International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 5 May 2023, pp: 983-988 www.ijaem.net ISSN: 2395-5252

Waste-Water Treatment Using FlyAsh and Wood Ash as an Adsorbent-A Comparative Study

[1]Adarsh S, [2]Manasa M P, [3]Bhaskar C, [4]Tejas Gowda R, [5]Tejashwini M S, [6]Manu Preethu

[1,2]*Assistant Professor*
[3,4,5,6] *Students*
Department of Civil Engineering,
VidyaVikas Institute of Engineering and Technology, Mysuru, Karnataka, India.

Date of Submission: 15-05-2023 Date of Acceptance: 30-05-2023

ABSTRACT: An experimental investigation was carried out for the treatment of sewage wastewater using low cost adsorbent. The fly ash and wood ash were used as adsorbent in this Study. Experiments were conducted on a filter media that was prepared with pebbles, sand, flyash and wood ash with 12cm thickness, characterized and used for the removal of impurities. The physico-chemical properties of waste-water before and after treatment were examined.

The present study investigates that successful use of low cost adsorbent like flyash and wood ash which are basically the discarded wastes from incineration or combustion from power plants and are readily available in the market as a source for the treatment of waste-water for various parameters like pH, TDS, TSS, BOD, COD & Turbidity. The results showed that the pH was reduced to 7.3 and 8.5for fly ash and wood ash from 9.2, The BOD and CODremoval was observed to be 71.52%, 65.42% and 81.42%, 56.93% for fly ash and wood ash respectively. TDS and TSS removal was observed to be 86.25%, 83.75 % and 93.58%, 92.15%for fly ash and wood respectively. There was a superficial increase in the Turbidity level by 91.64% and 85.36% for fly ash and wood ash respectively. The concept of utilizing fly ash and wood ash has proved to optimize the quantity of impurities in wastewater and an effective, Economical method to treat the wastewater.

KEYWORDS: Fly ash, Wood ash, Waste-water, Physico-Chemical Parameters, Adsorbent.

I. INTRODUCTION

Water is one of the universal substances, which is used by all the living species to sustain life. Clean and plentiful water provides the foundation for prosperous life and communities. Water covers about 71% 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 and therefore potentially accessible for human use such as drinking to prepare food, washing clothes, and necessary functions which water is a major component[3] [8].

Due to brisk industrialization growth, the waste effluent is discharged directly into river water causing pollution to the environment [1] [5].Wastewater pollution is one of the critical problems that the world is facing in this era. Water quality is extremely important because constant access to good quality water is necessary for life as well as the economy. Water is the major abundant natural resources of the ecosystem. The planet earth is having 79% of water. In India, major problem leading to waste pollution is increasing population, industrialization and urbanization. The entire living organism in the environment requires water for their growth and development. Water pollution occurs when the pollutants are discharged directly or indirectly into water bodies without adequate treatment. Collection, treatment and disposal of domestic and industrial wastewater are the serious issues to be handled for preventing damage to the environment. Water is mainly polluted by discharging effluents from domestic, industrial waste [2].

International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 5 May 2023, pp: 983-988 www.ijaem.net ISSN: 2395-5252

Fly ash is a pulverized fuel ash which is an industrial by product from thermal power plants and steel industries which is composed majorly of fine particles[2] [4] [6][7] [8]. In recent years, utilization of fly ash has gained much attention in public and industry, which will help to reduce the environmental burden and enhance economic benefit. The technical feasibility of utilization of fly ash as a low-cost adsorbent for various adsorption processes for removal of pollutants in air and water systems has been studied by various researchers [9].

There are many techniques in practice to treat the wastewater, in the present study; an attempt has been made to examine the application of low cost adsorbents like Fly ash and Wood ash for the treatment of wastewater from local Sewage Treatment Plant Mysuru, Karnataka, India and also to evaluate the adsorbent efficiency and to compare resul to f both the adsorbents which is more effective in removal of impurities.

II. MATERIALS AND METHODOLOGY

Effluent Collection

Waste-water Sample as shown in figure 1 were collected by grab sampling method in plastic cans from sewage treatment plant located in ringroad near manipal hospital located in Mysuru-Bengaluru
Highway. Collected samples seem to be highly polluted and have high concentration of Turbidity, BOD, COD, TSS, TDS, pH and the dissolved oxygen level would be saturated.

Figure 1: Sample Collection Location

Fly ash and Wood ash

Fly ash and Wood ash as shown in figure 2 and 3 were collected from nearby local vendors. The collected flyash and wood ash was kept in oven dried at 105° to110^0 C for 24 hours and sieved through 90 micron sieve before preparing the filterbed. The chemical composition of the flyash was shown in below table 1.

Figure 2: Fly ash

Figure 3: Wood ash

Table 1: Flyashchemicalcomposition

Chemicalsbyweight	**%byweight**
Potassiumoxide	0.85
Alumina	27.50
Calciumoxide	3.67
Sodiumoxide	0.18
Magnesiumoxide	0.35
Ironoxide	1.23
Sulphurtrioxide	0.01
Titaniumdioxide	1.84
Silica	63.53

Pebbles

In this present study small size (maximum 10 mm) pebble was used is the filter media as shown in figure 4. The pebbles were washed with distilled water and dried. Sand and gravel make good water filters because they form permeable layers. When comparing the rate of flow between different filters, it is the generally found that the tighter the spaces in the filter, the slower the flow of water. These small spaces cause tiny dirt particles to be trapped in the filter media.

Figure 4: Pebbles

River sand

Sand is a naturally occurring granular material composed of finely divide rock and

International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 5 May 2023, pp: 983-988 www.ijaem.net ISSN: 2395-5252

mineral particles. It is most common constituents of sand is silica which is in form of quartz. A layer of sand is also used in the filter media to make the effective as it passes through several physical and biological processes filter the water and eliminate the contaminants. The sand as shown in figure 5 which is passing through 2.36 mm sieve and retained on 600µ IS sieve is taken for the study purpose and project purpose.

Figure 5: River Sand

III. Experimental Method

Treatment of waste-water carried out in the laboratory using a reactor made up of Glass container of 10 Litre capacity width placed with a filter mesh of less than 0.0001 micron size as shown in figure 6. The dimension is as shown in figure 7 of the reactor is 68 cm depth and 30 cm width to accommodate Fly ash, sand, and pebblesas filter media for treating the waste-water.

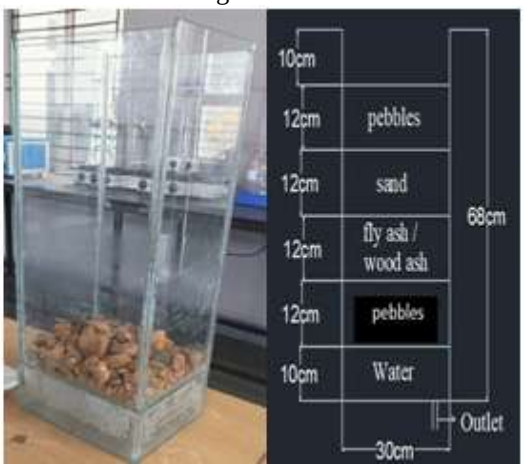

Figure 6: Filter Reactor **Figure 7:** Reactor Design

Preparation of Fly Ash and Wood Ash Filter Bed

The flirtation bed is the designed for the effluent effective treatment and for impurities removal. The filter bed has inlet and outlet point. Initially the filter bed consists of three layers. The first and the bottom layers are pebbles. The second layer is flyash/wood ash and the third layer is sand. The filter bed comprises and, pebbles, and fly ash/wood ash. The sand and pebbles will make the filter bed more effective. The fly ash medium is sandwiched between the layers of pebbles and sand to get beneficial results. Fly ash/wood ash was made as a filter bed of 12cmthick. The thickness of the each layer is similar. Fly ash/wood ash acts as an adsorbent as it contains high carbon content.

Procedure for Treatment of Wastewater using Fly Ash and Wood Ash as Filter Bed

Initially, the container is cleaned well and the fly ash/wood ash are sieved in 90micronISsieveandtakenup.Thepebbleswhicharepl acedinthebottomandtoplayerare washed with distilled water and dried in the sunlight for few minutes. The river sand which is passing through 2.36mm and retained on 600µm IS sieve is taken. It is placed in second layer the experimental setup is as shown in figure 8 and 9.The untreated effluent is tested to get initial readings of COD,BOD,TSS,TDS,pHand turbidity. The thickness of each layer is 12cm.Laying bottom layer with pebbles then layer of fly ash or woodash, above the adsorbents the sand is placed and the to player is of pebbles, each layer has 12cmthick.Belowtheadsorbents Cytiva What man filter paperis placed. Then the effluent is poured into the bed. The filtered water from the bed is collected and tested for COD, BOD,TSS,TDS, pHand Turbidity. Finally the result of both the adsorbents is compared to findout the efficiency in purification of waste-water.

Figure 8:FilterBed **Figure 9**: FilterBed using FlyAshusingWoodAsh

IV. RESULTS AND DISCUSSION

Table 2 shows the parameters and methodology used to conduct experiment of waste-water sample.

Table 2: Wastewater Parameters and Methodology

International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 5 May 2023, pp: 983-988 www.ijaem.net ISSN: 2395-5252

Sl No	Parameters	Experimental Method
1	pH	Instrumental
2	Turbidity	Instrumental
3	Totaldissolvedsolids	Gravimetric
4	Totalsuspendedsolids	Gravimetric
5	Chemicaloxygen demand	Colorimetric
6	Biologicaloxygen demand	Winkler Method

Experimental Results using Fly ash as Adsorbent

Table 3 depicts the experimental results that are obtained before and after the treatment of waste water using fly ash as adsorbent.

Table 3: Experimental Results using Fly ash as Adsorbent

Parameter	Initial Characteristics before Treatment (mg/L)	Final Characteristics after Treatment(mg/L)
pH	9.2	7.23
Turbidity	95.6	8
TSS	1400	90
TDS	800	110
COD	650	120
BOD	400	115

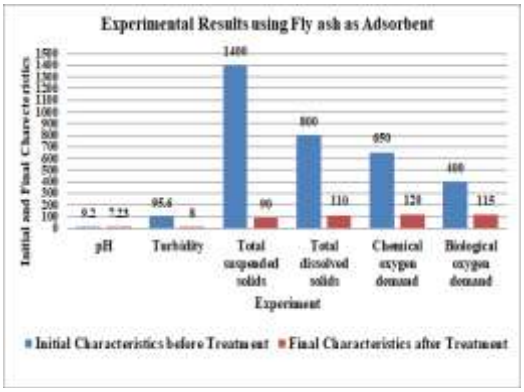

Figure 10: Plot showing Initial and Final Characteristics of various parameters using Fly ash as adsorbent.

Figure 10 depicts the plot of initial and final characteristics of various parameters where we can see that there is constant reduction in impurity level of wastewater and simultaneously increase in treatment efficiency after the treatment with fly ash as adsorbent, by the above results senses that the good amount of reduction of the impurities in waste water is achievedinthe12cmbedthicknessofflyash.

Table 4 depicts the experimental results that are obtained before and after the treatment of waste water using wood ash as adsorbent.

Table 4: Experimental Results using Wood ash as Adsorbent

Parameter	Initial Characteristics before Treatment (mg/L)	Final Characteristics after Treatment(mg/L)
pH	9.2	8.5
Turbidity	95.6	14
TSS	1400	110
TDS	800	130
COD	650	280
BOD	400	140

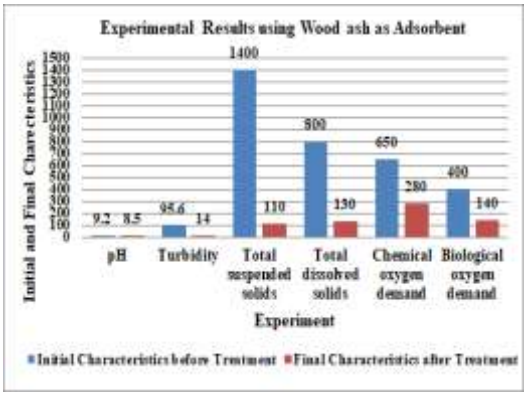

Figure 11: Plot showing Initial and Final Characteristics of various parameters using Wood ash as adsorbent.

Figure 11 depicts the plot of initial and final characteristics of various parameters where we can see that there is constant reduction in impurity level of wastewater and simultaneously increase in treatment efficiency after the treatment with wood ash as adsorbent, by the above results senses that the good amount of reduction of the impurities in waste water is achieved in the12cm bed thickness of woodash.

Comparative Experimental Results using fly ash and Wood ash as Adsorbent

Table 5 shows the comparative results of percentage reduction of contaminants in the waste-water that is treated using flyash and woodash.

Table5: The percentage reduction of impurities

International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 5 May 2023, pp: 983-988 www.ijaem.net ISSN: 2395-5252

Parameter	Fly Ash	Wood Ash
pH	85.24%	75.23%
Turbidity	91.64%	85.36%
TSS	93.58%	92.15%
TDS	86.25%	83.75%
COD	81.54%	56.93%
BOD	71.52%	65.42%

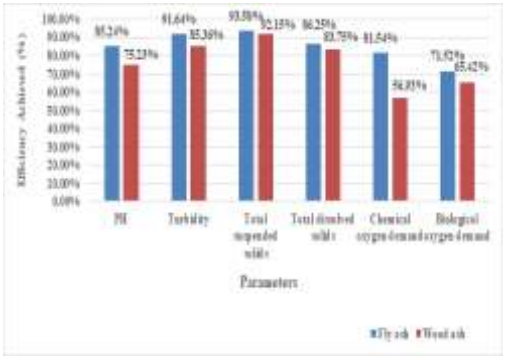

Figure 12: Plot showing Percentage of Efficiency Achieved of Various Parameters using Fly ash and Wood ash as Adsorbent

Fig 12 depicts Percentage of Efficiency Achieved of Various Parameters using Fly ash and Wood ash as Adsorbent. The percentage reduction of the impurities is more in flyash as compared to wood ash, by this we can say that the fly ash is more effective inpurifying the waste-water than the woodash.

V. CONCLUSION

Based on the experimental results the following conclusions were drawn.

- The parameters such as P^H, TSS, TDS, turbidity, BOD and COD in the sewage waste water that is treated by the adsorbents have reduced in suchaway that the purified water has the quality nearly the normal tap water.
- The study showed that the percentage reduction of impurities in the waste water that is treated using flyash is more effective than the water that is treated using wood ash.
- The treated water can be used for the agriculture purpose and boiler, cooling system and for gardening purpose.
- After the filtration the fly ash and wood ash are used as manure in gardening purpose and agriculture purpose.
- Waste-water treatment should be done by alow cost adsorbent ie.fly ash and wood ash both are cost-effective adsorbents available in plenty.
- Coalflyashbed and woodash bed is an in expensive and effective for removal of COD,TSS, TDS, pH, BOD and turbidity.
- The reduction of contaminants is due to its high porosity and adsorption capacity. When fly ash and wood ash is used as a filter bedof12cmthickness,the parameters value is reduced to great extent in12cm bed thickness.
- It is concluded that both the fly ash and wood ash are good in purifying the sewage waste-water.Butascomparedtothewoodashtheflyashis moreeffectiveinremovalofimpuritiesinwastewater.
- The obtained result values are within the permissible limits.
- Environmental pollution issues can be also minimized by using coal fly ash and wood ash in waste-water treatment and after the treatment the used fly ash and wood ash is also used as manure in agricultural purpose and gardening purpose.

REFERENCES

[1]. Adarsh S, Manasa M P, SheshaPrakash M N, ChandanBalu., 2020 “Dairy Wastewater Treatment using Orange Peels as an Adsorbent” International Research Journal of Engineering and Technology, Volume: 07, Special Issue, ISSN: 2395-0056.

[2]. C.Ganapathy, K. Nivetha, E. Ohm Kumar, T. Pratheep., 2018 “Waste water treatment using fly ash”, International are Research Journal of Engineering and Technology volume-05 issue; 02 ISSN: 2395-0056.

[3]. Dr. N. Nagarajan, Dr. K. Karthikeyan , Dr. S. Sivaprakasam., 2021 “Domestic Waste Water Treatmentusing Flyash - A Case Study” , International Journal of Engineering Research & Technology (IJERT),volume-10,issue-3, ISSN: 2278-0181.

[4]. Dr.Pankaj Singh, PoojaTripathi, ShubhraChauhan, Dr.Arti Mishra., 2016 “Domestic WastewaterTreatmentUsingFlyAshAloneorinCombinedForm”,InternationalJournalofCivilEngineeringandTechnology,volume-11, Issue-3, DOI: 10.9790/1676-1103033439.

[5]. Gaurav R. Dukare; ApekshaBhoir; SanchitaRaut; ParagParkar; Prof.ShilpaDeshpande;Prof.KiranThombre., 2018“Removal of Heavy Metals By Means of Banana and Orange Peels”, International Journal of Innovative Research in Science, Engineering and Technology, Volume 7, Issue 4,ISSN (Online): 2319-8753.

[6]. JunCongGe,SamKiYoonandNagJungChoi., 2018“ApplicatonofFlyashasanAdorbentforRemoveofAirandWaterPollutants”,Applied

Sciences,Volume 8, doi:10.3390/app8071116.

[7]. NeetuDabi and NehaPatwa., 2015 "Flyash: an Effective Method for Treatment of Wastewater" International Journal of Engineering Research & Technology volume-03 issue; 23ISSN: 2278-0181.

[8]. P. Saravanakumar, PreethiGopalakrishnan, M.Sivakamidevi, E.S.Archana., 2019 "Domestic WastewaterTreatmentusingFlyashasAdsorbent",InternationalJournalofEngineeringandAdvancedTechnology,volume-08,issue-5,ISSN: 2249-8958.

[9]. Sunil J. Kulkarni , Sonali R. Dhokpande, Dr.Jayant P. Kaware., 2013 "Studies On Flyash As An Adsorbent For Removal Of Various Pollutants From Wastewater" International Journal of Engineering Research & Technology Vol. 2 Issue 5, ISSN: 2278-0181.