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Godavari River Pollution & Use of Coconut Shell as Filter Media for Design of Dual Media Filters

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Abstract: *The research and developmental activities for generating new water quality models provide a valuable source of knowledge in the fields of water resources and environmental engineering. Due to limited water quality data and high cost of water quality monitoring, the data based modeling approaches are being extensively used. This paper presents the forecasted monthly values of water quality parameters viz., pH, Water Temperature and Dissolved Oxygen of River Godavari especially in Ramkund region. As the puja materials such as coconut are extensively used in this region, we will analyze the efficiency of coconut shells as filter media, as it is in large quantity in this area. WQI is found out for the specific purpose of 'irrigation'. The Ramkund Region and its surrounding region are subjected to high river pollution due to large bathing and other activites. Also the wastes of all the activities such as puja is generated .Peoples throw large amount of materials such as flowers and coconut shells etc which are also responsible for pollution of river water. The wastes such as coconut are in abundant quantity, which is the main problem regarding pollution. One of the remedial measure regarding this is use of these shells as a filter media and design the dual media filters. The papers also deals with the effectiveness of dual media filter using coconut shell as filter media.*

Keywords: pH, Turbidity, Hardness, BOD, COD, WQI, Dual media filters

I. INTRODUCTION

Nashik city is situated on the banks of river Godavari and its tributaries namely Nasardi, Waghadi, Darna and Waldevi. On the upstream of city Gangapur, darna, Alandi, Kashyapi and Gautami Godavari dams are constructed on Godavari and its tributaries. Nashik city is a pilgrimage place for the peoples of the country, the city hosts kumbh mela and many rituals throughout the year. The Godavari is the largest river in south India and ranks 3rd among the Indian rivers, flows 1465Km and empties into the Bay of Bengal. It rises in the Sahayadri hills, in Maharastra state and it reaches Andhra Pradesh receiving water from the Manjira, the Pranahita (which itself is itself formed by the confluence of the three rivers viz., the Wardha, the Painganga and the Wainganga); the Mannair, the Indravathi and the Sabari. Nasik is one of the major emerging cities of maharastra, the study area consists of the water quality monitoring stations of Ramkund and surrounding region of river Godavari in Nashik. The portion of river Godavari in the NMC region is being subjected to the high intensity of pollution due to the non awareness of peoples. And also direct disposal of sewage water in the river. The waste from the industrial area is also disposed in the tributaries such as Nasardi, Waghadi which pollute the river.It is well known that clean water is absolutely essential for several purposes for healthy living. Rivers are the most important natural resource for human development but it is being polluted by indiscriminate disposal of sewage, industrial waste and plethora of human activities, which affects its physicochemical and microbiological quality. Increasing problem of deterioration of river water quality, it is necessary to monitoring of water quality to evaluate the production capacity.

II. AREA OF STUDY AND OBJECTIVES

2.1 Background of the Work

The 2008 National Urban Sanitation Policy (NUSP) of the Ministry of Urban Development (MoUD), Government of India (GOI) outlined an inspirational sanitation vision for Indian cities.

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2.2 Scope

1. Scope for further enhancement of STPs to treat up to tertiary level to recycle and reuse of waste water thereby reducing pollution load on river
2. Potential for reuse of recycled of waste water for gardens, flushing of public toilet complexes etc.
3. Scope for creating the awareness in peoples for keeping the river clean
4. Reduction n in the process of eutrophication i.e. growth of green algae in the river.

2.3 Area of Study

The Godavari is the largest river in south India and ranks 3rd among the Indian rivers, flows 1465Km and empties into the Bay of Bengal. It rises in the Sahayadri hills, in Maharashtra state and it reaches Andhra Pradesh receiving water from the Manjira, the Pranahita (which itself is itself formed by the confluence of the three rivers viz., the Wardha, the Painganga and the Wainganga); the Mannair, the Indravathi and the Sabari. The last major tributary of Godavari is Sabari which falls into Godavari about 1268Km from its source.Nasik is one of the major emerging cities of maharastra, the study area consists of the water quality monitoring stations of Ramkund and sourrounding region of river Godavari in Nashik. The study area consists of the following water quality monitoring stations on River Godavari.

1. Someshwar- Anandwali
2. Ramkund,Laxmankund
3. Goda Kapila Sangam
4. Tapovan
5. Panchak Dasak

2.4 Objectives of the Work

This projects observes the negative and harmful effects of water pollution on the environment and the surrounding area of Ramkund. The most common form of water pollution is unethical disposal of wastes such as flowers, and other material generally used in puja. It then goes on to explain the research and effectiveness of Best Management Practices and their positive effects. These are conservation practices that can preserve or improve the state of the environment in the region . Most regulations are laid by the NMC for the control of pollution in the region, but they are ineffective if carried out improperly. The main objectives are,

1. To evaluate the temporal and spatial variations of water quality at all collecting points.
2. Checking quality of water and its pollution extent on basis of following parameters
   - **a.** pH
   - **b.** BOD
   - **c.** COD
   - **d.** Chlorides
   - **e.** Hardness
   - **f.** Alkanity
   - **g.** TDS
   - **h.** TSS
3. To utilize the wastes mainly coconut shells as a filter media and design of dual media filter

III. SAMPLE COLLECTING STATIONS

Sr. No	Sampling Station	Designation	Remarks
1	Someshwar-Anandwali	S1	Pilgrimage location, One of the Shiv Jyotirling, Puja material thrown in the river directly, boating, holy bath takes place. Anandwali is the major slum area near the river.
2	Ramkund, laxmankund	S2	Pilgrimage location-Major point of Kumbmela and throughout the year for special occasions for holy bath, major point where Post

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			Funeral activities are carried out and Astivisarjan is done throughout the year
3	Goda Kapila Sangam	S3	Meeting point of two river Godavari and kapila,sewage and wastewater is discharged in the river.
4	Tapovan	S4	Pilgrimage location-Treated wastewater from the STP of 78 MLD discharged in the river.
5	Panchak Dasak	S5	Remains/ashes of human dead bodies discharged in the river, funeral point for the Nashikroad,discharge containing the greese,industrial effluents, vehicle washings added in the river. Hospital wastes and over flow from septic tanks is discharged in river.

Table 1: Sampling locations

IV. Dual Media Filter

These filters were brought into practice during the decade 1960-1970,but in India it is not much used. It is also called as mixed media filters as two or more different filter media are used in the filter. The size of filter media is in the progressive decrease in size of particles.

Further these filters have advantages over the conventional upflow filters, these filters have flow direction in downward direction, and depth of filter bed is less as compared to other conventional filters. In addition to this there is no bouncy effect in these filters. These filters can be design for very high rate of filtration from 10000-20000 lph/m^2. These filters may be the cheapest as compared to others and may become popular provided local availability of filter media. In order to tackle some additional floc loads as compared to clarified water through conventional treatment unit,dual media filter beds can be used. It consists of layer of coarse media of crushed coconut shell at the top of the fine sand in the filter beds.

4.1 Design Aspects of Dual Media Filters

The filter media consists of crushed coconut shell coarse media with effective size of 1.45-1.47 mm sieved through 2.3 mm opening sieve and retained on 1mmopening sieve.

4.2 Theory behind the Dual Media Filter

The theoretical aspects in design of dual media filter or multimedia filter is that the dual media filter with use of coarse size media at the top of fine sand media is the increase in sludge storage capacity in the filter bed.

4.3 Necessity of Dual Media Filter

1. The aim of designing the dual media filter is to utilize the waste generated in and nearby the river Godavari and in the pilgrimage places in the Nasik which are mostly located near the bank of river Godavari.
2. The other aim is to propagate the simplified filters based on low cost technology for the rural area water supply schemes.
3. The conventional rapid sand and slow sand filters have become costly and show the difficulty in the maintenance particularly for small capacity plants.
4. If we see the actual plant performances of the existing water treatment plants it will be seen that many if the treatment plants are not functioning satisfactorily and needs urgent improvements.
5. Due to unsatisfactory performance the turbidity removal and bacteriological removal is not within the acceptable limits and chemical and wash water consumptions are more than the desired values.
6. Thus the consumers do not get the good quality water supply at their taps.
7. Thus there is urgent need to improve the performance of such treatment plants by carrying out appropriate modifications and improvements.

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V. Improvements In The Filtration

5.1 Conversion of Rapid Sand Filters into Multi-media, Dual-media capped Filters

It is generally observed that rapid sand filters contain fine sand that is not uniform in size and consequently it stratifies during the backwashing process to form a size graded medium in the filter bed. There is an inherent disadvantage in the size graded filters because they become rapidly clogged within the few centimeters at the surface where the medium is finest.

The development of the multi-media and dual-media filter beds has overcome this disadvantage by using the decreasing grain size in the direction of flow. As there is large silt storage capacity in the upper coarser layer, in these filters coarse to fine filtration offers enormous advantages of high filter rates.

It also allows the filtration of more turbid water widening the choice of raw water fit for transforming into a good quality drinking water and in many cases it does away with the necessity of pretreatment.

The multimedia filtration achieve the rational requirement that the suspension to be filtered passes coarser grains first and then through subsequent finer and finer media. With regard to hydraulic classification accompanying backwashing, downward filtration from coarse to fine is only possible by composing the filter bed of two or more layers of filtering material with different mass densities. Due to density gradation the filter is hydraulically stable in configuration even after upward fluidization.

The sizes and depths of the media will be adopted for a particular design ,however multimedia bed generally have 8-10cm gravel of 0.4-0.8 mm size,20-25 cm of sand of 0.6-0.8 mm size and 50-60 cm of course top media of 1-2mm size. However there is sudden decrease in grain size between the media layers there is possibility of rapid clogging at the interface. To prevent this clogging the ratio between the successive grain size should be chosen to correspond the ratio between the successive mass densities, allowing a certain amount of mixing of the two filtering material during the backwashing. For this reason these filters are called as the mixed –media filters.

VI. Selection of Filter Media

There is great difficulty in selection of suitable filtering material for these filters. There is no difficulty in obtaining the good quality sand and also garnet, but the price is very high. While the anthracite is not only expensive but also very difficult to obtain uniform grade with adequate wear resistance and satisfactory length of useful life. The bituminous coal which is available in India is not of uniform grade and considerably softer inadequate to wear resistance.

6.1 Use of Coconut Shell as the Filter Media

The crushed coconut shell can successfully be used as the filter media in the sand filter for the dual or mixed media filters. A comparative study has shown that the crushed coconut shell media is superior to the other media including the bituminous coal which are available in India.

One of the important advantage with coconut shell media is its uniform quality as available in India. The specific gravity of fully grown dry hard shell is about 1.35-1.4 when it is soaked in water. The media is hard and tough and microscopic observation shows compact and uniform structure. Its solubility in 20% HCL is about 0.7% in 24 hours and the durability test on the media showed only 2.5% loss in weight when media was washed continuously for 100hrs.

6.2 General Specifications & Design of Dual Media Filter Used in the Experiment

1. No.Of unit = 1 nos (potable type filter)
2. Size of bed = 0.3x 0.18 m
3. Area of filter Bed = 0.06 sq.m
4. Effective height of filter =0.37m
5. Depth of crushed coconut shell media = 0.07m
6. Avg.size of coconut shell media= 1-2 mm
7. Uniformity coefficient= 1.47
8. Depth of fine sand media=0.1m

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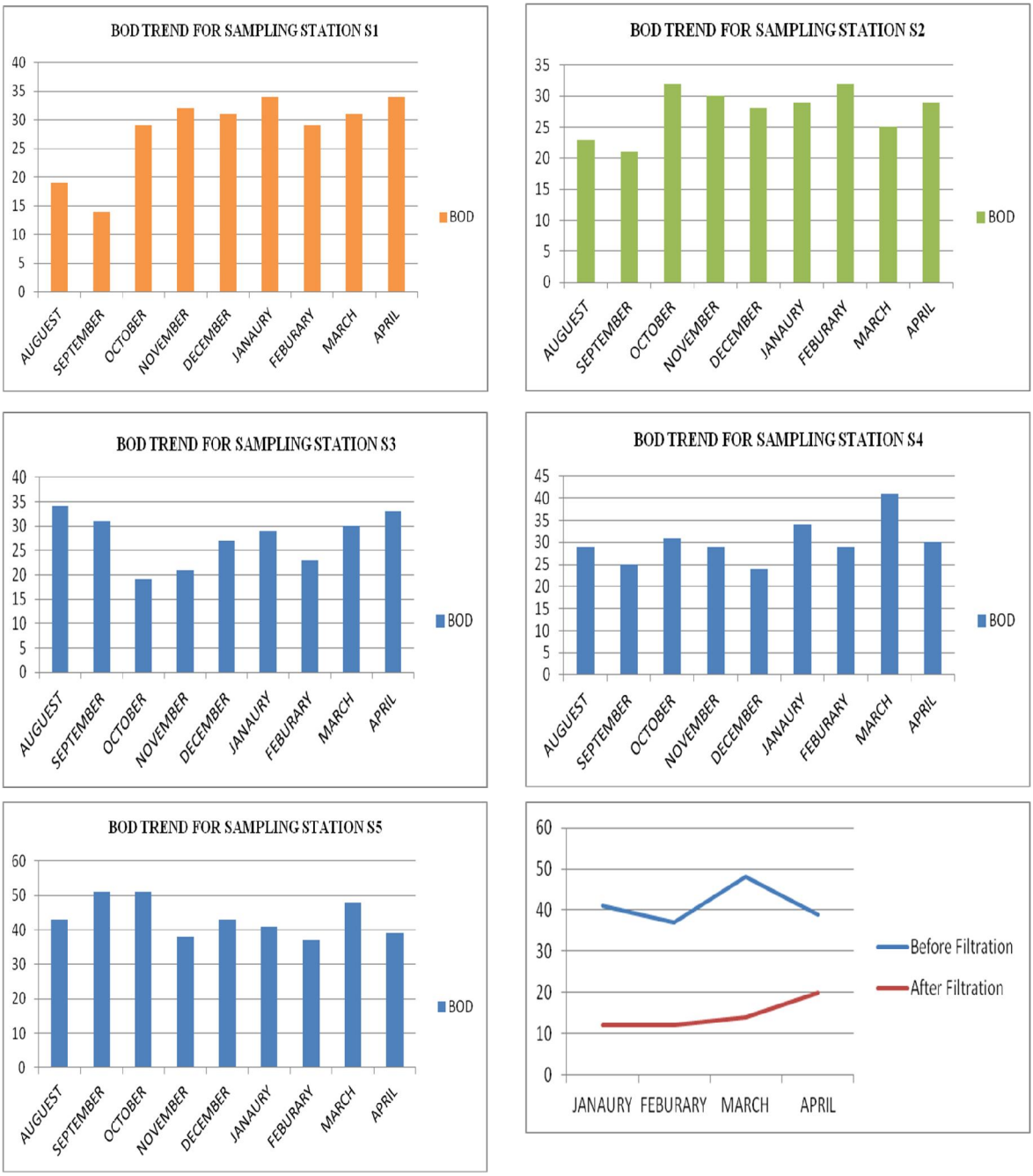
9. Effective size of fine sand= 0.5mm
10. Depth of coarse sand media= 0.1m
11. Depth of supporting gravel = 0.07 m
12. Depth of covering top layer= 0.03

VII. RESULTS AND DISCUSSIONS



Graph 5.7: BOD trend for sampling station 2 before and after filtration from dual media filter

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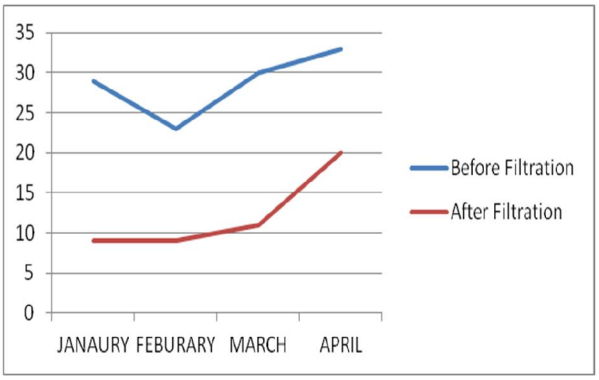
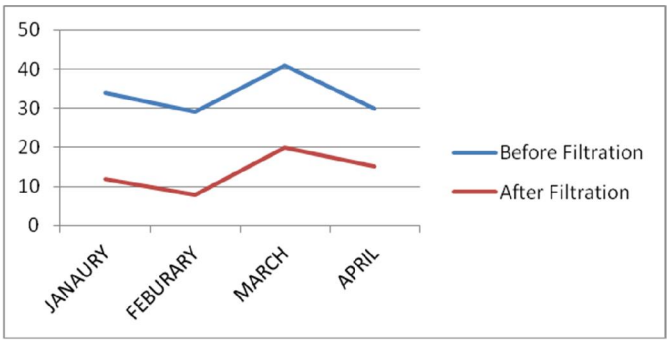
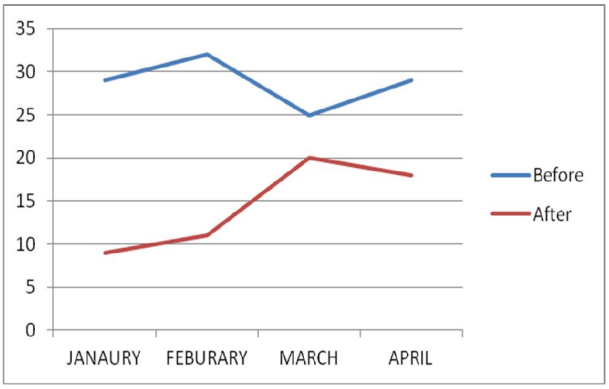


Graph 5.8: BOD trend for sampling station 3 before and after filtration from dual media filter



Graph 5.9: BOD trend for sampling station 4 before and after filtration from dual media filter



Graph 5.10: BOD trend for sampling station 5 before and after filtration from dual media filter

VIII. Conclusions Regarding The Assessment Of Water Quality Of Godavari River

1. The water quality assessment of Godavari River in Nasik District from Someshwar Anandwali to Dasak Panchak in Maharashtra State indicates that the river is heavily polluted due to 125 large and 350 medium scale units and about 2,500 small scale units, in addition to massive growth of some other industries like laundry, hotels, restaurants, pathological laboratories, nursing homes, etc., which are discharging into the river.
2. The evidence of river pollution is clearly visible in terms of eutrophication, i.e., the spread of green algae in the river, indicating high levels of the pollutants Potassium and Nitrogen, presence of hyacinth and other species that thrive in polluted water, and dead fish. While Industrial pollution is a major concern area, other sources of pollution including agricultural run-off and residential waste-water flows particularly from slum areas adjoining the river needs to be comprehensively studied and acted upon.

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3. There are no Common Effluent Treatment Plants (CETPs) for Ambad and Satpur Industrial areas and information available on effluent flows from these areas is sketchy. Although there is awareness of pollution hotspots along the river, there is a need for a detailed study on the level and nature of industrial effluents in order to address Industrial pollution issues comprehensively
4. The intensity of pollution in Ramkund region is severe the provision of disposal of dead remains of humans and other pilgrimage related waste should be stopped.
5. In the study area the pH of water lies in the range of 7.8 to 8.8. All the samples in the vicinity of MIDC area have pH more than 7, showing alkaline range.
6. Total Alkalinity in ground water lies in the range of 150 to 300 mg/l
7. Total Hardness in ground water lies in the range of 160 to 310mg/l

IX. RECOMMENDATIONS

1. Develop and implement a comprehensive River Pollution Mitigation program. NMC should initiate a focussed comprehensive River Pollution Mitigation Program for Godavari and its tributaries.
2. A Detailed Study Report will be prepared by NMC to identify various sources of pollution and measures required to mitigate it.
3. The most important part of this Mitigation Program will be to conduct a study on compilation of information on treated/untreated waste water flows, various industries and flow of effluent discharged by them. Role of MIDC and MPCB will be very crucial here given that the industrial areas are largely managed by them.
4. Conduct a comprehensive study and prepare a Detailed Project Report level report covering entire stretch of Godavari River and its tributaries in the vicinity of Nashik city to identify points of pollution and measures to mitigate the same.
5. The existing and on-going initiatives of waste water collection and treatment shall be taken into account in this study. The various options such as waste water recycling, tertiary treatment of sewage water, decentralized treatment etc. will be explored
6. The status of various natural drains with respect to their natural flow path, illegal constructions obstructing their flow, solid waste dumped into these drains and silting due to erosion of soil especially from Panchavati area.
7. The principal advantage of the dual media filter is that the dual media filter beds with the use of coarse size media at the top of fine sand media there is increase in the sludge storage capacity in the filter bed itself,and thereby distributing the head loss uniformly in the in the filter bed.


Picture: Experimental setup of Dual Filer Media & Photo: Drainage arrangement setup of Dual Filer Media

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