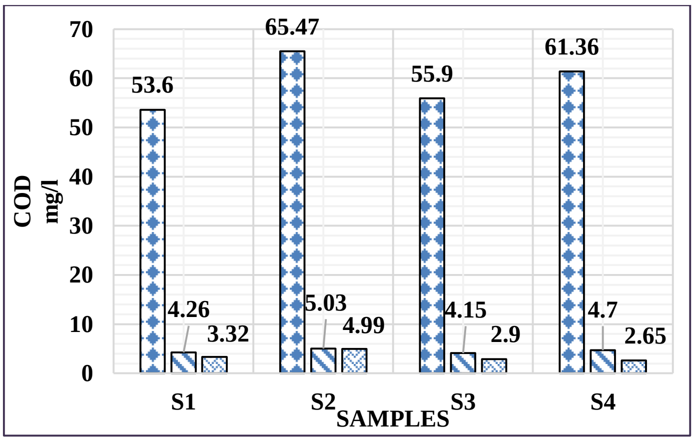
Graph No. 5 Determination of TDS



Graph No. 8 Determination of Total Hardness



Graph No. 6 Determination of BOD



Graph No. 6 Determination of COD

11. CONCLUSION

The treatment process carried out for the different samples shows the effectiveness of physical and chemical process. A wide range of samples were used to check the performance of the treatment unit in treating samples of completely different nature. The results of the various tests were compared with the permissible limits specified in IS 10500:2012 standards .The results were conforming to the specifications. Hence this treatment is found to be performing as was intended, thus making this project a success. The treated sullage water was found to be useful for potable purpose. This unit made even more efficient by making the treatment processes a continuous one.

From the experimental results an attempt is made to compare both the chemical and physical methods of treatment of both filter media. For physical methods of treatment, as the depth of the filter bed is increased, percentage removal is higher. Hence for comparison, the percentage removal corresponding to a filter bed1 of height 25 cm is considered and filter bed 2 consists of height 15cm. The natural materials have higher percentage removal of COD and BOD .For oil and grease removal, all the methods of treatment had almost same removal efficiency.

The natural materials can be easily applied in the field for treating sullage effluent, which will facilitate the use of water for potable purpose. Fly ash which is available as a residue in coal fed thermal power plants can be efficiently used for the treatment of sullage waste water. When Fly ash is used as filter bed of 10cm thick, the parameter value reduced down to more than 75% from the initial value. The use of clinoptilolite zeolite as powerful adsorbents helps exceptional ion-exchange and sorption properties due to its tetrahedral aluminosilicate structures. Their effectiveness in different technological processes depends on their physical-chemical properties.

This helps in proper filteration of water by penetrating through the filter media with very good adsorption capacity. Physical properties of pebbles makes it among the finest available in the world for water filtration applications.

Thus both the filter media helps in the low-cost purification of the sullage water that triggers the quality of water. The filter media 2 that consists of zeolite and pebbles was found to be the best one compared to the filter media 1 due to the better sorption and ionization properties.

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