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Feasibility Study of Modified Flow Pattern for the Onsite Treatment of Polluted River, Case Study on Mutha River

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Abstract: ***Paper Present situation demands immediate attention to improve conditions of rivers. The solution is restoring the water quality and develops river fronts to achieve a healthy environment. Though Mula-Mutha River passes through centre of Pune city, so it is necessary to rejunuavate river and improve the environmental condition in nearby locality. This is achived by treating the river in it's line of flow. The industrial effluents, domestic wastes as well as municipal waste leads to various pollution such as air pollution and water pollution which has ill-effects on environment and human health. The restoration of river by controlling water pollution is done by various methods and measures such as regulation of standards for effluent emission in natural streams. The already polluted rivers and the rivers which are considered as dead due to its polluted water as well limited flow into it can be treated by various methods. The treatment done by using of 3-D Zig-Zag method helps to increase the settlement of sediment and conserve the water. Treatment based on natural processes such as algae based treatment and biodegradation of organic matter and in addition to this cost effective method must be selected for the river water treatment. This both method of zig-zag flow of water and algae treatment help in treating the water on it's flow line which minimizes the STP's construction and maintenance along the river.***

Keywords: **3-D Zig-Zag flow, Algae, Biodegradation, Sedimentation**

I. INTRODUCTION

The treatment of water in general requires two treatment i.e. Primary treatment and Secondary treatment. In which there are multiple units and different processes to be carried out. All this becomes inefficient as well as uneconomical to be carried out in treatment plants due to large volume of the river flow. A new method is introduced by modification of concept of check dams, in which a river channel is divided into different compartments by constructing baffle walls which has opening on the alternate side as well as in top or bottom respectively. The 3-D zig-zag method is important for sedimentation and screening of floating material. This is done by compartments which has top opening on one side (for e.g. Top left opening) and bottom opening on other side (for eg. Bottom right opening) in alternative manner. The top opening helps for settling of sediments and the bottom opening blocks the floating matter.

In addition to this method of treatment, Algae based treatment can be provided which helps in increasing of Dissolved oxygen and biological degradation. Microalgae are normally unicellular called as phytoplankton. We cannot see by naked eye due to microscopic in size. If we consider present scenario, microalgae has been in news since last ten years in terms of the capability of producing biofuels as well as treating or polishing municipal and dairy wastewater. Extreme focus to be given on microalgae based treatment.

II. LITERATURE REVIEW

Several research papers were reviewed to study how the HEC-RAS can be used for its applications. Reviewing papers helped in determining and limitation and the scope of the study. In literature study, the results forecasted in the research papers were also compared with the real incidents that had happened in recent years, ascertaining the accuracy of the software. The results in research paper on Dam Break Analysis of Idukki Dam using HEC RAS found matching to recent event happened in Kerala floods.[10]

III.METHODOLOGY

Data collection was carried by visual survey i.e., site visit, satellite images collected through Google Earth and Google Maps. Further, research paper and EIA report of Mula – Mutha River was studied. On basis of this study, river stretch from Nanded city to Sangamvadi (approx. 12kms) was selected. Thereafter, samples were collected by using method of Grab Sampling. A container having volume of 5 litres was used for collecting the sample. These samples were tested to determine their physical, chemical and

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biological characteristics such as pH, total solids, DO, BOD and COD. Depending upon test results and volume of river flow, it was evaluated that the treatment of waste water in STPs cannot be done effectively and efficiently. To overcome these flaws, treatment can be done in river itself by using methods such as zig-zag flow channel and algae based water treatment.

In this treatment, primary and secondary treatment can be done altogether by providing baffle walls which has alternative openings at top-left and bottom-right and vice versa. These walls are provided at regular intervals. This baffle walls provide additional surface area for growth of algae. In this method setting is done by gravity and obstruction provided by baffle walls. The biodegradation of settled sediments is further carried out by facultative bacteria which help in reducing the thickness of deposited sediments. Algae growth is affected by various factors such as light, temperature, availability of nutrient, carbon dioxide, competition between species, and virus infections. Mixing, dilution rate, depth, addition of bicarbonate, harvesting frequency also affects the growth.

A. Model Making

Since In accordance with the treatment method selected, a model is created which is made of plywood. The model consists of three compartments:

1) Inlet Tank.
2) Channel with four compartments with alternative openings ie. Top left opening in one baffle wall and bottom right in another.
3) Outlet Tank.

The dimensions of the project model are as follows:

a) Inlet Tank
i) Length = 0.3m
ii) Width = 0.5m
iii) Height = 0.3m
iv) Holes =10 no's of dia. 10mm in two rows at the bottom of tank.

b) Channel
i) Length = 2m
ii) Width = 0.3m
iii) Height = 0.2m

Dimension of each compartment:
i) Length = 0.5m
ii) Width = 0.3m
iii) Height = 0.2m
iv) Baffle walls i.e. compartment having opening of 1/3rd of width.

c) Outlet Tank
i) Length = 0.2m
ii) Width = 0.3m
iii) Height = 0.2m
iv) Opening in the bottom of the tank.

Flow Characteristics:
1. Velocity of river = 0.8m/s
2. Velocity maintained in model = 0.8m/s



Fig. 1 Model

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B. Working Mechanisms Of Model

The working principle of this method is a combination of two methods which are Sedimentation and Biological degradation. A known volume of waste water is allowed to flow through the inlet tank which passes through the series of holes drilled and flows through the four compartments of the channel. The flowing pattern is in such a way that the baffle walls obstruct the flow in such a manner that it only is allowed to flow through the openings. The main aim residing for such flow pattern is the division of the channel into compartments in order so as to make the compartments work as Sedimentation tank. The depth of the channel is also kept low in a view point of having shallow depth to form Algae. The algae formed on the banks of river have its own set of benefits in the natural purification of water in river. The significance of algae is in the formation of Dissolved oxygen (D.O.) and absorption of inorganic matter such as phosphorous, nitrogen. This further breaks down the complex inorganic matter by aerobic condition resulting in the purification of river.

After allowing river water to flow through model for 4.5 hours daily for 12 days, testing of the same water was carried out to determine its physical, chemical and biological characteristics.

IV. RESULTS

The results of various characteristics of waste water are as follows:

A. Total Solids

Sewage sample collected from the River Mutha contained total solids up to 600 to 870 mg/lit. When this was passed through model, the total solids were removed up to 180 to 350 mg/lit. Average reduction of 30% was found by collecting the effluent after 3 hrs.

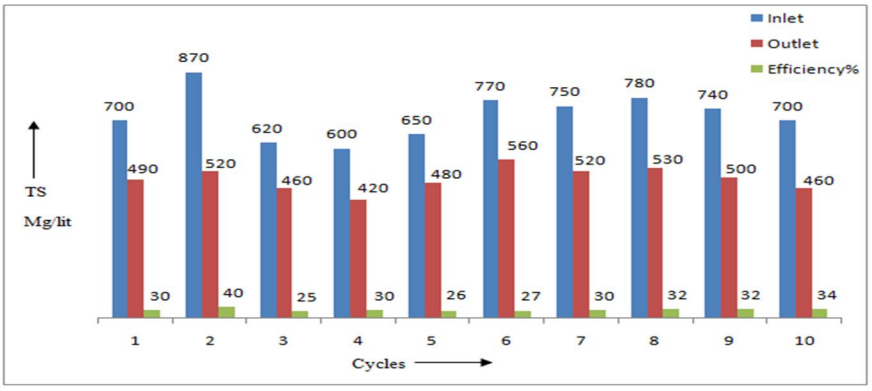


Fig. 2 Total Solids

B. Biochemical Oxygen Demand

BOD is the measure of amount of oxygen required to oxidize the organic matter present in the wastewater. For untreated sewage sample BOD value varies from 130 to 180 mg/lit, when it was passed through system BOD was reduced up to 20 to 100 mg/lit. Average BOD reduction was found by 53%. Due to long detention time bacterial activity takes place and it oxidize all organic matters in the waste water.

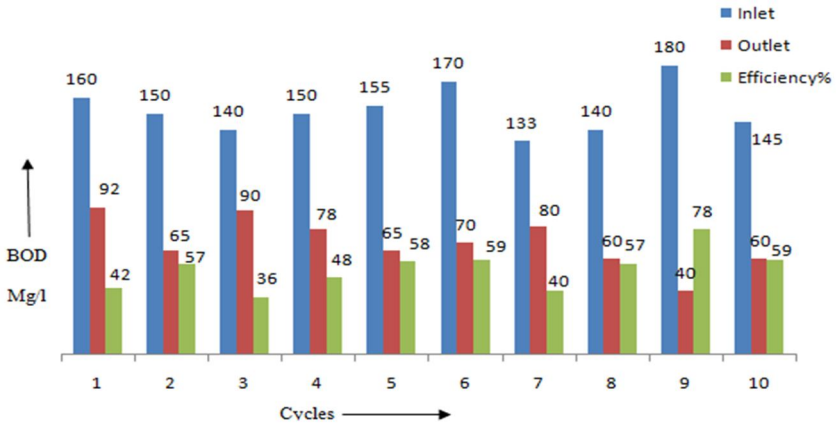


Fig. 3 BOD Variation of Sewage

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C. Chemical Oxygen Demand

COD is a measure of the total quantity of oxygen required for oxidation of nearly all organic compounds in wastewater. For untreated sewage sample COD value varies from 200 to 306 mg/lit, when it was passed through system COD was reduced up to 100 to 140 mg/lit. For sewage treatment efficiency was found up to 53%.

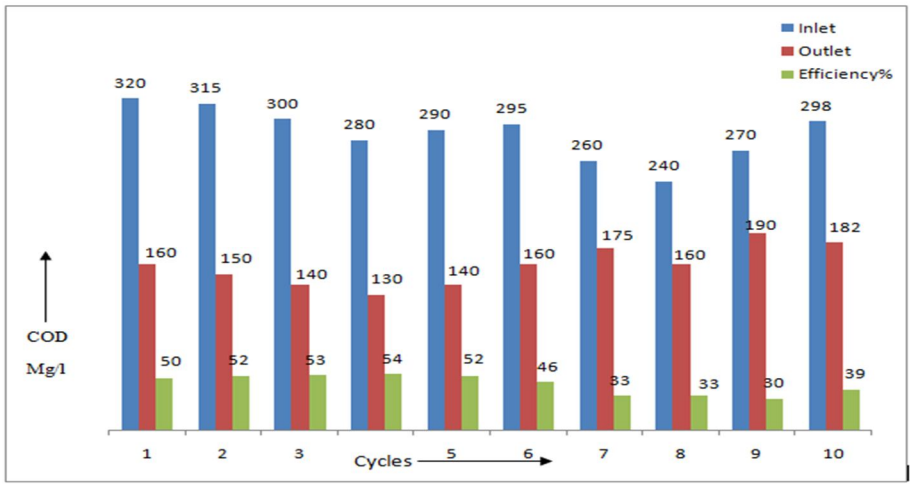


Fig. 4 COD Variation of Sewage

D. Dissolved Oxygen

DO measurement is important for maintaining aerobic condition in aerobic biological treatment. By measuring DO level we can easily find the pollution strength of any water bodies. DO of untreated wastewater was found nil and after treatment it was increased up to3 mg/lit.

Table No. 1 DO Variation of Sewage

Sr.No	Inlet(mg/lit)	Outlet (mg/lit)
1	Nil	2.8
2	Nil	3.1
3	Nil	2.9
4	Nil	2.7
5	Nil	3.2
6	Nil	3.1
7	Nil	2.8
8	Nil	3.0
9	Nil	3.2
10	Nil	2.7



Fig. 5 Before & After Treatment

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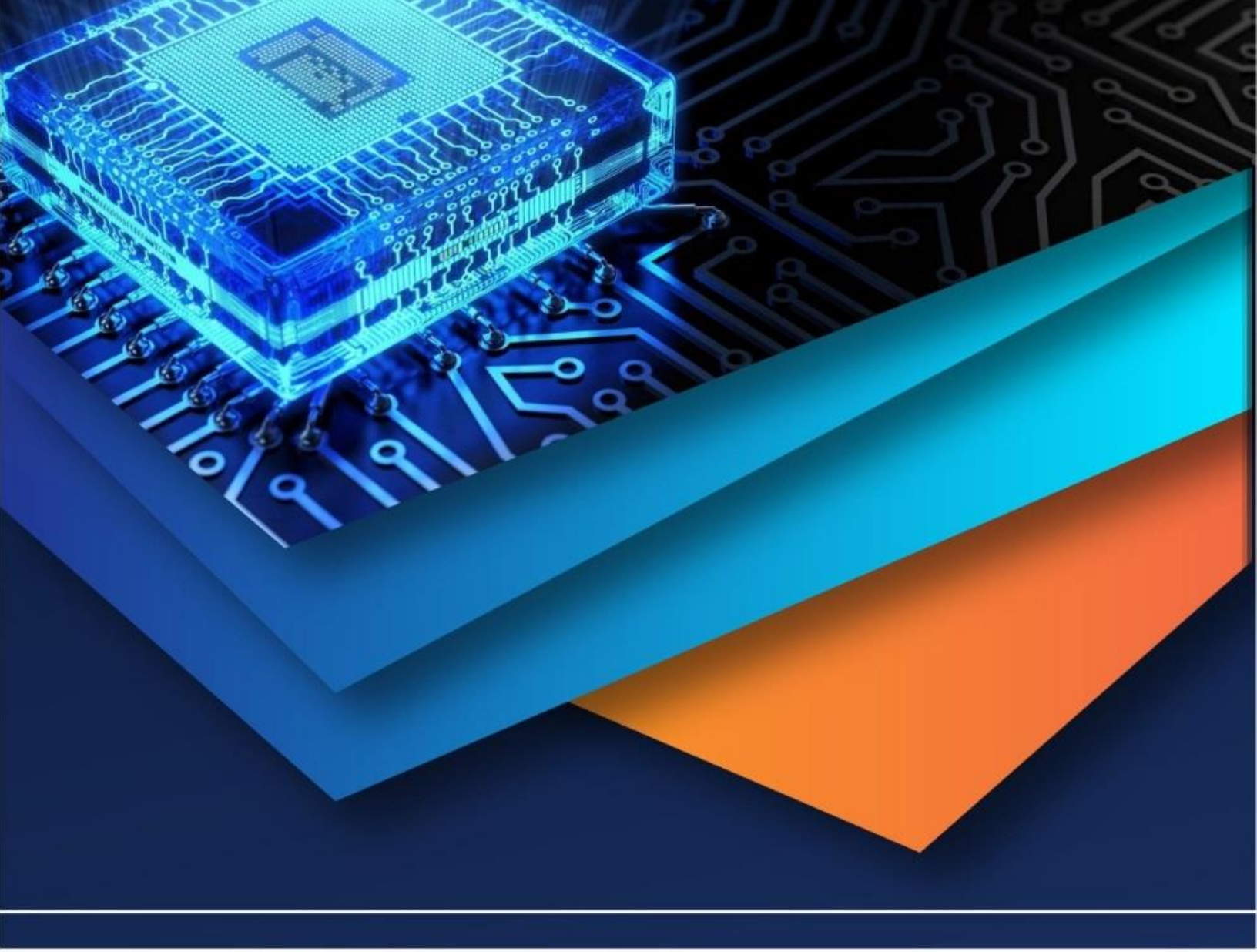
V. CONCLUSIONS

By modifying the existing flow pattern to zig-zag flow pattern, direct treatment is given to rivers. This system has minimum operation cost as it does not require any work to be done specially by any skilled labor. As this system does not require any additional energy, therefore its operation cost is further reduced. As locally available materials are used for construction of bunds, initial cost is considerably low. This system is eco-friendly as it does not require any chemicals for the treatment of sewage. The treated effluent is under desirable limits of pollution parameters such as BOD, COD etc so that we can discharge this effluents into dam storage, lakes etc directly. Algae are found to be grown in the beds it helps to maintain DO and remove heavy metals as well as some organic toxic organic compounds.

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