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Enhancing Stability in Chor Nallah through Eucalyptus Tree Plantation and Oxidation Pond

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Abstract - *The sewage treatment system in middle-sized towns like Vidisha often faces numerous challenges, including limited financial resources, outdated infrastructure, and increasing wastewater volumes due to population growth. This research paper delves into the intricate mechanisms and efficacy of oxidation ponds in the treatment of wastewater flowing through chor nalla which is currently discharging directly in to river Betwa without any treatment ,in Vidisha. The current situation is leading to inefficiencies in pollutant removal and potential environmental contamination. However, implementing eco-friendly solutions such as oxidation ponds/lagoons, and the strategic planting of trees like eucalyptus can offer both environmental and economic benefits. Oxidation ponds and lagoons utilize natural processes to treat sewage, relying on sunlight and microbial activity to break down organic matter and remove contaminants. These systems require minimal energy input and maintenance, making them cost-effective alternatives to conventional treatment methods. Additionally, planting trees like eucalyptus around treatment facilities can help absorb excess nutrients from wastewater, improve air quality, and provide habitat for wildlife. By harnessing the power of nature, middle-sized towns like Vidisha can overcome sewage treatment challenges while promoting sustainable and economically viable solutions. Algae thrive in oxidation ponds because they initiate the oxidation process, which aids in the breakdown of organic materials. The process of photosynthesis involves the first consumption of oxygen by agae, which is then consumed by organic matter. As a result, all bacterial colonies are reduced and water is treated as a result of the organic matter finishing with the assistance of oxygen produced. The oxygen in this air is far more beneficial for breaking down organic materials. The oxidation pond must be no deeper than ten feet. After BOD is removed, the waste is stabilized in oxidation ponds, which are inexpensive waste water treatment units that operate in both aerobic and anaerobic conditions.*

***Key Words*: Oxidation Pond, Eucalyptus tree, Screening, sewer line and sewerage etc.**

1. INTRODUCTION

Large, shallow pools known as oxidation ponds—also referred to as lagoons or stabilization ponds—are created to treat wastewater by means of the interplay of sunlight, bacteria, and algae. The pond's algae used sunlight for photosynthesis, which produced oxygen. Aerobic bacteria in the oxidation pond use this oxygen to break down the organic trash in the wastewater. The decomposed materials sink to the bottom of the ponds, producing comparatively well-treated wastewater.

For stabilisation of chor nallah, an oxidation pond with eucalyptus trees is suggested to handle sewage waste water in particular. Anaerobic and aerobic forms of oxidation ponds are the two types available. Algae are prevalent and eat the organic stuff because of the sunshine.

The meeting place of different nallahs is the Betwa River. Because of this, the The river between becomes contaminated and polluted. Disruptions to the aquatic life also result in a decrease in dissolved oxygen. Sewage water that meets the stream between with little to no pretreatment is deteriorating the beautiful stream between.

Oxidation ponds, alternatively referred to as lagoons or stabilization ponds, stand as a prevalent method for wastewater treatment, capitalizing on the interplay of sunlight, bacteria, and algae. Within these extensive, shallow reservoirs, a symbiotic relationship flourishes: algae utilize sunlight during photosynthesis to generate oxygen, vital for fueling aerobic bacteria tasked with decomposing organic waste in the wastewater. As these solids settle, the effluent emerges comparatively purified.

In the pursuit of refined wastewater treatment solutions, we propose an inventive amalgamation: the integration of eucalyptus trees within oxidation ponds. This innovative approach aims to enhance natural purification processes by harnessing the distinct properties of eucalyptus plants in absorbing organic material. Specifically, the incorporation of eucalyptus trees within oxidation ponds aims to tackle the urgent requirement for efficient sewage treatment, particularly in regions afflicted by pollution and contamination, such as water bodies like the Betwa River.

1.1 Oxidation Pond

Oxidation lakes, also known as tidal ponds or adjustment lakes, are large, shallow bodies of water designed to filter wastewater by combining light, microorganisms, and vegetation. Utilizing carbon dioxide, solar energy, and inorganic mixes carried by water-dwelling microbes, green growth emerges. Green growth releases oxygen during photosynthesis, which is necessary for high-impact bacteria to survive. Sometimes, mechanical aerators are added to provide even more oxygen, reducing the size of the lake that is required. In the end, excavation should be used to remove any ooze stores found in the lake. Filtration or a combination of substance treatment and settling can be used to remove green vegetation that is still present in the lake.

Oxidation ponds, frequently denoted as stabilization ponds or lagoons, form a crucial element in wastewater treatment methodologies, leveraging the synergy among sunlight, microorganisms, and algae. Algae, thriving on solar energy and nutrients from microbial activity, produce oxygen during photosynthesis, indispensable for the metabolism of aerobic bacteria. Supplementary aeration mechanisms, like mechanical aerators, can further refine oxygenation, thereby diminishing the overall footprint of the pond. Regular removal of sediment deposits is imperative for sustained efficiency, typically necessitating dredging. Residual algae in effluent can be eradicated through filtration or a combination of chemical treatment and settling.

Furthermore, oxidation ponds create favorable conditions for anaerobic processes to occur in the deeper layers of the pond. In these anaerobic zones, devoid of oxygen, specialized anaerobic bacteria thrive and contribute to the decomposition of complex organic compounds through anaerobic digestion. This process results in the conversion of organic matter into simpler compounds, such as methane and carbon dioxide, along with the release of additional nutrients.

The combination of aerobic and anaerobic processes in oxidation ponds allows for the comprehensive treatment of wastewater, leading to the removal of suspended solids, organic pollutants, and pathogens. Moreover, oxidation ponds offer several advantages, including low operational costs, minimal energy requirements, and natural treatment mechanisms.

Through a detailed examination of the operational parameters, design considerations, and environmental outcomes associated with oxidation ponds, this research aims to provide valuable insights into the optimization of wastewater treatment systems. By harnessing the potential of aerobic and anaerobic processes within oxidation ponds, communities can achieve sustainable and efficient management of wastewater, thereby safeguarding public health and preserving environmental quality for future generations.

The utilization of oxidation ponds for wastewater treatment, employing both aerobic and anaerobic processes, has emerged as a promising solution to address the escalating challenges of water pollution and environmental degradation. Advantage of oxidation ponds, also known as lagoons or stabilization ponds is that these bodies, harness the power of sunlight, bacteria, and algae to facilitate the degradation of organic pollutants present in wastewater. The process begins with the growth of algae, which utilize sunlight and carbon dioxide to undergo photosynthesis, generating oxygen as a byproduct. This oxygen is then utilized by aerobic bacteria inhabiting the pond to break down organic matter, thereby reducing the Biological Oxygen Demand (BOD) of the waste water.

1.2 ROLE OF EUCALYPTUS PLANTS IN CLEANING WATER

Eucalyptus trees are vital components in wastewater treatment due to their unique biological properties. Their extensive root systems act as natural filters, efficiently absorbing water and nutrients from the soil. Planted strategically near treatment facilities or in constructed wetlands, they play a crucial role in extracting excess nitrogen and phosphorus from wastewater, thus mitigating the risk of nutrient pollution in water bodies. Moreover, eucalyptus trees release various compounds through their roots, including allelochemicals, which possess antimicrobial properties. These compounds inhibit the growth of bacteria and pathogens in the soil, contributing to overall purification. Additionally, through transpiration, where water is absorbed by the roots and released through the leaves into the atmosphere, eucalyptus trees actively reduce water levels in wastewater treatment systems. This aids in managing water levels and improves overall water quality by diluting pollutants. The multifaceted role of eucalyptus trees underscores their importance in eco-friendly and sustainable wastewater management. By harnessing their natural mechanisms, communities can achieve efficient nutrient removal, soil purification, and water quality enhancement, promoting a healthier environment.

2. LITERATURE REVIEW

A number of researchers have explored the effectiveness and applications of oxidation ponds in sewage treatment, providing valuable insights and perspectives.

Mahapatra et al. (2022) conducted an extensive review on Waste Stabilization Ponds (WSPs) for wastewater treatment, focusing on factors such as design considerations, contaminant removal methods, and cost analysis. Their study underscores the versatility and cost-effectiveness of WSPs, highlighting their potential as secondary or tertiary treatment units in sewage treatment plants. Additionally, the natural symbiosis between algae and bacteria in WSPs offers an environmentally friendly and economically viable solution for sewage treatment, with effluent reuse options for various purposes such as agriculture and gardening.

In a study by Butler et al. (2015) on oxidation ponds for municipal wastewater treatment, attention is drawn to the cost, design, and operational aspects of oxidation ponds. The natural treatment process utilizing microorganisms like bacteria and algae is emphasized, showcasing the cost-effectiveness and sustainability of oxidation ponds. Furthermore, the generation of reusable effluent adds to the overall productivity and environmental benefits of this treatment method.

Sato et al. (2007) conducted a financial evaluation of sewage treatment processes in India, comparing the costs and efficiencies of various systems including Up-stream Anaerobic Slop Blanket (UASB) and Waste Stabilization Ponds (WSPs). Their findings suggest that, considering factors like capital and operational costs, UASB systems may offer favorable options in terms of cost-effectiveness and treatment efficiency, particularly in the Indian context.

Wear et al. (2021) explored the ecological ramifications of sewage contamination, highlighting its adverse effects on ecosystem health. Their study underscores the widespread impact of untreated or poorly treated sewage on natural environments, with elevated levels of pollutants posing significant threats to biodiversity and ecosystem integrity. The authors advocate for interdisciplinary collaboration between conservationists and public health sectors to address this global challenge effectively, emphasizing the importance of innovative sewage management solutions.

In addition to these studies, other researchers have also contributed to the discourse on sewage treatment through oxidation ponds, offering diverse perspectives and insights. For instance.

"Waste Stabilization pond (WSP) for waste water treatment: A review on factors modeling and cost analysis" is the main topic of Saswat Mahapatra et al.'s (2022) study. In his study article, "Design considerations for the Waste Stabilization Pond" (WSP), he took a number of aspects into account. There are several approaches for cleaning up WSP Pond-related mathematical models of impurities. Cost analysis of pond stabilization.

Installing waste stabilization ponds (WSPs) in centralised or semicentralised sewage systems is a natural technique that may be used to treat a variety of waste materials, including sludge and septage from businesses and residences. WSPs are very easy to use, inexpensive, easy to construct, and effective. It can be utilized alone or in a coupling as a secondary or tertiary treatment unit in a treatment plant.

When considering maintenance costs and energy requirements, WSP becomes more cost-effective than other treatment methods because to its algal-bacterial symbiosis, which makes it a fully natural treatment process. WSP wastewater can also be utilized for gardening, farming, road irrigation, car washes, and other purposes. Modern technologies are being incorporated into WSP to improve its efficiency and design, yet there are still major obstacles.

The study "Oxidation Pond for Municipal Waste Water Treatment" was the main topic of Erick Butler et al. (2015). He claims there are problems with oxidation pond utilization, cost, and design in waste water treatment. Numerous topics have uses for laboratory analysis, either at full scale or in isolation.

Oxidation ponds offer a lot of benefits. Because the oxidation pond treatment method makes use of microorganisms such like algae and germs. Because of this, the treatment approach is economical to build, maintain, and use energy-wise. Oxidation ponds are beneficial because they produce wastewater that has multiple uses. Lastly, oxidation ponds are regarded as a sustainable wastewater treatment technique.

Table -1: POPULATION GROWTH OF VIDISHA

Census Year	Population
1921	4441
1931	11001
1941	13132
1951	19133
1961	27807
1971	43212
1981	65522
1991	92918
1993	93874

Table -2: POPULATION FORECASTING OF VIDISHA BY INCREMENTAL INCREASE METHOD

Decade	Population	Increase in Population	Incremental Increase
1941	13001	6133	2543
1951	19133	8675	6733
1961	27805	15407	6904
1971	43213	22309	5088
1981	65522	27397	-6097
1991	92918	21290	21539
2001	114217	42839	16673
2021	157053	59511	
2041	216566		

Table -3: Sewage generation

Year	Population	Water Demand @ 135 L.P.C.D.	Sewage @ 80% of Water Demand
1991	92918	12.540 MLD	10.03 ML per Day
2001	114216	15.410 MLD	12.31 ML per Day
2021	157053	21.20 MLD	16.97 ML per Day
2041	216565	29.230 MLD	23.39 ML per Day
2051	249637	33.70 MLD	26.97 ML per Day

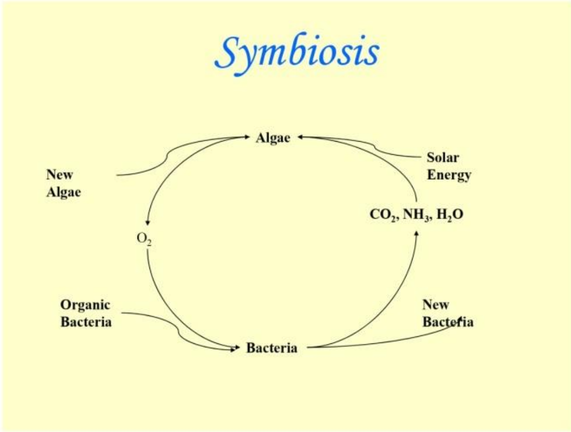

Fig -1: SYMBIOTIC RELATION BETWEEN ALGAE AND BACTERIA

3. MATURATION PONDS

Maturation ponds play a crucial role in wastewater treatment, particularly in enhancing the removal of nitrogen and phosphorus. When comparing their algal population to that of facultative ponds, it becomes evident that maturation ponds exhibit a significantly higher level of diversity. This diversity is paramount as it contributes to a more efficient treatment process. Throughout the series of ponds, there is a noticeable increase in algal variety from pond to pond.
Algal growth within maturation ponds works synergistically with photooxidation processes to regulate the main mechanisms responsible for pollutant removal. One of the primary functions of maturation ponds is the elimination of bacteria and fecal coliforms, which helps in improving water quality. While maturation ponds only remove a small amount of solids, their effectiveness in the removal of nitrogen and phosphorus is substantial.
Research focusing on total nitrogen removal from wastewater treatment pond systems has consistently shown impressive results. It has been found that these pond systems, including maturation ponds, are capable of removing up to 80% of nitrogen present in the wastewater. This finding aligns with the observed performance of maturation ponds in nitrogen removal.
The efficiency of maturation ponds in nitrogen and phosphorus removal highlights their importance in wastewater treatment processes. By harnessing the power of algal growth and photo-oxidation, maturation ponds contribute significantly to the overall purification of wastewater. Their role in enhancing water quality and reducing the environmental impact of wastewater discharge cannot be overstated. As research continues to refine and optimize wastewater treatment methods, maturation ponds remain a vital component in achieving sustainable water management goals.

4. CONCLUSIONS

Based on the results presented in the previous sections, it is evident that the sewage water is directly meeting the regular stream between the two by various means, or nallahs, with almost no pretreatment. As a result, an oxidation lake is created and eucalyptus trees are planted along the nallah. One significant factor in the consumption of organic matter is the oxidation pond. Therefore, in vidisha, eucalyptus trees and oxidation ponds should be utilized to remove organic materials. The Vidisha sewage treatment plant has a 22.25 MLD limit, which is sufficient for the current situation. However, the city's sewage is not going to the sewage treatment plant because it gets diverted into the stream, which is very harmful to the ocean's life and for human health. Additionally, the river becomes degraded in a few years in the unlikely event that the sewage doesn't stop to join the other. As a result, it's critical to take direct action about the many nallah meeting the waterway. In order to avoid these problems, we have designed several treatment plant units, including a coarse, fine, medium, and nallah screen as well as an oxidation lake and a tree of eucalyptus alongside which will clean the sewage water to a certain extent before it meets the betwa. Everyone should be responsible for preserving the typical river flow through various methods based on the requirement.
The maximum depth of 1 meter, length of 245 meters, and width of 61.23 meters for the oxidation pond will be more effective in treating sewage. A coarseness chamber is designed after assuming several hypotheses. The coarseness chamber's length is 12.25 meters, its viable profundity is 1.70 meters, its freeboard is 0.3 meters, and its overall profundity is 2.5 meters. Its area is 24.51 square meters. the strategy and resolve as shown in the drawing that is provided below. The cost analysis is also completed, and using S.O.R. prices, an amount of about 30 lakhs is evaluated. Additionally, the gauge is referenced below.

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