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Water Quality Assessment of Raw Sewage and Final Treated Water with Special Reference to Waste Water Treatment Plant Bhopal, MP, India

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Abstract

This study aims at describing the parameters of waste stabilization technique using anaerobic and facultative ponds. The waste water samples were taken from raw sewage & final treated water and analyzed physicochemical parameters like conductivity, total hardness and chemical oxygen demand in the 2009. The efficiency of conductivity, total hardness and chemical oxygen demand was significant. The waste water treatment plant system using different materials showed excellent potential for conductivity, total hardness and chemical oxygen demand removal from waste water treatment plant. The results of analysis of treated water for conductivity, total hardness and chemical oxygen demand (COD) indicate that the final treated water can be used for industrial cooling and agricultural purposes.

Keywords: Sewage, waste water treatment plant, conductivity, total hardness and COD.

Introduction

Waste water treatment plants (WWTP) are supposed to make the municipal sewage compatible for disposal into the environment (surface and underground water bodies or land), to minimize the environmental and health impacts of the sewage, and to make the sewage fit for recycling and reuse (agricultural and aqua-cultural uses an municipal and industrial uses[1]. Water resources on earth are diminishing rapidly and human activities continue to affect detrimentally the quality and quantity of existing fresh water resources[2]. There are conventional and non conventional approaches for wastewater treatment. For waters already treated to primary and secondary levels, land treatment is a promising tertiary treatment technology. There are many types of land treatment system namely slow-rate irrigation system[3], rapid infiltration systems[4], sand filters[5] soil infiltration systems[6] and intermittent buried sand filters[7] Operation cost, mismatch of operating requirements with local skills and space constraint has limited their applications[5]. There are a variety of degradation mechanisms in anaerobic zones, such as fermentation or methanogenesis. Fermentation is the conversion of organic compounds from one form to another with no significant loss in COD. In fermentation, organic compounds serve as the electron acceptor as well as the electron donor. Two groups of methanogens carry out methanogenesis: aceticlastic methanogens and hydro genutilizing methanogens. Aceticlastic methanogens split acetic acid, typically produced by fermentation reactions, into methane and carbon dioxide[8]. Reduction of chemical oxygen demand (COD) from highly concentrated wastewaters prior to discharge into receiving waters or municipal treatment plants is a challenge for many industrial treatment systems. As more information becomes available on the ecological impacts of wastewater discharge, permit limitations are becoming more stringent.

Material and Methods

The present waste water treatment plant (Kotra Waste Water Treatment Plant) is situated in Bhopal, the capital of central Indian State, Madhya Pradesh, within the geographical coordinates of 23° 15’ 44’’ N, 77° 28’ 23’’ E. It receives the waste water generated in Nehru Nagar, Kotra Sultanabad and adjoining areas. Kotra waste water treatment plant (WWTP) is designed to treat 10 MLD. The Kotra (WWTP) is based on waste stabilization technique using anaerobic and facultative ponds. Under present study waste water samples were collected from raw sewage and treated water of waste water treatment plant (WWTP) during the period January to December 2009. Samples were analyzed to determine the efficiency of the treatment plant in reducing the conductivity, total hardness and chemical oxygen demand from the raw sewage and final treated water samples. Waste water samples were collected in glass containers, precleaned by washing with non-ionic detergents, rinsed in tap water, in 1:1 hydrochloric acid and finally with demonized water before usage. Before sampling, the bottles were rinsed three times with sample water and then filled and conductivity, total hardness and chemical oxygen demand (COD) were analysis in the analytical laboratory according to the methods prescribed in the APHA[9].

Results and Discussion

Monthly samples were collected from raw sewage & final treated of the Waste water treatment plant (WWTP) Kotra, Bhopal. The results obtained for conductivity, total hardness and chemical oxygen demand are shown in the table-1.

Table-1
Monthly variation of different parameters in the 2009

Parameters/Months		Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Cond.	**Raw Sewage**	0.615	0.905	1.315	1.411	1.987	1.747	2.232	2.184	1.562	1.684	1.453	0.735
	Treated water	0.384	0.519	0.764	0.768	1.102	1.042	1.438	1.394	1.056	1.114	0.942	0.497
	% Reduction	37.56	42.65	41.90	45.57	44.54	40.35	35.57	36.17	32.39	33.84	35.16	32.38
Total Alk.	**Raw Sewage**	214	236	274	262	298	286	298	289	258	248	222	215
	Treated water	112	118	130	126	138	137	162	152	143	132	120	112
	% Reduction	47.66	50	52.55	51.90	53.69	52.09	45.63	47.40	44.57	46.77	45.94	47.90
Total Hard.	**Raw Sewage**	286	338	358	386	406	386	398	396	370	338	324	284
	Treated water	156	176	184	186	192	206	218	230	196	188	172	156
	% Reduction	45.45	47.92	48.60	51.81	52.70	46.63	45.22	41.91	47.02	44.37	46.91	45.07
COD	**Raw Sewage**	346.4	528.2	478.4	622.6	792.4	658.4	536.4	458.8	548.2	618.2	488.2	353.2
	Treated water	108.6	146.8	122.4	149.2	182.6	178.4	145.8	122.4	163.2	181.6	148.4	110.6
	% Reduction	68.64	72.20	74.41	76.03	76.95	72.90	72.81	73.32	70.23	70.62	69.60	68.68

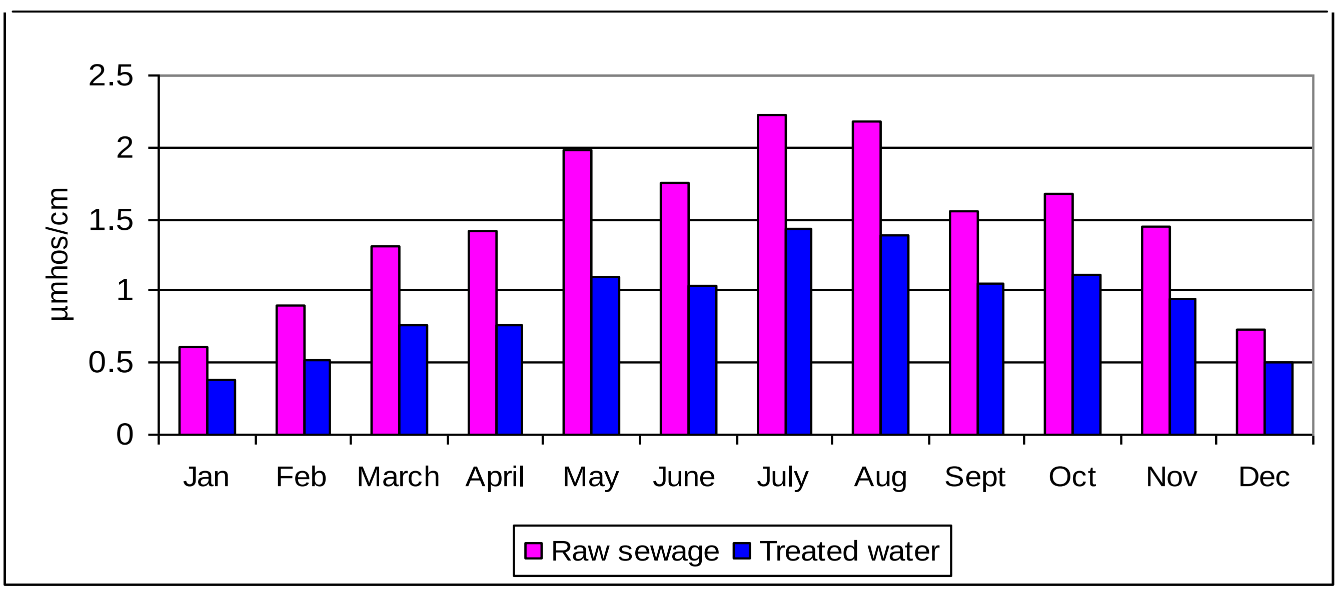

Figure-1
Range values of conductivity in during 2009

Monthly variation in Conductivity at Kotra waste water treatment plant during in the year 2009 is shown in figure-1.

During the period of investigation Conductivity varied from 0.615 µmhos/cm to 2.232 µmhos/cm in the raw sewage and 0.384 µmhos/cm to 1.438 µmhos/cm in the final treated water. The minimum value was observed in the month of January while the maximum value was observed in the month of July, in the raw sewage of waste water treatment plant. The minimum value was observed in the month of January while the maximum value was observed in the month of July in the final treated effluent water of waste water treatment plant. Percent reduction in Conductivity values at Kotra WWTP during the period 2009 is shown in table -1. Maximum reduction in conductivity values during the period of investigation was observed in the month of April (45.57 %), while the efficiency of reduction was comparatively less in the month of December (37.56 %).Guideline for conductivity in treated water that could be discharged into the receiving water bodies is[10] and based on this guideline; the effluent quality does not appear to be compliant with the regulation for electrical conductivity. This limit was exceeded in the receiving water body. Thus, the parameter does give concern and it could make the water unsuitable for direct domestic use. The conductivity values obtained in this study is similar to the findings of previous study on the nearby river[11].

Monthly variation in Total alkalinity at Kotra waste water treatment plant during in the year 2009 is shown in Figure-2.

During the period of investigation Total alkalinity varied from 214 mg/l to 298 mg/l in the raw sewage and 112 mg/l to 162 mg/l in the final treated water. The minimum value was observed in the month of January, while the maximum value was observed in the month of May, in the raw sewage of waste water treatment plant. The minimum value was observed in the month of January and December, while the maximum value was observed in the month of July in the final treated effluent water of waste water treatment plant. Percent reduction in Total alkalinity values at Kotra WWTP during the period 2009 is shown in table -1. Maximum reduction in Total alkalinity values during the period of investigation was observed in the month of March (52.55 %), while the efficiency of reduction was comparatively less in the month of January (47.66 %).

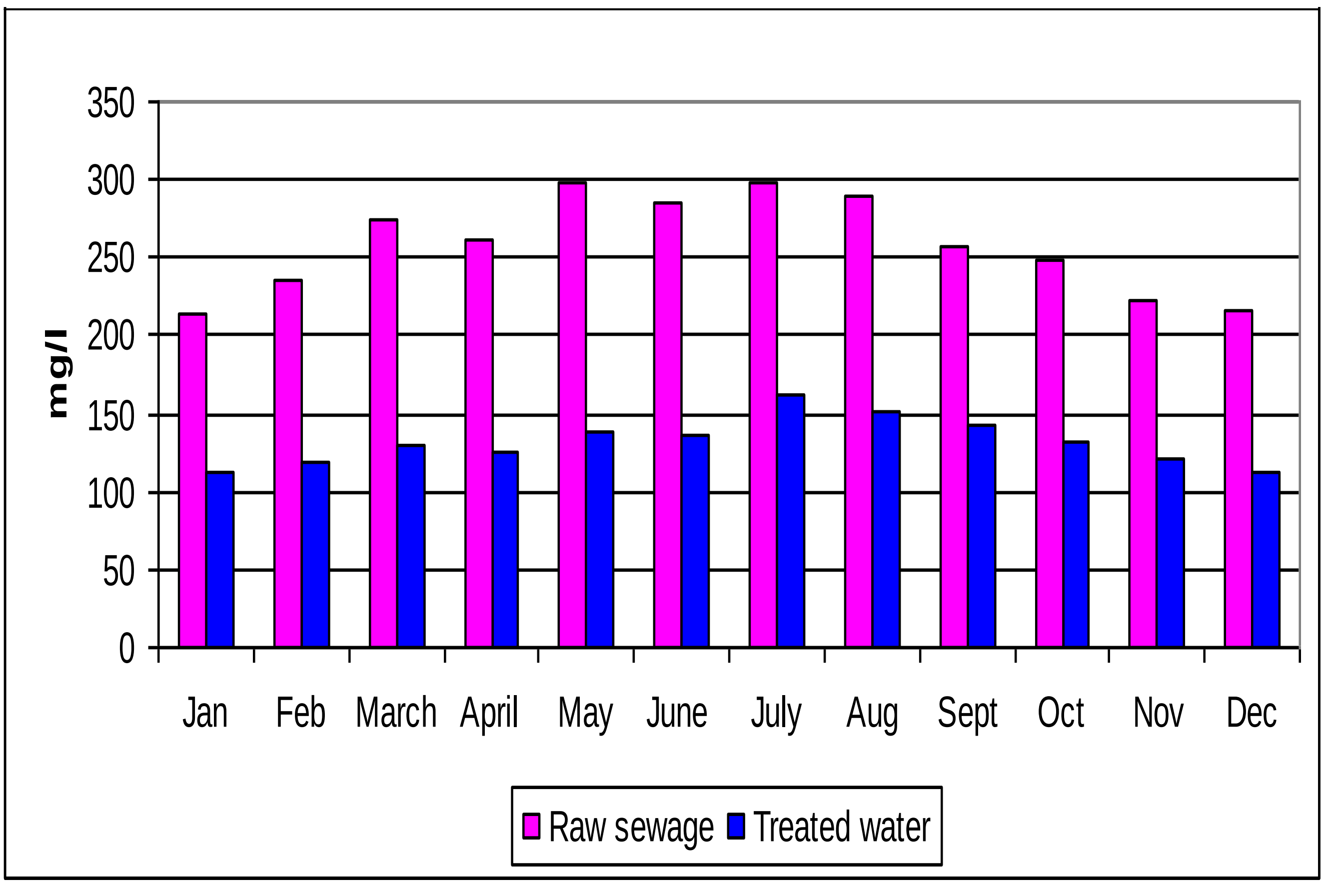

Figure-2
Range value of total alkalinity in during 2009

Monthly variation in total hardness at Kotra waste water treatment plant during in the year 2009 is shown in figure-3.

During the period of investigation total hardness varied from 284 mg/l to 406 mg/l in the raw sewage and 156 mg/l to 230 mg/l in the final treated water. The minimum value was observed in the month of December while the maximum value was observed in the month of May, in the raw sewage of waste water treatment plant. The minimum value was observed in the month of January and December while the maximum value was observed in the month of August in the final treated water of waste water treatment plant. Percent reduction in total hardness values at Kotra WWTP during the period 2009 is shown in table -1. Maximum reduction in total hardness values during the period of investigation was observed in the month of May (52.70 %), while the efficiency of reduction was comparatively less in the month of December (45.07 %).The total hardness of both raw sewage and treated water was conforms to the Standard. Iron concentrations of the raw (<1.0 mg/l) and treated water (<0.05 mg/l) were found very low all over the year, which conform the WHO guidelines[12].

Monthly variation in chemical oxygen demand at Kotra waste water treatment plant during in the year 2009 is shown in figure-4.

During the period of investigation chemical oxygen demand varied from 346.4 mg/l to 792.4 mg/l in the raw sewage and 1.8.6 mg/l to182.6 mg/l in the final treated water. The minimum value was observed in the month of January, while the maximum value was observed in the month of May in the raw sewage of waste water treatment plant. The minimum value was observed in the month of January while the maximum value was observed in the month of May in the final treated water of waste water treatment plant. Percent reduction in chemical oxygen demand values at Kotra WWTP during the period 2009 is shown in table -1. Maximum reduction in chemical oxygen demand values during the period of investigation was observed in the month of June (72.90 %), while the efficiency of reduction was comparatively less in the month of January (68.64 %). Higher levels of COD were observed in raw sewage in the month of May. The increased of COD concentrations during summer season could be attributed to run-off washed into water body. This is undesirable since continuous discharge of effluent has impacted the receiving water body to some extent and this may have negative effects on the quality of the freshwater and subsequently cause harm to the aquatic life especially fish[13]. When this present result was compared with results of COD of the treated final effluent and receiving water bodies from developed countries, it was observed that the concentrations of COD differ as reported by UNEP (1993). According to[14], this increase in COD could be attributed to an increase in the addition of both organic and inorganic substance from the environment, as well as organic contaminant entering the systems from the municipal sewage treatment plants. In the same light, one observation agrees with the previous works of[11] and[13].

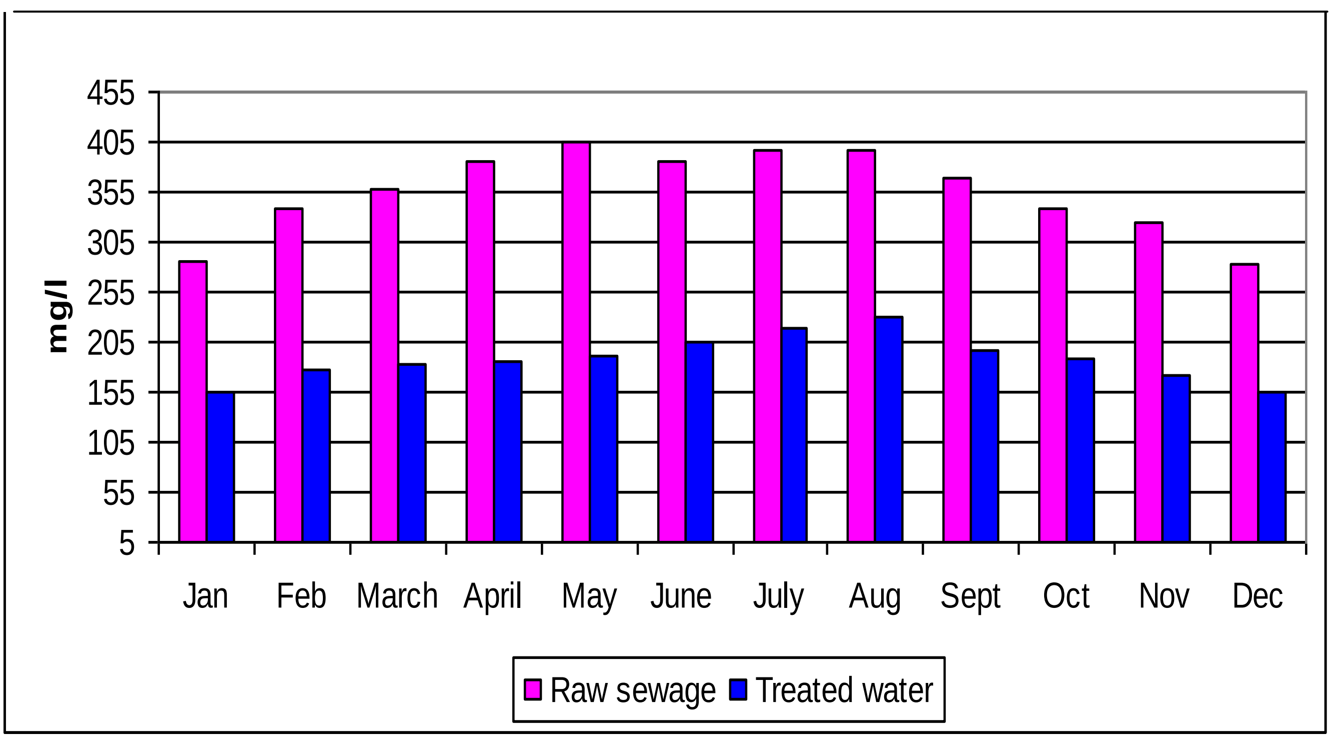

Figure-3
Range values of total hardness in during 2009

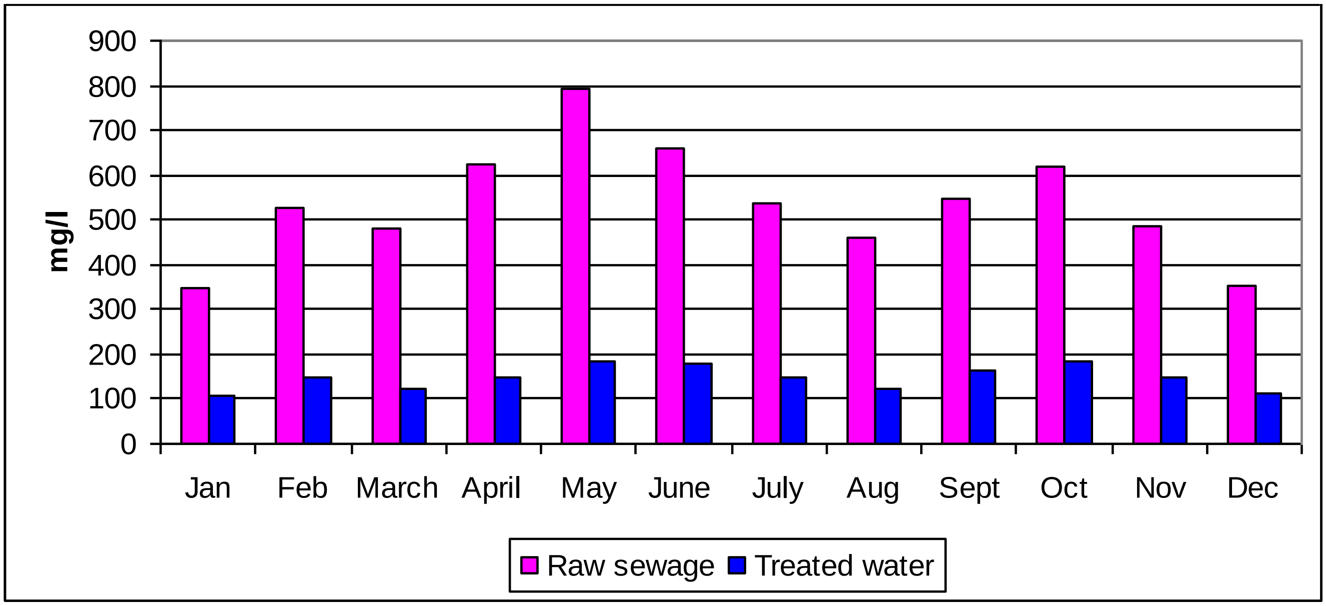

Figure-4
Range values of Chemical Oxygen Demand in during 2009

Conclusion

The present study reveals the assessment of physico-chemical parameters like conductivity, total hardness and chemical oxygen demand (COD) high concentration in raw sewage and low concentration in the final treated waste water due to various stages of waste water treatment plant (WWTP) Bhopal. Performance of Kotra WWTP was evaluated which has shown its capability to reduce conductivity, total hardness and chemical oxygen demand (COD) from raw sewage. From the above study, it was observed that high concentration of conductivity, total hardness and chemical oxygen demand (COD) was present in the raw sewage however better water quality was found after treatment in final treated water. Instead of discharging the treated water onto the nearby bodies of water, it is proposed to let it pass through the waste water treatment plant which would reduce most of the pollutants. So the waste water treatment is essential for maintaining the water quality and the final treated wastewater can be used for secondary purposes like irrigations gardening and industrial cooling.

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