iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 **Issue:** III **Month of publication:** March 2019

DOI: http://doi.org/10.22214/ijraset.2019.3340

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 7 Issue III, Mar 2019- Available at www.ijraset.com

Performance Evaluation of Sewage Treatment Plant Relating to Chemical Characteristics and Re-use of Treated Sewage in Landscaping

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Abstract: ***It is known that agriculture sector needs most of the water (70%-80%) available in our country India. The use of partially treated municipal waste-water is one such aspect of importance and could prove revolutionary in itself, especially in arid and semi-arid areas including India. The treated sewage from STP located near Railway colony, Tikrapara, Bilaspur (C.G.) is being used in landscaping and gardening of a golf course situated near-by the plant, the effluent is analysedrelating to the chemical parameters for use of treated sewage for irrigation in agriculture in accordance with Indian standards. The parameters considered for evaluation are B.O.D., pH, Chlorides, Total hardness, Manganese, Sulphates and Iron.***
Keywords: B.O.D., pH, Chlorides, Total hardness, Manganese, Sulphates and Iron and Re-use of treated wastewater.

I. INTRODUCTION

This paper determines the efficiency with which the sewage treatment plant is able to remove the biological oxygen demand and various other parameters using the IS method that is adopted to calculate it. And it is analysed and evaluated in accordance to the Indian Standards for the use of wastewater in agriculture/landscaping.In India, water availability per capita has declined from 5000 cubic meters (m^3) per annum in 1950 to around 1550 m^3 in 2016 and is expected to decline to around 1400 m^3 by 2025. Much work has to be done in India for popularizing the re-use of sewage in industries as well as in agriculture. Design of the whole system or facility can and should be undertaken right from the start i.e. treatment plus farming. The disposal of wastewater would not remain a burden then and even some earnings can be made through it by the concerned municipalities. The use of partially treated wastewater can be advantageous if it is used properly, because of various nutrients present in it such as nitrogen, sulphate, phosphorous etc. In India, the specifications and rules regarding the re-use of partially treated municipal wastewater in parks/landscapes and agriculture are not separate as is in U.S.A and other European countries where the rules for use of treated wastewater in parks are stricter as compared to agriculture.

II. LITERATURE REVIEW

1) *Leena A.V:* Leena determined the efficiency of a STP treating the effluent of a dairy farm/industry. Dairy industries have their own set of effluent treatment problems and she found out that dairy industry requires 2.5 to 4 liters of water per liter of milk process which comes out as waste water. Waste water (effluent) from dairy processing units contains dissolved sugars, proteins and fats which are organic in nature and biodegradable which in-turn liberates gases, causes taste and odour, and creates colour and turbidity. It was noticed that more than 75% of BOD removal was observed to be achieved in Dairy A plant and also a consistency was seen in the performance of the ETP. Here, all the ETP's performance is seen consistent results in its own standard.
2) *M. Salgot, E. Huertas et al.: Wastewater reuse and risk: definition of key objectives***:** Key objectives of wastewater re-use and the risk associated with them are thoroughly researched on in this thesis. Wastewater reclamation holds promise as an important water resource, as our wish to develop arid and semi-arid regions continues to place growing demands on fixed or gradually decreasing water resources. In the case of wastewater reuse, they conclude that the biological parameters have to indicate all potential pathogens causing infection diseases and/or intoxication in all living beings which includes plants and animals.
3) *Jeroen H. J. Ensinket al.: Implementation of the who Guidelines for the safe use of Wastewater in Pakistan:* Wastewater use substantially poses a risk to public health if it is not properly managed. In Pakistan the use of wastewater in agriculture is already common, though in most cases untreated and unregulated wastewater is used.The study some health risks such as increased risk of intestinal disease in wastewater farmers but also found major financial and nutritional benefits for farmers and

consumers in the city of Faisalabad. This paper presents a policy approach for the implementation of the WHO guidelines for the safe use of wastewater in agriculture in Pakistan.

III. THEORY AND STANDARD OF REUSE OF SEWAGE FOR IRRIGATION/LANDSCAPING IN INDIA

The re-use of treated wastewater in landscaping and agriculture is to be discussed. In India, the specifications and rules regarding the re-use of partially treated municipal wastewater in parks/landscapes and agriculture are not separate as is in U.S.A and other European countries where the rules for use of treated wastewater in parks are stricter as compared to agriculture, it is mainly because of the related health concerns of common citizens. There are various parameters of importance in the intended re-use of wastewater in the agriculture field such as BOD, SS, TDS, pH, Salinity, SAR, Nitrogen, Phosphorous and Sulphate etc. Out of them, several important parameters have been tested in this analysis of the sewage treatment plant situated at Tikrapara, Bilaspur (C.G.).

Quality limits for waters used for irrigation in USA and India (Adapted from US, 1967):

S.No.	ITEM	CALIFORNIA		INDIA
		AGRICULTURE	PARKS	
1.	Total dissolved solids, mg/l	2100	1500	2100
2.	Electrical cond., mmhos/cm	-	-	3000 at 20^0C
3.	Chlorides, mg/l	355	250	600
4.	Sulphates, mg/l	-	250	1000
5.	Boron, mg/l	2.0	2.0	2.0
6.	Percent sodium	-	-	60
7.	Sodium absorption ratio, meq/l	10	08	-
8.	Residual sodium carbonate, meq/l	2.5	-	-

TABLE: Schedule 6 of environment (protection) third amendment rules, 1993:

PARAMETER	STANDARDS LAND FOR IRRIGATION
Suspended solids, mg/l, max	200
pH value	5.5-9.0
Oil and grease, mg/l, max	10
BOD (5 days at 20^0C)	100
Arsenic (as AS) mg/l	0.2
Cyanide (as CN) mg/l, max	0.2
Alpha emitters, micro-curie, mg/l, max	10^{-8}
Beta emitters, micro-curie, mg/l, max	10^{-7}
Bio-assay test after 96 hours in 100% effluent	90% survival of fish
Manganese (as Mn) mg/l	02
Iron (as Fe), mg/l	03

A. Current Status Of Treated Sewage Use In Agriculture

A 2010 Centre for Science and Environment (CSE) report puts installed treatment facility at only 19% of total sewage generation and reportedly even this limited capacity runs at 72% utilization (CSE 2010). A Central Pollution Control Board sample survey of existing Sewage Treatment Plants (STPs) found out that only 10% of STPs were 'good' with 54% falling into the 'poor' and 'very poor' categories (CPCB 2009). An IWMI study carried out on Gujarat state in 2012 alone came up with a figure of 17859 ha (net area). Thus we can say that the use of wastewater in India is on the rise, majority of them being untreated or partially treated.In India, 100-200 m^3/d of wastewater can be applied per ha of land approximately. Although site specific data of water application rates has to be obtained during the growing season of the crop.

B. Analysis Of Sewage For Reuse

BOD i.e. biological oxygen demand is of primary concern when it comes to the treatment of sewage. It indicates the amount of oxygen present in the water, this oxygen is used by microorganisms to synthesize their food; BOD can generally be stated as the food of micro-organisms. Total dissolved solids (TDS) and suspended solids (SS) are also important factor to be considered in the wastewater analysis, as it is related to the health of soil. Other important parameters which influence health of farm workers and crops include pH, electrical conductivity, chlorides, sulphates, boron, per cent sodium, sodium absorption ratio (SAR), salinity, fecal coliforms and intestinal nematodes etc.

IV. RESULT

S.NO	PARAMETER	INLET	OUTLET
1.	BIOLOGICAL OXYGEN DEMAND (B.O.D.)	190.5 mg/l	58.2 mg/l
2.	pH	7.97	7.81
3.	TOTAL HARDNESS	908 ppm	628 ppm
4.	MANGANESE	TRACES	TRACES
5.	SULPHATES	567.34 mg/l	373.34 mg/l
6.	IRON	TRACES	TRACES
7.	CHLORIDES	383.45 mg/l	235.95 mg/l

Also, the TDS was found to be reduced from 1628.9 mg/l to 1162.85 mg/l and B.O.D. removal efficiency is found out to be 69.44%; which is considered to be satisfactory. And all the other parameters that are determined, qualify the Indian Standards.

V. CONCLUSION

The Biological oxygen demand removal efficiency is found to be satisfactory and the main objective of the sewage treatment plant i.e. B.O.D. removal is attained along with other objectives. Although the B.O.D. removal efficiency was found to be satisfactory (≈70%), It was largely due to the fact that the sewage had large volume of fresh water (rain water). For achieving satisfactory efficiency in seasons other than rainy season, the STP shall have to be well maintained i.e. the sedimentation tank and clarifiers will have to be cleaned at regular interval and chlorine dosage must be adequate along with regular inspection of the multi graded filter and activated carbon filter so that the used material could be changed after completion of the life cycle.The performance of STPs and RE-USE of waste-water (particularly in agriculture/landscaping) covers a broad and extensive field of study because the factors involved are numerous and to a large extent unpredictable.

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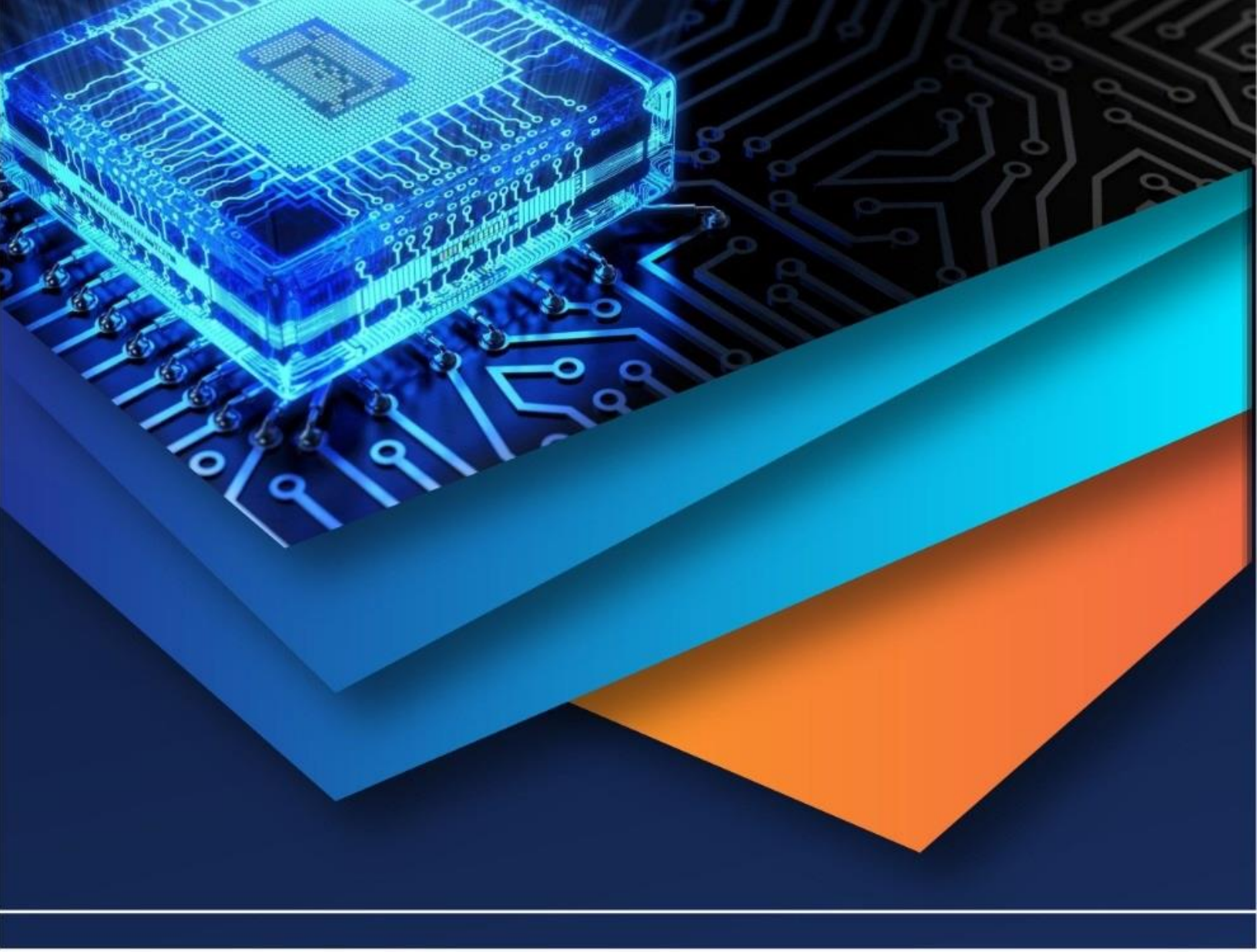

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