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Leachate treatment using up flow reactors with low cost waste adsorbent materials

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ABSTRACT*-Nowadays, population growth is rapid. Increased industrialisation is their goal. The main issue in metropolitan areas is the development and management of solid garbage. The odour is made worse by waste prevention and minimization. They encourage the development of insects that spread disease, such as flies, street animals, and mosquitoes. Physical, chemical, and biological approaches are employed to treat the disease. Utilizing inexpensive waste adsorbents, upflow reactors are constructed from components that are easily accessible. Materials like discarded brick bats and laterite stone are inexpensive waste adsorbents. The effectiveness of treatment for landfill leachate removal. mostly relies on the adsorbent media's surface area in the upflow reactors.*
Key word- Brick bats, laterite stone, up-flow reactors, and landfill leachate. It uses primary materials.

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I. INTRODUCTION

Urban cities find it challenging to deal with the complexity of garbage. Worldwide, there are between 1.8 and 2 billion metric tonnes of municipal solid waste produced annually. Municipal garbage is not properly handled in developing nations; of the approximately 70% of varied solid waste items that are collected from low-income nations, only 15% are suitable for recycling and proper disposal as municipal solid waste.

Waste minimization and prevention are the causes of the bothersome odour.

They encourage the development of insects that spread disease, such as flies, street animals, and mosquitoes.

The production of leachate will harm nearby soil, aquifers, and other water sources. Leachate control presents a significant challenge in urban regions. Solid waste production rises along with population growth, urbanisation, and industrialization. Both the disposal of solid waste and the handling of landfill leachate are particularly challenging.

Leachate treatment and management if levels surpass those that are desired. The most crucial difficulties with landfills It creates complex issues. for the soil, the nearby water's surface, and the water's aquifer. We use a variety of procedures that are based on physico-chemical principles.

At this step, experimental low-cost waste adsorbent materials are set up by utilising up-flow reactors made of polyvinyl chloride (PVC) pipes.

II. MATERIALS AND METHODOLOGY

2.1 Materials used in treatment of Leachate

In this stage, experimental setup is made in the laboratory to treat landfill Leachate with low-cost waste adsorbents using up-flow reactors which ares fabricated using PVC pipes.

For experimental study following materials are used

1. Reactor body: PVC pipe reactor . 2. Adsorbent material: Waste Laterite stones and waste brick bats.
3. Leachate is collected from Municipal solid waste disposal site at BAGLKOT .

2.2 Laterite stone: Laterite stone Laterite stone It is highly concentrated in iron, aluminium, or both oxides, giving it a reddish-brown colour. It is porous in nature and has strong adsorbency.

2.3 Waste brick bats: Additionally, it serves as a waste adsorbent medium when treating municipal leachate. Different granular sizes range from 4.75mm to 9.5mm. In the upflow reactors they are studying.

2.4 Experimental setup in the treatment of Landfill Leachate

The therapy options are determined via experimental trials. using manufactured reactors that include the inexpensive waste adsorbent media of land fill leachate. For the treatment of landfill leachate, brick bate granules (Type-1) with a diameter of 4.75 mm and laterite granules (Type-2) with a diameter of 9.5 mm are utilised.

Table 2.1 Details of experimental studies. Using low cost adsorbent material using upflow reactors treatment of leachate.

sl.no	upflow reactors	media used in reactors	Sizes
1.	Reactor(R1)	Brick bat	4.75mm
2.	Reactor(R2)	Laterite	9.5mm

2.5 Reactor-1($_{R1}$)

Brick bats with a height of 800 mm are used to fill the reactor. When preparing the medium, a 4.75 mm passing sieve was used. Before filling the reactors, the sieve is drenched in the brick bat and leachate filtered through it. Additionally, layer-by-layer compaction is to be conducted there as the media is filled with an efficient liquid.

2.6 Reactor-2($_{R2}$)

The reactor is made up of coarse granular lateritic stone. With an 800mm height, The media was prepared using a 9.5 mm sieve. The lateratic stone was then sieved and the leachate filtered before filling the reactors. where proper compaction is made layer by layer and effective liquid is filled with media.Landfill leachate treatment using upflow reactors

For treatment with upflow reactors, the landfill leachate samples were diluted to various concentrations with distilled water.

2.7 Upflow reactors.

R_1 and R_2 are the two reactors. PVC pipes of 800 mm in length are used to construct reactors, while a free board measuring 100 mm is used instead. The pipe's interior diameter is 140 mm. Their separate 25-liter leachate storage tank is taken into consideration. Using a peristaltic pump, the leachate is pumped through the pipe at rates of 10, 20, 30, 40, and 50 millilitres per minute, depending on the hydraulic retation time that is taken into account.

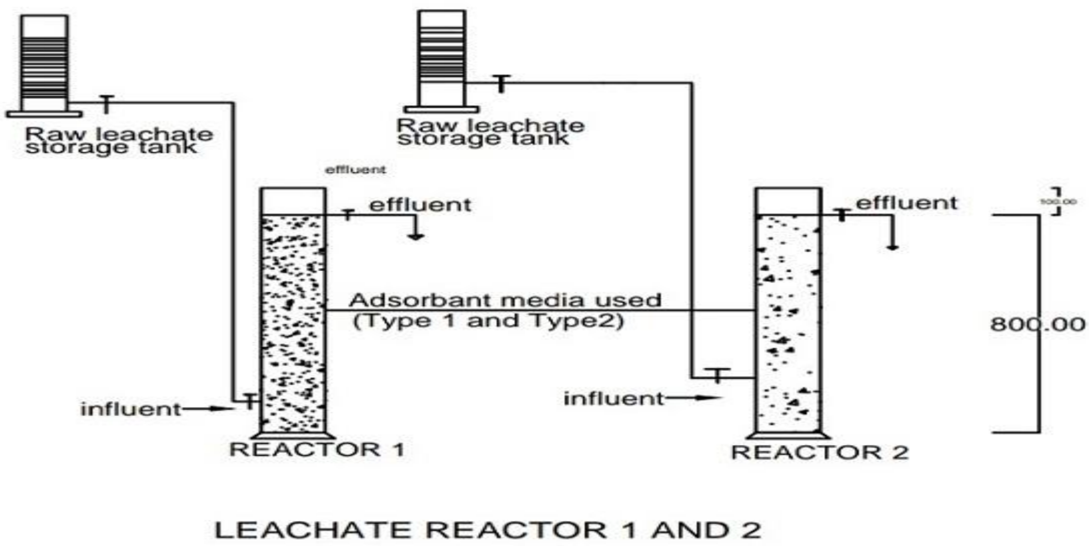


Fig 3.1 Line diagram showing cross sectional view of the reactors

2.8 Leachate Initial characteristics.

Tabale2.2 Leachate Initial characteristics.

SL.NO	Characteristics/ Properties	Values
1	pH	8.9
2	Total Dissolved Solids(mg/Liter)	4253
3	Conductivity(µS/cm)	6253
4	BOD(mg/Liter)	3482.622
5	COD(mg/Liter)	1741.311

III. RESULT AND DISCUSSIONS

The municipal region of Baglkot provides the fresh leachate, which is then promptly examined at room temperature to determine its initial properties. Use a pH metre to measure pH, a digital TDS metre to measure TDS, a conductivity metre to measure conductivity, a titrmetric method to measure COD, a Winkler method to measure BOD5@20 °C, and a toc analyzer to measure TOC. A pH metre is used to calculate the pH. At pH 8.9, where COD and BOD initial concentrations were 3482.622 and 1741.311 mg/l, respectively, conductivity was 6253 NTU, and TOC was 653.4 mg/l.

The results for the removal efficiency of BOD and COD are obtained after filtering the landfill leachate using upflow reactors, and they are discussed below.

Biochemical Oxygen Demand

1ml of distilled water, 1ml of magnesium sulphate solution, 1m calcium chloride solution, and 1ml of ferric chloride diluted water were prepared from the aerated distilled water.Take the 4 bottles, which contain 300ml BOD bottles. Take 50ml of sample and dilution water, two of sample and two of blank.

1 sample and 1 blank bottle were incubated at 20 degrees Celsius. After five days, add 2ml manganese sulphate and 2ml alkali iodide reagents and allow to settle.The yellow colour comes when you add starch solution to the conical flask. The colour changes from yellow to dark blue. Titrate against sodium thiosulfate solution. Color changes to colourless after 5 days. The procedure is repeated for incubated bottles . BOD is estimated by the formula.

Calculations

Initial D.O of a diluted sample = D.O, and D.O of a diluted sample after 5 days = D 5. Initial D.O of distilled water (blank solution) = Co, D.O after 5 days = C5, D.O. Depletion of dilution water = Co-C5, D.O Do-D5, BOD of sample at 20 degrees Celsius = [(Do-D5volume of bottle)-(Co-C5) ml of sample.

Chemical Oxgen Demand

In a reflux flask, 20 mL of leachate were collected.Mercuric sulphate (0.4gm), potassium dichromate (10ml), and sulfuric acid (30ml) are added.The answer is mixed up. prior to heating. If they don't, they bump, and the sample can blow out. The sample is heated for up to two hours. If the colour turns green, the operation is rejected and redone, and the condenser maintains cooling while no sample is present.

Take the sample and dilute it with 150 mL in a conical flask. Take 25 ml from it and add a sample of the ferrion indicator colour to the first conical flask. The blue turns to green. As soon as the colour changes to wine red, the sample is periodically titrated against 0.1 N ferrous ammonium solution (FAS).

COD calculation COD (mg/l) = (A-B) N of FAS 1000/volume of sample

FAS = ferrous ammonium sulphate, N = normality.

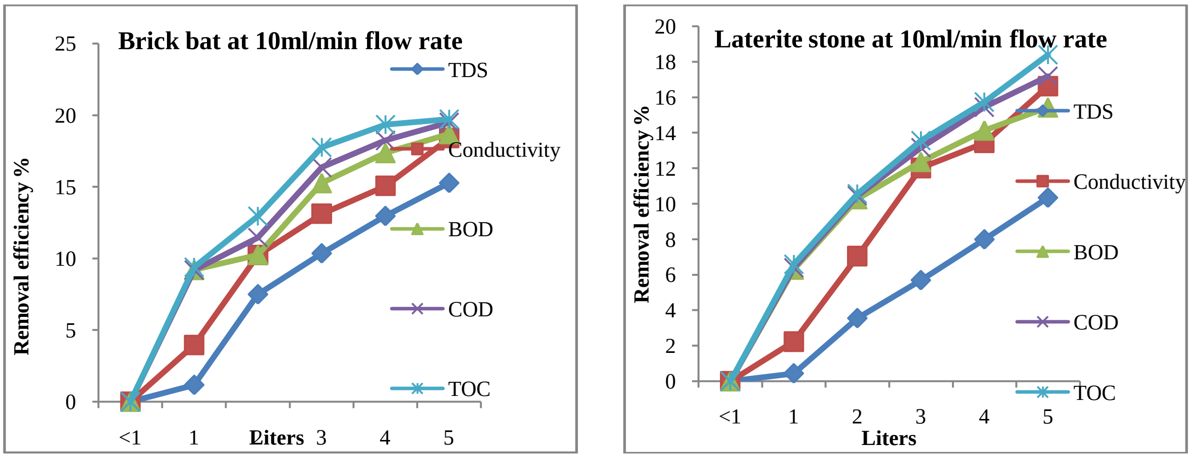


Fig.3.1 Graphical represention of Treatment efficiency of Brick bat and Laterite stone of size 4.75 and 9.5 at flow rate 10ml/min.

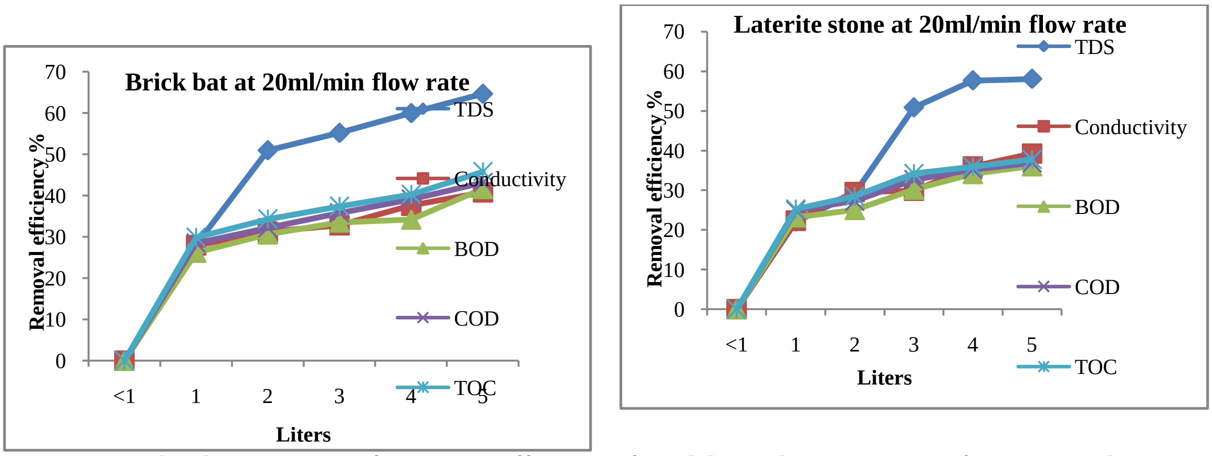


Fig.3.2 Graphical represention of Treatment efficiency of Brick bat and Laterite stone of size 4.75 and 9.5 at flow rate 20 ml/min.

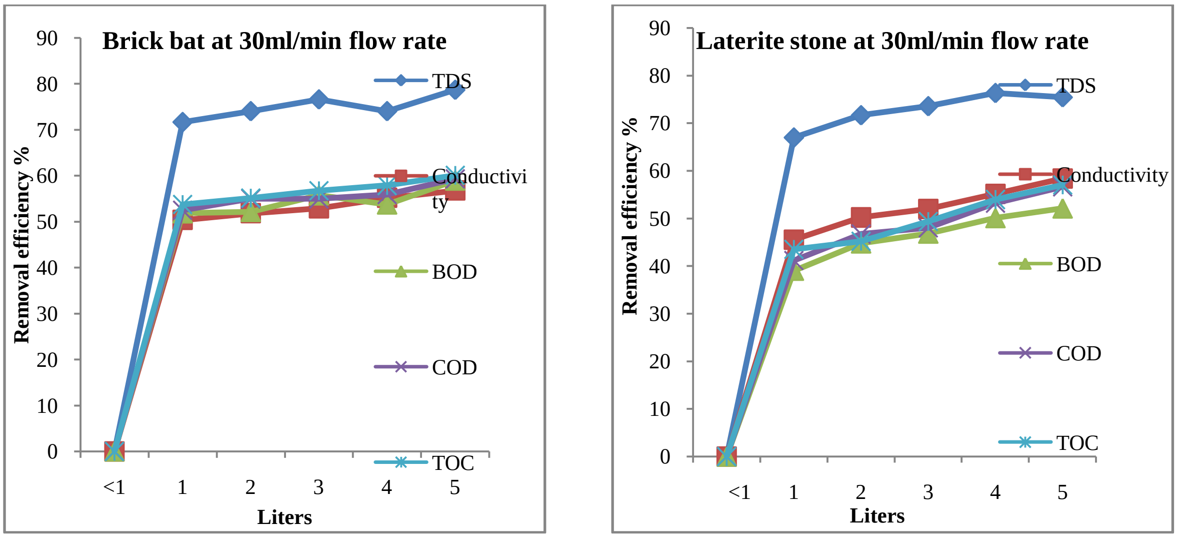


Fig.3.3 Graphical represention of Treatment efficiency of Brick bat and Laterite stone of size 4.75 and 9.5 at flow rate 30 ml/min.

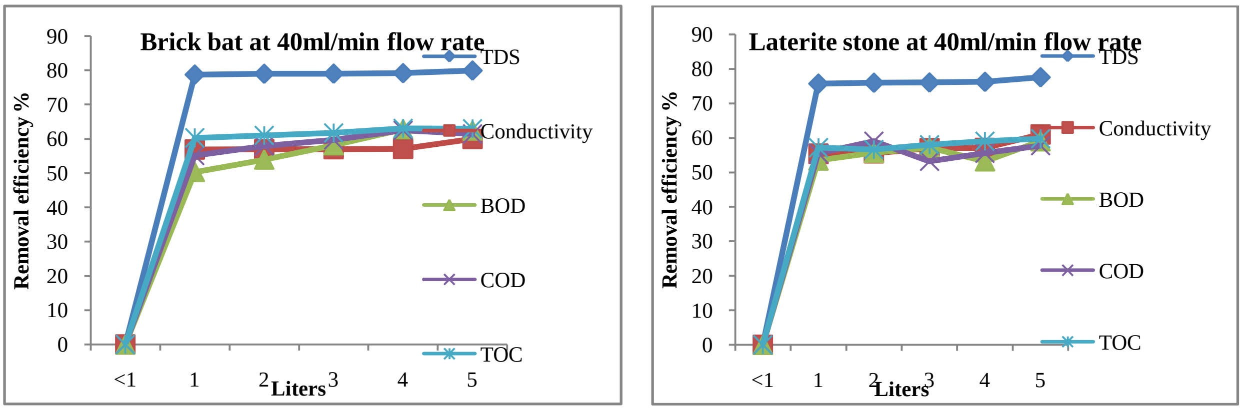
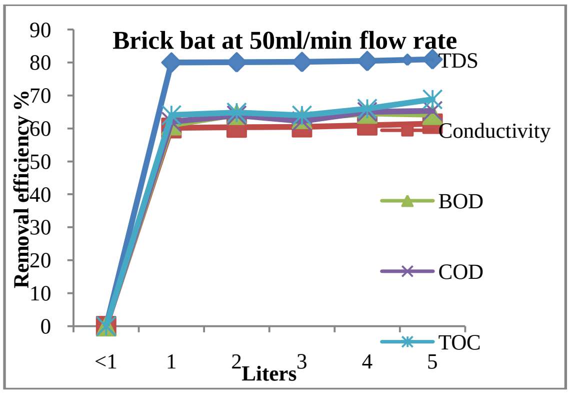


Fig.3.4 Graphical represention of Treatment efficiency of Brick bat and Laterite stone of size 4.75 and 9.5 at flow rate 40 ml/min.



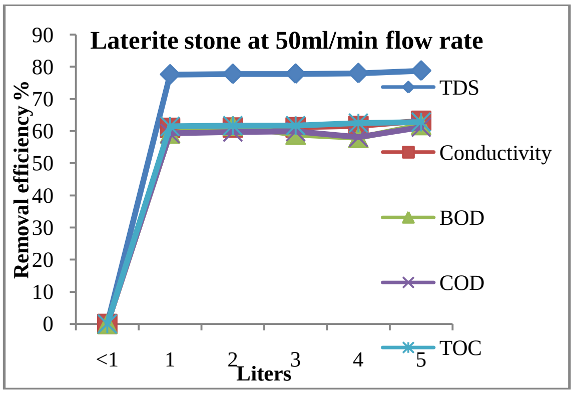


Fig.3.5 Graphical represention of Treatment efficiency of Brick bat and Laterite stone of size 4.75 and 9.5 at flow rate 50 ml/min.

IV. CONCLUSIONS

The examination of various treatment options was carried out experimentally at a landfill for solid waste with leachate. Using upflow reactors and low-cost waste adsorbent materials, experiments were done on particles ranging in size from 4.75 mm to 9.5 mm. There are physico-chemical differences between treated and untreated leachate effluents. The results of an experimental analysis were studied using up-flow reactors. As conclusions are reached, several graphs are drawn.

- Leachate treatment using inexpensive waste adsorbent materials is an economical procedure.
- Leachate treatment without the use of any additional or different chemicals.
- The hydraulic retention time in the upflow treatment process is easily controllable.
- Media with a smaller surface area than an efficiency grater.

4.1 FUTURE WORK SCOPES

• Calculate the effectiveness of the treatment by adjusting the hydralic retention time. • The treatment efficiency of combining various adsorbent materials should be calculated. • Microbiological experiments for various treated effluents were conducted.• Two reactors can be used to conduct experiments on various adsorbent media.

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