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SCHEMATIC PROCESS DESIGN OF SEWAGE TREATMENT PLANT AT DHAMTARI TOWN IN (C.G.)

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ABSTRACT

The main objective of this study is to carried out design of a sewage treatment plant for Dhamtari municipality, because it has been a developing place and due to rapidly increase in population, which in results huge quantity of sewage is produced. This project is focuses on quantity of sewage generation in Dhamtari area, to avoid the pollution of town through Sewage, to construct the sewage treatment plant. The main objective of the project is to treat the sewage of the town in such a way that treated sewage complies the parameters laid by MoEF (Ministry of Environment, Forest and Climate change). Objective is also of using treated sewage for non-potable purposes and thereby improving health and living standards of the people. Effort has been made to collect the sewage at a point due to which open flow of sewage is stopped. Which helps keeping environment less polluted. The scope of this project include identify Existing sewerage system, drains, disposal of sewage, calculation of present sewage generation and calculation of future sewage generation with the help of population forecasting, Compare different technologies for treatment of sewage and propose one of them. Design treatment unit and calculating its cost estimation. STP based on SBR Technology has been considered for treatment of sewage having Capacity of 19.60 MLD. The STP technology is being selected primarily taking into consideration less land requirement and to have effluent characteristics as per MOEF, so that treated water can be reuse or discharged into inland water ways which are being potential drinking water sources.

Keywords: Sewage, Dhamtari, Climate, Environment, Schematic, SBR Technology

1. INTRODUCTION

1.1 Background of study

Dhamtari is a district in the Indian state of Chhattisgarh. It was officially formed on 6 July 1998 from an amalgamation of Dhamma and Tarai (hence the name). The district headquarters is Dhamtari. Dhamtari dividing the Raipur district currently the capital of Chhattisgarh along with Mahasamund. Raipur district was broken up into the districts of Raipur, Mahasamund and Dhamtari. Dhamtari, Kurud and Nagari are included in Dhamtari district as tehsils, and blocks.The total area of the district is 2029 km2 and it is 305 meters above the sea level. In the east, Satpura range is located. It is popularly known as Sihawa Pahad.

Dhamtari's population was 17,278 in 1955. At that time, the town was part of Raipur District in the state of Madhya Pradesh. In 2000, it became part of the new Chhattisgarh state and headquarters for the Dhamtari tehsil. As a terminus of a narrow-gauge railway running 80 km (50 miles) north of Raipur on the main Bombay-Calcutta line of the Bengal Nagpur Railway, Dhamtari became a trade centre. Goods shipped from there included timber, shellac, morabulum nuts, beedi leaves (for cigarettes), rice and animal hides.

The American Mennonite Mission was established in Dhamtari in 1899. By 1952 the mission had merged with the Mennonite Church (MC) in India, which had its headquarters in Dhamtari. In 1955 the 558-member congregation was one of several missionary groups in Dhamtari, including the Dhamtari Christian Academy, Dhamtari Christian Hospital, the Samuel Burkhard Memorial Boys' Orphanage and a nursing school. **At the present Dhamtari is a "Nagar Nigam"**. According to the 2011 census Dhamtari district has a population of 799,199, roughly equal to the nation of Comoros or the US state of South Dakota. This gives it a ranking of 485th in India (out of a total of 640). The district has a population density of 236 inhabitants per square kilometre (610/sq mi). Its population growth rate over the decade 2001-2011 was 13.11%.Dhamtari has a sex ratio of 1012 females for every 1000 males, and a literacy rate of 78.95%.

Figure: 1.1 Dhamtari District Location Map

1.2 Need of the project

Towns are equipped with the modern facilities viz. electricity and water supply. With increase in the requirement of Water Supply, proper disposal of sewage is necessary. At present there is no sewage treatment facility in the town. Sewage flowing through open Drain gets disposed off in to the Open land. Due to increase in the use of water, Drains get filled up and their maintenance becomes a nuisance. It causes lot of unhealthy conditions for the people in general and the people rightly desire to have proper disposal system. Hence it is most necessary to provide this project of collection, treatment of sewage and safe disposal of treated effluent.

2. LITERATURE REVIEW

Zeng et al., (2021) Explained that with the growing public attention on sustainable development and green ecosystems, the efficient management of fuzzy sewage treatment processes (FSTPs) has been a major concern in academia. Characterized by strong abstraction and analysis abilities, data mining technologies provide a novel perspective to solve this problem. In recent years, data-driven management for FSTP has been widely investigated, resulting in a number of typical approaches. However, almost all existing technical approaches consider FSTP a unidirectional, sequential process, ignoring the bidirectional temporality caused by backflow operations. Therefore, we propose a data-driven management mechanism for FSTP based on hybrid neural computing (IM-HNC for short). This mechanism attempts to capture the bidirectional time-series features of

FSTP with the aid of a bidirectional long short-term memory model, and further introduces a convolutional neural network to construct feature spaces with a stronger expression capability. Empirically, we implement a series of experiments on three datasets under different parameter settings to test the efficiency and robustness of the proposed IM-HNC. The experimental results manifest that the IM-HNC has an average performance improvement of approximately 5% compared to the baselines.

Song et al., (2020) Conducted a study to solve the difficulties in operation and supervision of rural sewage treatment facilities, the intelligent management mode was proposed on the information-to-intelligence strategy. The mode is based on intelligent monitoring facilities to improve the data collection quality, supported by intelligent management platform to establish functional systems, and guaranteed by application services to excavate the whole process management efficiency. A set of systems were constructed to integrate functions such as data collection and management of the whole process, data value analysis, standardized process management, etc., by which the operators and supervisors can comprehensively and timely master the related operation information, aiding for decision making. Compared with the traditional information platform, as for the operation and supervision of rural sewage treatment facilities, the intelligent management platform can be more efficient on labor-saving, efficiency-improving, application-enhancing with the case application study in Jiaxing City, Zhejiang Province.

al plants under Goa Public Works Department were evaluated.

Bhargavi et al., (2018) The main objective of this study is carried out to design of a sewage treatment plant for a vizianagaram municipality, because it has been a developing place due to steady increase increasing population, which in results excess of sewage is produced. To avoid this problem, to construct the sewage treatment plant. This paper focuses on sewage generation in vizianagaram area, which was estimated 38.203MLD considering population of next 30 years. We are designed the various components of sewage treatment plant like screens, grit chamber, primary sedimentation tank, activated sludge process, sludge drying beds. It is proposed to design the various components of sewage treatment plant considering various standards and permissible limits of treated sewage water. The treated water will be used for irrigating the crops and the sludge which is generated after the treatment will be used as manure, so it increases the fertility of soil. Also reduce the ground water usage.

Yang et al., (2017) Explained that Funding shortages can greatly affect the construction and implementation of urban sewage treatment projects. Applying the public–private partnership model to urban sewage treatment projects will increase the financing capacity and mitigate the risk of local debt. Based on analyses of current urban sewage treatment projects and the relationship between the public–private partnership model and these projects, we demonstrated that the public–private partnership model is applicable to city sewage treatment projects, thereby enhancing social capital, improving the management and operation of the projects, and facilitating various management methods for innovation and optimization. We studied the relationships between responsibility and authority, benefit sharing, and risk sharing using the public–private partnership model as well as the main issues that affect urban sewage treatment, and we then analyzed these issues from the perspectives of government, enterprises, intermediary agencies, and public groups. We conclude that the implementation of public–private partnership models affect urban sewage treatment projects by defining the relationship between the government and market. Based on our comprehensive analysis, we provide policy suggestions regarding the public–private partnership model for urban sewage treatment with respect to government, social capital, and intermediary organizations, thereby providing a guide to the implementation of the public–private partnership model.

Chatterjee et al., (2016) Explained that Centralized sewage treatment plants may not be a sustainable solution for a developing country such as India. Therefore, we conducted for the first time an integrated assessment of the different technologies currently used for sewage treatment in the state of West Bengal, India. Five decentralized sewage treatment plants and one centralized sewage treatment plant located in different parts of Kolkata were evaluated. We compared influent and effluent water quality, energy consumed, capital and operating costs, and treated wastewater reuse potential. F test was used to validate results on the effect of working days and holidays and seasons on treated water quality. Wastewater management strategy was assessed by performance indicators. Our results show that treatment efficiency was lowest in anaerobic plants not because of faulty technology but due to unskilled operation. Therefore, performance improvement of plants is expected if factors such as monitoring, training of staff, regular and scrupulous desludging, reuse aspects, and rational water tariff are implemented earnestly.

3. OBJECTIVES OF THE STUDY

1. The main object of this project of preparation of sewer collecting system includes
2. Problem identification during survey of town.
3. To forecast population and calculate quantity of sewage generation of Dhamtari town.
4. To classify the process of treatment and comparison of different technologies for treatment of sewage.
5. Provision of treatment unit and its Cost Estimation.

4. METHODOLOGY

During site visit it was observed no Drain meet the river. All houses dispose off their sewage (Through Septic Tank) in various Drain's. These Drains are connected to Main Drain's namely PD Drain or Sorid Drain.

There is a canal passing at Northen side of town. Smaller area above canal disposing sewage in Arjuni Drain. Arjuni Drain flowing Southen to Northen side. After few km this Drain become dry.

PD Drain runs across the town carrying most of the seweage of this town. It serves Industrial Area, Dhamtari Railway Station area, Ghadi Chowk, Balak Chowk, Gole Bazar, Bhairudan Manaklal Nahar, Vivekanand Nagar, Bania Para Itwari Bazar, Brahaman Para, Maratha Para, Rambagh, St. Lahari Nagar, Sundar Ganj, Shitalpara, Hatkeshar, Subhash Nagar, Dak Bungalow, Housing Board Colony, Post Office ward etc.

Another Drain is Sorid Drain which serves the area of Dani Tola, Gokulpur, Moat of Maratha Para area, VIP Bazar, Bhatgaon, Sori Ward, Jodhapur Ward, Tikrapara, Banspara, Post Office Ward etc.

Figure 3.1 (a): PD Drain

Figure 3.1 (b): PD Drain

4.1 Population Forecast

Table No. 4.1: Census population of Dhamtari Town in Last five Decades

S.no.	Year	Population
1	1971	43362
2	1981	55797
3	1991	69357
4	2001	82111
5	2011	101677

4.2 Arithmetic Method

This method is suitable for large and old city with considerable development. If it is used for small, average or comparatively new cities, it will give lower population estimate than actual value. In this method the average increase in population per decade is calculated from the past census reports. This increase is added to the present population to find out the population of the next decade. Thus, it is assumed that the population is increasing at constant rate.

Table No. 4.2: Calculation of mean growth rate in Last five Decades by Arithmetic method.

YEAR	POPULATION	INCREASE per DECADE	%age INCREASE per DECADE	INCREMENTAL INCREASE per DECADE
1971	43362			
1981	55797	12435	28.68%	
1991	69357	13560	24.30%	1125
2001	82111	12754	18.39%	-806
2011	101677	19566	23.83%	6812
TOTAL	352304	58315		
MEAN	**58717**	**14578.8**	**23.80%**	**2377**

Base Year Total Population = (2011)	101677	Souls

Considered next 30 years of population forecasting: -

Commissioning Year	2020
Prospective year	2035
Ultimate year	2050

Calculation: -

Population in Commissioning Year 2020 will be			
= 101677 + (14578.8 * 0.9)	= 114797.9	**114798**	Souls
Population in Prospective year 2035 will be			
= 101677 + (14578.8 * 2.4)	= 136666	**136666**	Souls
Population in Ultimate year 2050 will be			
= 101677 + (14578.8 * 3.9)	= 158534.2	**158534**	Souls

4.3 Incremental Increase Method

This method is modification of arithmetical increase method and it is suitable for an average size town under normal condition where the growth rate is found to be in increasing order. While adopting this method the increase in increment is considered for calculating future population. The incremental increase is determined for each decade from the past population and the average value is added to the present population along with the average rate of increase.

Table No. 4.3: Calculation of mean growth rate in Last five Decades by Incremental increase method.

YEAR	POPULATION	INCREASE	INCREMENTAL INCREASE
1971	43362		
1981	55797	12435	
1991	69357	13560	1125
2001	82111	12754	-806
2011	101677	19566	6812
	TOTAL	58315	7131
	AVERAGE	**14579**	**2377.00**

Calculation: -

Population in Commissioning Year 2020		
101677+ (0.9*14579) + [(0.9*(1 +0.9) *(2377))/2] =	**116831**	Souls
Population in Prospective year 2035		
101677+ (2.4*14579) + [(2.4*(1 +2.4) *(2377))/2] =	**146365**	Souls
Population in Ultimate year 2050		
101677+ (3.9*14579) + [(3.9*(1 +3.9) *(2377))/2] =	**181248**	Souls

Adopting Incremental increase method for population forecasting because it is most favourable and appropriate method for population forecasting.

4.4 Sequencing Batch Reactor

Sequencing batch reactors (SBRs) - SBRs are used all over the world and have been around since the 1920s. With their growing popularity in Europe and China as well as the United States, they are being used successfully to treat both municipal and industrial wastewaters, particularly in areas characterized by low or varying flow patterns. Municipalities, resorts and a number of industries, including dairy, pulp and paper, tanneries and textiles, are using SBRs as practical wastewater treatment alternatives.

Since the 1970s, Improvements in equipment and technology, especially in aeration devices, have made SBRs a viable choice over the conventional activated-sludge system and it has been successfully used to treat municipal and industrial wastewater. The pollutant removal efficiency of SBR system is higher for nitrogen and phosphate. The SBR system can remove heavy metal such as Zinc (Zn), Copper (Cu), lead (Pb) with organic pollutant and nitrogen.

5. RESULTS

The Design Component and Cost Estimation

1. Name of Town: - Dhamtari

2. Design Period in year:

Immediate Stage: - 2020
Intermediate Stage: - 2035
Ultimate Stage: - 2050

3. Town area: - 2978.45 Ha.

4. Design Population(souls): Immediate Stage, Intermediate Stage**,** Ultimate Stage

LOCATION	**2020**	**2035**	**2050**
Population	**116831**	**146365**	**181248**
Total	**116831**	**146365**	**181248**

5. Adopted DWF

Water Supply (lpcd)	**DWF (90% of Water supply-lpcd)**	**10% for Infiltration**	**Total DWFwith infiltration**
135	**121.5**	**12.15**	**133.65**

6. Projected DRY WEATHER FLOW(MLD)

Immediate Stage, Intermediate Stage and Ultimate Stage

LOCATION	2020	2035	2050
DRY WEATHER FLOW (MLD)	15.61	19.56	24.22
Total (MLD)	**15.61**	**19.56**	**24.22**

7. Present Position

During site visit it was observed no nalla meet the river. All houses dispose off their sewage (Through Septic Tank) in various nalas. These nalas are connected to Main Nalas namely PD Nala or Sorid Nala.

There is a canal passing at northern side of town. Smaller area above canal disposing sewage in Arjuni nalla. Arjuni nalla flowing southern to northern side. After few km this nalla become dry.

PD Nala runs across the town carrying most of the seweage of this town. It serves Industrial Area, Dhamtari Railway Station area, Ghadi Chowk, Balak Chowk, Gole Bazar, Bhairudan Manaklal Nahar, Vivekanand Nagar, Bania Para Itwari Bazar, Brahaman Para, Maratha Para, Rambagh, St. Lahari Nagar, Sundar Ganj, Shitalpara, Hatkeshar, Subhash Nagar, Dak Bungalow, Housing Board Colony, Post Office ward etc.

Another nala is Sorid Nala which serves the area of Dani Tola, Gokulpur, Moat of Maratha Para area, VIP Bazar, Bhatgaon, Sori ward, Jodhapur Ward, Tikrapara, Banspara, Post Office Ward etc.

Seweage from both these drains is proposed to be collected in collection chamber designed for their respective quantity of seweage. This seweage is then proposed to be carried to STP through underground pipeline of RCC NP3 Pipes.

STP is proposed to treat seweage and treated seweage (as per MoEF standards) is proposed to be disposed off in different area for non-potable use of treated seweage.

1. In natural low area by gravity pipeline
2. In canal by nominal pumping of treated seweage.
3. Proposed to be carried to the required places with the help of tractors and trollies for non-potable purpose.

6. CONCLUISON AND RECOMMEDATIONS

6.1 Conclusion

- Sewerage system is an important environmental infrastructure component for the development of the town as well as for good health and hygiene of the community.
- Once the project is completed and in use, the town shall benefit in the following ways.
- Engineered sewer collecting system shall maintain the proper sanitary conditions in the town.
- Overall improvement of public health is caused due to the proper treatment of sewage.
- Treated sewage shall be available for irrigating agricultural fields leading to more production of agricultural products.
- After implementation of project habitants of the town get advantage of the system. 7. During monsoon STP may not work properly because there are chances of mixing of storm water with sewage.
- Capacity of STP has been decided based on population forecasting.
- Hence, during monsoon STP may not be functioning fully.

6.2 Recommendations

- Water use planning should be done on micro-watershed basis with government support and people's participation in blocks and districts on the pattern of land use planning for optimal and sustainable water resource development. Teams of leading scientists and experts of water management should be formed to explore and develop technology packages for better integrated water resource utilization in the region.
- For promoting conjunctive use of surface and groundwater construction of SFR and shallow dug well in individual farmer's field need to be subsidized to the extent of 50% of the total cost and the money be transferred to the bank account of farmers to avoid regularities in such money transactions. Such water harvesting structures in Indonesia and Phillippines are individually owned, managed and operated by farmers where similar land holding pattern as that of our country exists.
- Policy makers of water resources development in our country should realize that expenditure on water resource development to individual farmers in an investment for future food security, because these small water resource/ water harvesting structures contribute to a great extent the recharge of ground water, alleviate submergence and drought in order to promote sustainable agriculture and crop diversification.
- 4 In most of the canal command areas, the efficiency of water use is about 30% or less. At least it should be improved to the extent of 50% by adopting transient storages system and using pressurized irrigation system such as drip, sprinkler and surge irrigation.
- For effective crop diversification and increase in cropping intensity low water requirement and high value crops are need to be promoted. More flexibility of irrigation system to meet water demands, in terns of time, amount and locational accessibility should be ensured. Appropriate marketing and processing facilitates hold the key to success of the diversified agriculture and the measures should be taken by the government to meet this need.

7. SCOPE OF FUTURE SCOPE

Prepare a detail scope of work including Connection of Drains, sewerage network to carry the complete sewage of whole town to Sewage Treatment Plant by gravity or by pumping without any obstruct, STP of require capacity to treat sewage and work on reuse or retreatment of effluent obtain from STP after sewage treatment process. Operation and maintenance charges area calculated according to the norms defined by the Government of Chhattisgarh.

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