Sustainability of Gosthani River and Design of Sewage Treatment Plant for Tanuku Town, West Godavari District, Andhra Pradesh, India

Surisetti Vamsi Harischandra Prasad, A. Aravindan, Koya Naga Venkata Siva Prasad

Abstract: ***The present study discusses the sustainability of the Gosthani River which is flowing through Tanuku town. In Tanuku, this river water is not used for drinking purpose. After crossing Tanuku town, some of the villages like Velpur, Relangi, Attili etc., are used for drinking and irrigation purpose also. The entire sewage of Tanuku is directly discharged into the Gosthani River which creates an alarming situation to the water quality of Gosthani River. So the samples of Gosthani River are collected and then samples were tested for various physicochemical parameters. The results were compared with Beaure of Indian Standards (10500-2012). It is found that the results obtained from the study area are within the limits. But in future, they may vary due to a rapid increase in population. There is no Sewage Treatment Plant in Tanuku. In this study, the design of sewage treatment plant in Tanuku is discussed. The construction of the sewage treatment plant is to prevent the direct disposal of sewage in the Gosthani River. In the present study, a comprehensive design of unit operations and unit processes are discussed. By the execution of the project, the Gosthani River gets sustained.***

Index terms: Alarming, Gosthani River, sustainability, Unit operations, Unit processes.

I. INTRODUCTION

Drinking water has great effects on human health. Access to safe drinking water is a key to sustainable development. Now -a-days waste generated by the various activities of human and industries are directly discharged into the river which affects human as well as aquatic life. According to IS standards guidelines, the water quality of about 60-70% river water contaminated due to pollution in India. Sewage pollution is a major problem because it causes risk to human health. Sewage may contain many types of diseases causing organisms that can cause various health problems .The present study was to examine the quality of Gosthani river in and around Tanuku town of West Godavari District. The river Gosthani is flowing through Tanuku town. Since there is no sewage treatment plant in Tanuku, the domestic sewage is directly discharged into Gosthani River which creates an alarming situation to the quality of the water of Gosthani River. In Tanuku, this river water is not used for drinking purpose but after crossing Tanuku town, some of the villages like Velpur, Relangi, Attili etc., are used for drinking and irrigation purpose also. Before supplying this water to households, the municipality treats this water. Even after treatment also, the heavy metals remains in water itself which are toxic and causes health issues. So we should prevent the contamination of Gosthani River so as to reduce its toxicity. Here an attempt is made to control the pollution load over Gosthani River. For controlling pollution load of Gosthani river, we have to design a sewage treatment plant .The construction of the sewage treatment plant is to prevent the direct disposal of sewage in the Gosthani river. The importance of activated sludge treatment process is that it treats the water in most economical way [1].The reasons for treating a wastewater is to prevent the pollution of the river and to safeguard the public health [2].The main objective of the wastewater management is to protect the environment and public health [3].With the steady growth of the population, the generation of the household sewage will also increases [4].Due to modernization production of waste has increased day by day [5].The present sewage system in Chinhoyi should be upgraded and rehabilitee. Chambal River is affected badly due to discharge of open drains in kola city [7]. A study was considered for the development of water quality index using various parameters [8].If waste water treatment is done properly, it removes toxic pollutants present in the water and it also eliminates waterborne diseases [9].The ultimate design of various components of sewage treatment plant should be at least 30 years [10].The sludge obtained from the sewage treatment can be used as a manure [11].The average quantity of sewage exceeds 400m^3/h, mechanical screens are recommended. The top of the screens shall be at least 300mm above the highest flow level [12].In grit removal devices the specific gravity for removing particles should be 2.3[13]. A minimum velocity of 0.6m/s is maintained to prevent sedimentation [14].

II. STUDY AREA

Tanuku is located at 16.75^{0}N 81.7^{0}E in West Godavari of Andhra Pradesh. The below figure 1 shows Tanuku area. There are 8 villages and 2 towns in Tanuku Mandal. It has tropic climate with an annual rainfall of 313.4mm. Its area is 56.54 sq.km. As per the census India 2011, Tanuku

Revised Manuscript Received on April 09, 2019.

S.Vamsi Harischandra Prasad, Department of Civil Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, A,P, India.

Dr.A.Aravindan, Professor, Department of Civil Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, A,P, India

Koya Naga Venkata Siva Prasad, Department of Civil Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, A.P, India.

population is 90,520.The River Gosthani is flowing through Tanuku town. The study area of Tanuku town is shown in Figure I.

Figure 1 : Study area of Tank
(Source: www.google.in)

III. RESEARCH SIGNIFICANCE

The present study aims to control pollution load over .Gosthani River in Tanuku town and to design a suitable sewage treatment plant to meet the domestic demands in Tanuku town.

IV. ATERIALS AND METHODOLOGY

Sampling of Water

The sampling of water has been carried out from various points of Gosthani river of Tanuku town. Water samples are collected from different locations and the samples are examined. The above table shows the geographical coordinates of the samples collected sites as shown in Figures 2,3,4,5,6,7,8.

Table I: Geographical coordinates of the sample collected sites.

S.No	Sample collected sites	Latitude	Longitude
1.	Chowdary Spinner Limited	16.783969	81.672271
2.	Near Lakshmi Ganapathi Alayam	16.775602	81.672585
3.	Sivalyam Street	16.760859	81.678882
4.	Society Road	16.759199	81.682606
5.	Andhra Sugar Colony	16.735860	81.674606
6.	GDM Church	16.7294797	81.682606

Figure 2: Samples collected area
(Source: www.google.in)

Figure 3: Sample collected site S1

Figure 4: Sample collected site S2

Figure 5: Sample collected site S3

Figure 6: Sample collected site S4

Figure 7: Sample collected site S5

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

Figure 8: Sample collected site S6

B. Physico-Chemical Parameter Analysis

Various physico-chemical tests like pH, temperature, electrical conductivity, turbidity, acidity, alkalinity, total hardness, chlorides, fluorides, Total Dissolved Solids, Total Suspended Solids, Total Solids, Dissolved oxygen, BOD, COD, pH and TDS were performed in the laboratory. The values of physcio-chemical parameters of Gosthani River water are shown in below Table II and Figures 9,10,11,12,13,15,16,17,18,19,20.

Table II: Physico-Chemical parameters values for Gosthani River samples

Note-All units are mg/lit except pH and Temperature (^{0}C)

S.No	Parameters	SAMPLES						IS10500-2012
		Chowdary Spinner Limited	Near Lakshmi Ganapathi Alayam	Sivalyam Street	Society Road	Andhra Sugar Colony	GDM Church	
1.	pH	7.8	7.2	7.3	7.4	7.7	7.3	6.5-8.5
2.	Temperature	29	26	28	27	26	28	----
3.	Electricity conductivity	0.3	0.4	0.3	0.4	0.2	0.3	05-0.7
4	Turbidity	8.91	22.1	8.56	9.18	14.2	12.6	1-5
5.	Alkalinity	8	7	11	7	12	14	200-600
6.	Acidity	16	22	16	14	18	22	45
7.	Chlorides	9.99	10.2	7.9	8.4	8.2	7.3	250
8.	Fluorides	0.03	0.03	0.015	0.03	0.03	0.015	1.0-1.5
9.	Dissolved Oxygen	1.6	1.1	1.8	2.1	1.4	1.7	6
10.	Total Dissolved Solids	2.05	1.25	1.68	0.69	1.4	0.73	500-1000
11.	Total Suspended Solids	3.2	4.2	3.12	4.11	3.8	4.72	_
12.	Total Solids	5.25	5.45	4.8	4.2	5.2	5.45	_

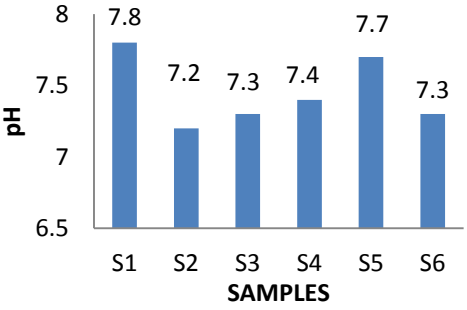

Figure 9: pH values of collected samples

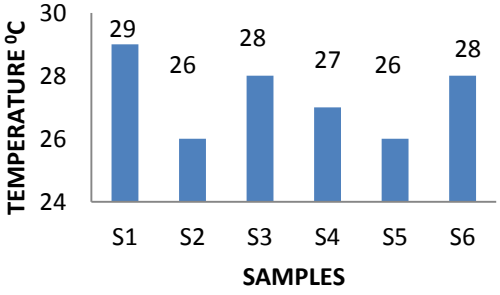

Figure 10: Temperature values of collected samples

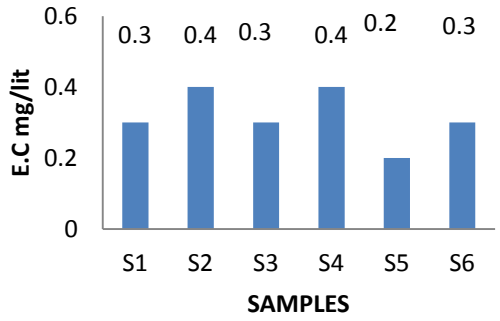

Figure 11: Electrical Conductivity values of collected samples

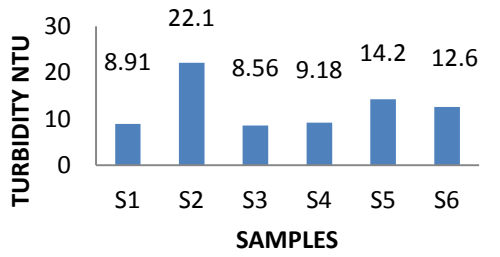

Figure 12: Turbidity values of collected samples

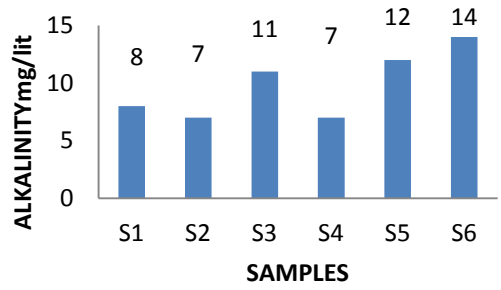

Figure 13: Alkalinity values of collected samples

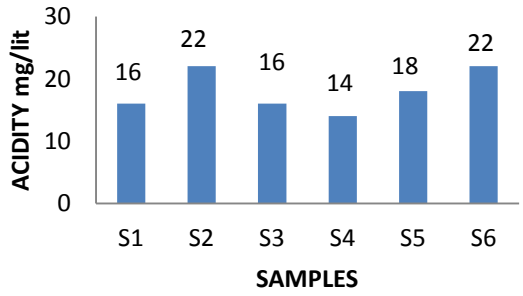

Figure 14: Acidity values of collected samples

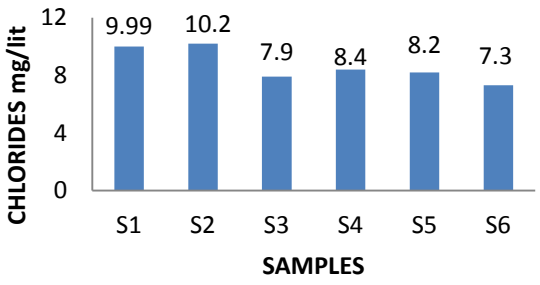

Figure 15: Chloride values of collected samples

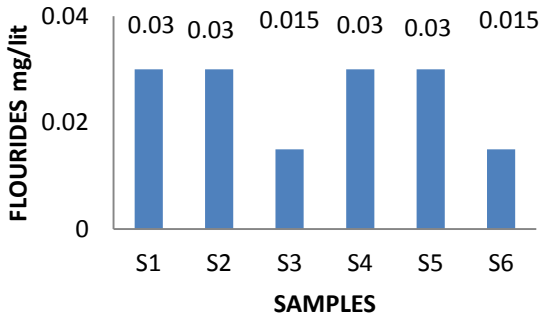

Figure 16: Fluoride values of collected samples

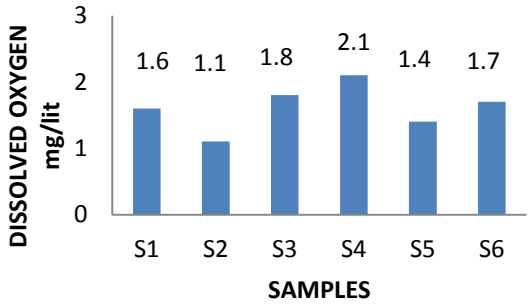

Figure 17: Dissolved Oxygen values of collected samples

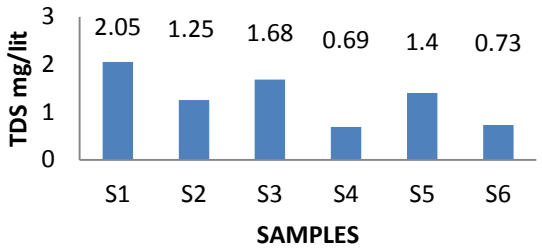

Figure 18: Total Dissolved Solids values of collected samples

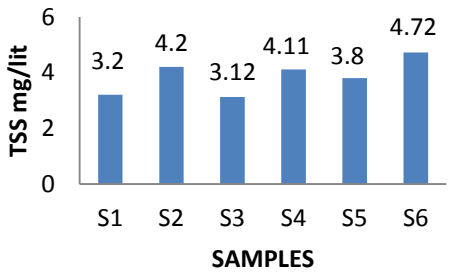

Figure 19: Total Suspended Solids values of collected samples

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

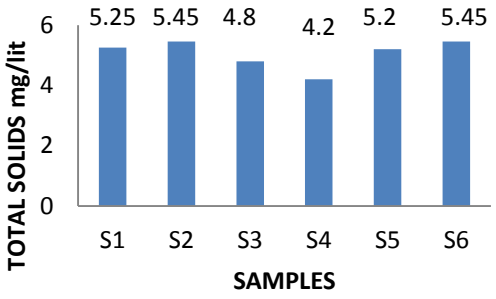

Figure 20: Total Solids values of collected samples

The results were compared with Beaure of Indian Standards (10500-2012).It is found that except turbidity, remaining all parameters obtained from the study area is within the limits. But in future they may vary due to rapid increase in population because of rapid increase in industrialization. For sustainability of Gosthani River, we should design a sewage treatment plant for Tanuku town.

C. Need For Treatment:

- Pollutants must be removed from the water to protect the environment and public health.
- The water becomes contaminated with pollutants. If left untreated, these pollutants would negatively affect our nature.
- The pollutants must remove through proper waste treatment.

D. Geometrical Increase Method:

This method is suitable because the Tanuku have a rapid growth of population since it belongs to municipality. The details of population increase in shows in below Table III.

Table III: Population Forecasting

Year	Population	Increase in	%increase in
1981	53,618	----------	----------
1991	62,913	9,295	17.3%
2001	65,585	2,672	4.24%
2011	90,430	24,845	37.88%

The design period should be considered for at least 30 years.

$P=P\ (1+I_G/100)^n$

$P_{2021}=90,430(1.14050)^1=1,03,135$

$P_{2031}=90,430(1.14050)^2=1,17,625$

$P_{2041}=90,430(1.1405)^3=1,34,152$

Per Captia Demand=135/lit/day/person.

Water demand=1,34,152x135=18.11MLD

Sewage Demand=80% of water demand

=14.48MLD

E. Sampling of Sewage:

The sample locations and their coding are shown in below Table IV.

Table IV: Sample Locations

S.No	Sample Location
1.	Near Pyduparu
2.	Rastrapathi Road
3.	Narendra Centre
4.	Near Palangi

F. Physico-Chemical Parameter Analysis Of Sewage In Tanuku:

The values of physico-chemical parameters of sewage in Tanuku town are shown in below Table V and Figures 21,22,23,24,25,26.

Table V :The Physico-Chemical Parameters of sewage

S.No	Parameters	Samples				Effluent Standards As Per Environmental Protection Act 2002 (Regulation 6)
		Near Pyduparu	Rastrapathi Road	Narendra Centre	Near Palangi	
1.	B.O.D mg/lit	26.34	31.27	14.73	49.13	40
2.	C.O.D mg/lit	150.34	180.46	160.28	168.52	120
3.	Dissolved Oxygen mg/lit	0.3	0.1	0.4	0.3	6
4.	Total Suspended solids mg/lit	0.4	0.7	0.7	0.8	35
5.	Total Settleable Solids mg/lit	60.46	75.13	40.26	52.14	—
6.	pH	6.4	6.2	6.52	6.73	5-9

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

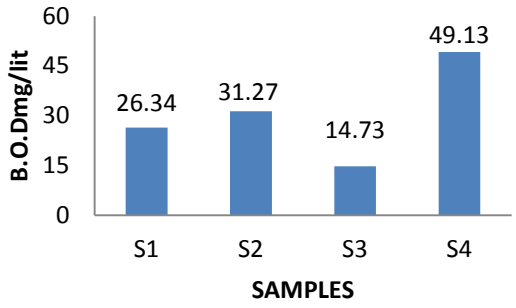

Figure 21: B.O.D values of collected sewages

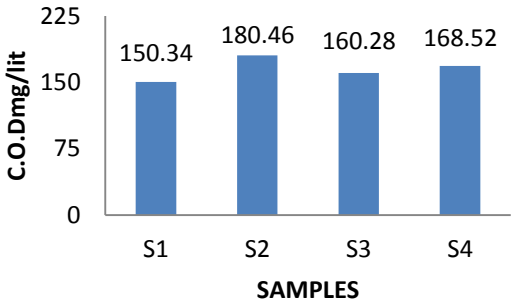

Figure 22: C.O.D values of collected sewages

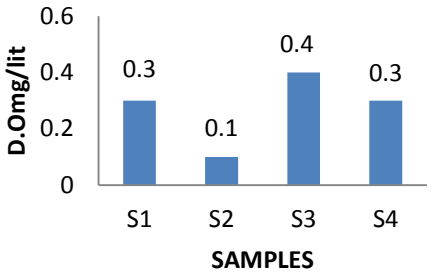

Figure 23: Dissolved Oxygen values of collected sewages

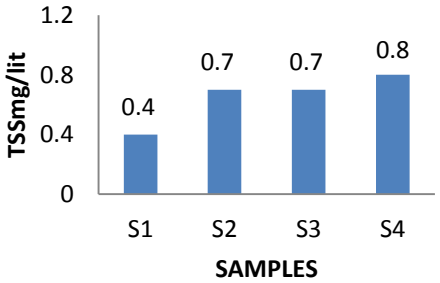

Figure 24: Total Suspended Solids values of collected sewages

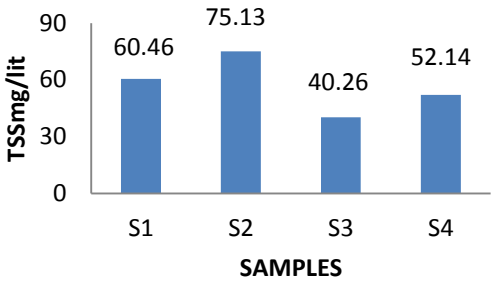

Figure 25: Total Settleable Solids values of collected sewages

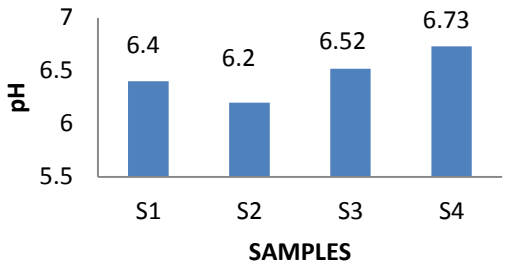

Figure 26: pH values of collected sewages

V. RESULTS

DESIGN OF SEWAGE TREATMENT PLANT

A. Screens:

Designing of screens has done as per IS:6280-1971

No. of screens= 2
Length =-1.0m
Width=2m
Depth=0.5m
Size of bars=10×50mm
Cross Sectional opening =25mm
Provide 14 bars at an inclination of 45^0 with slope as 1 in 500.

B. Grit Chamber:

Designing of Grit chamber has been carried out as per IS:6279-1971

No. of grit chamber=1
Length=15m
Width=2.5m
Area=5.583m^2
Depth =2.25m
Settling velocity=0.03m/sec.
Horizontal velocity=0.25m/sec.
Provide size of grit chamber of 15×2.5×2.25.

C. Primary Sedimentation Tank:

As per IS:10261-1982, primary sedimentation tank has been designed.

No .of primary settling tank= 2
Diameter=15m
Area=181m^2
Depth=2.5m
Volume=352.49m^3

Detention Period=1hour 17minutes
No of collecting channel=
Length=----------m (depends on site area).
Breadth=0.5m
Depth=0.33m
Total depth=0.7m

D. Activated Sludge Process:

Design of Activated Sludge process is done using IS:8413 (Part II)-1982
Volume=4826.66m^3
Hydraulic Retention time=8hrs.
Total Length=360m
Width=28.5m
Depth=3.5m

E. Secondary Sedimentation Tank:

Designing of secondary sedimentation tank has been carried out as per IS:10261-1982
Diameter of each clarifier=17.6m
Area of each clarifier=241.33m^2
Total depth of each clarifier=2.5m
Detention time=2hr

F. Digester Units:

Design details of digester units are shown below
Volume of digester sludge=834
Height of digester=5m
Area=166.8m^2
Diameter=14.6m

G. Sludge Drying Beds

Design of sludge drying beds as per IS:10037-1-1977
Length of each sludge drying bed=2.5m
Width of each sludge drying bed= 0.8m
No. Of sludge drying beds=9

VI. CONCLUSION

The water quality of the Gosthani River water in Tanuku town is compared with BIS 10500-2012.It isparameters obtained from Tanuku town are within the limits. But in future they may vary due to industrialization. That indicates that generation of sewage also gets increased. The entire sewage is discharged into Gosthani River so that pollution load of Gosthani River will be increased. So, for sustainability of Gosthani River, we have to design a sewage treatment plant for Tanuku town.

In the present study, an sewage treatment plant has been developed for managing the sewage generated in Tanuku town.

1. The predicated population of Tanuku for 2014 is 1,34,152 and estimated sewage generated from Tanuku town is 14.48MLD.
2. The dimension of screen is provided 14 bars of 10x50mm size at an inclination of 45^0
3. The dimension of grit chamber is 15×2.5×2.25m
4. The dimension of the primary sedimentation tank is diameter of 15 m and depth of collecting channel including free board=0.66m.
5. The dimension of activated sludge process is width of 28.5m and depth of 3.5m.
6. The dimension of the secondary sedimentation tank is diameter of 17.6m and total depth as 2.5 m.
7. The dimension of digester unit height 5 m and volume as 834m^3/day.
8. The dimension of sludge drying bed of length 2.5 m and width as 0.8 m and no. of beds are 9.
9. The area should require for sewage treatment plant is 5.84 acre.
10. The cost for initialization of sewage treatment plant including land cost is Rs.260Lakhs.

In Tanuku, there is no such government land for constructing this sewage treatment plant. So, government should initiate some scheme for collection of land in order to construct the sewage treatment plant in Tanuku town. The construction of the sewage treatment plant will sustain the Gosthani River so that water contamination can be irradiated and pollution free water can be supplied to surrounding villages. prevent the direct disposal of sewage in nearby Gosthani River in Tanuku so that the river water gets sustained.

VII. REFERENCES

1. Akshey Bhargava, "Activated Sludge Treatment Process – Concept and System Design", *International Journal of Engineering Development and Research*,, vol. 4,no. 2,pp. 890-897, (2011)
2. Baba Uqab, Anita Singh and Syeed Mudasir, "Impact of sewage on physcio-chemical water quality of Tawi River in Jammu city," *ResearchGate*, vol. 1, no. 2, pp. 56-61, (2017).
3. Farid Ansari, Yashwant K. Pandey," Conceptual Design of a Wastewater Treatment Plant for the Dera Bassi Industrial Estate, Punjab (India)", *Global Journal of Science Frontier Environment and Earth Science* ,vol.13, no.14,pp.1-10, (2013)
4. M. Bhargavi, E. Ananta Rao, T.Pravallika," Analysis and Design of Sewage Treatment Plant: A Case Study on Vizianagaram", *International Journal of Civil Engineering*, vol. 5, no. 4, pp.23-28, 2018.
5. Murhekar Gopalkrishna, "Determination of Physico-Chemical parameters of Surface Water Samples in and around Akot City," *International Journal of Civil Engineering*,, vol. 1, no. 2, pp. 183-187, (2011).
6. Muisa Norah, Zingundu Shumirai, Mangori Lynda Zelma, Mupfiga Upenyu**,** " The Conventional Design Impacts of Untreated sewage discharge on water quality of middle Manyame River: A Case of Chinhoyi Town, Zimbabwe", *International Jounal of Envirnomental Monitoring and Analysis* , vol. 3, no. 3, pp.133-138, (2015).
7. Naveen Kumar and Mahendra Pratap Choudhary, "Effect on water quality of chambal river due to discharge of open drains in kota city," *International Research Jounal of Engineering and Technology*, vol. 4, no. 11, pp. 890-894, (2017).
8. Nidhi Gupta, Pankaj Pandey and Jakir Hussian, "Effect of physicochemical and biological parameters on the quality of river water of Narmada, Madhya Pradesh, India," *Elesevier*, vol. 02, no. 48, pp. 1-13, (2017).
9. Nidhi Jain, "Physico-chemical assessment of water quality in one part of Hinjewadi, Pune, Maharashtra,India," *International Journal of Advances in Science Engineering and Technology* vol. 7, no. 1, pp. 1-7, (2018).

10. Sejalkumar J patel, Sagar Chuhan, Heri Patel, Shahid Patel and Prapati Tailor, "Proposed Design of sewage treatment plant for kodadara town located at south gujarat region,"*International Research Jounal of Engineering and Technology*, vol. 5, no. 5, pp. 2280-2283, (2018).
11. Swati Shree Samal, " Design of Sewage Treatment Plant", *Jounal of Mechanical and Civil engineering*,vol. 13, no. 15,pp.25-31, (2016)
12. IS:6280-1971,"Indian Standard Specification For Sewage Screens".
13. IS:6279-1971, "Indian Standard Specification For Sewage Grit Chamber".
14. IS:10261-1982,"Indian Standard Requirements For Settling Tank (Clarifier Equipment For Waste Water Treatment)".

ABOUT THE AUTHORS

S.VAMSI HARISCHANDRA PRASAD received the B.Tech Degree in Civil Engineering from SRKR Engineering College, Bhimavaram; Andhra Pradesh, India in 2017.He is pursing M.Tech degree in Construction Technology and Management from Koneru Lakshmiah Education Foundation (Deemed to be University), Vaddeswaram, Guntur district, Andhra Pradesh, India.. \He highly shows interest in participating in all events and workshops in and around the college.

Dr. A.Aravindan working as Professor in Department of Civil Engineering at Koneru Lakshmiah Education Foundation (Deemed to be University), Vaddeswaram, Guntur district, Andhra Pradesh, India. He has completed Master of Technology in Environmental Engineering in 2007 and Ph.D. in Environmental Engineering from Anna University in 2017. His research interests include Solid waste management and Hazardous waste management of Environmental Engineering. He has published 7 research papers in international journals and conferences and guiding 7 number of Ph.D. scholars, guided 6 number of masters and 2 number of Bachelor's dissertation work. He is a lifetime permanent member of IE (Institute of Engineers), ISRD (International Society for Research and Development) and ISTE (Indian Society of Technical Education).

Koya Naga Venkata Siva Prasad awarded B.Tech from JNTU kakinda in 2017. He is having Lifetime membership of Indian society of Water Resources and Indian Society of Hydraulics, Associate member in Institution of Engineers in India. He is Pursuing M.Tech degree in Environmental Engineering from Koneru Lakshmiah Education Foundation (Deemed to be University), Vaddeswaram, Guntur district, Andhra Pradesh, India. He actively participating in workshops and seminars in and Around the University