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CHARACTERIZATION OF WASTEWATERS IN SEMI URBAN SETTLEMENTS OF VISAKHAPATNAM

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ABSTRACT

The indiscriminate dumping of wastewater, particularly residential wastes waters encompass a wide range of potential contamination and concentrations. The present study deals with the analysis of the wastewater of certain locality in an unsewered, semi urban areas of Visakhapatnam. The wastewater samples were collected from seven sampling points in the selected area and were subjected to laboratory studies. Several working parameter's such as pH, Conductivity, Total Solids, Total Suspended Solids, Total Dissolved Solids, Alkalinity, Total Hardness, Calcium, Magnesium, Chlorides, Chemical Oxygen Demand, Biochemical Oxygen Demand, Sulphates, Phosphates and Nitrates were analyzed using standard methods. The characteristics of the wastewater coming from different points varied according to the activities.

Keywords: Wastewater; Physico-Chemical Parameters; Visakhapatnam

INTRODUCTION

Due to increase in urbanization and industrialization, environmental pollution is increasing day by day. The disposal of city waste, sewage water and industrial effluents (herein referred as municipal Wastewater) is becoming a major problem[1]. Household wastes are completely biodegradable and homogenous[2].

Sewage analysis is usually made for the purpose of measuring the strength of sewage or the degree of pollution of a stream, for determining the degree of purity[3]. The biological, chemical and physical characteristics of any given wastewater such as pH, dissolved oxygen, total dissolved solids, nitrates, phosphates chloride and heavy metal concentrations determine its treatability[4].

Although, application of sewage effluents were reported to be beneficial in increasing crop yield and reduce fertilizer requirement but some other studies showed that metals enter in the food chain through their applications in soil and this ultimately causes health concern significantly. Disposal of raw sewage on land or in natural streams causes physical, chemical and biological hazards[1].

An important segment of environmental pollution that is directly affecting the health via crops and soil is due to the indiscriminate use of untreated sewage water[5]. The growing population and freshwater scarcity increase the scope of reuse of urban wastewater in agriculture[6]. Pollution of groundwater resources has become a major problem today. The pollution of air, water and land has an affect on the pollution and contamination of groundwater[7], which may be direct or indirect. The work has been carried out to examine the effects of the wastewater on the quality of ground water around disposal stations because of its use for human consumption[8]. Since wastewater is not only residential wastewater, some effort may need to be exerted to determine the wastewater characteristics.

EXPERIMENTAL

Study Area: Visakhapatnam is a coastal station situated on the east coast of India. The extent of GVMC study area is 515 Sq.km and geographically lies between 17º 32' N to 17º 51' N latitudes and 83º 07' E to 83º 21' E longitude. Visakhapatnam, described as the "City of Destiny" is the fastest growing city of the

Asian Continent and is rated as one of the top twenty five cities in the world that have a high rate of expansion, both population wise and in the direction of industrial development[9].

Sampling: Sampling points were chosen with the aim of collecting wastewater samples at a place that truly represents the sample. Seven representative sites of Visakhapatnam at Aarilova (S1), Balajinagar (S2), Bheemili (S3), Gandhinagar (S4), Rushikonda (S5), P.M. Palem (S6), Yendada (S7) were selected. Samples were collected using plastic containers and were labeled with date, time and sample code.

Physico-chemical Analysis: Parameters like pH and conductivities were determined in the field. The samples were stored in the refrigerator at a temperature of about 4°C prior to the analysis. Several working parameters were estimated using Standard Methods[10]. The Total Solids, Total Suspended Solids and Total Dissolved Solids were estimated by gravimetric methods. Nitrates, Phosphates, sulphates were estimated spectrophotometrically by plotting standard curves. Total hardness, calcium hardness, magnesium hardness, alkalinity and chlorides were estimated by titrimetry. Chemical Oxygen Demand and Biochemical Oxygen Demand were estimated by reflux method and Wrinklers method.

RESULTS AND DISCUSSIONS

The physico chemical parameters of the wastewater samples of the study area are listed in Table: 1, General Standards for Discharge of Effluents (CPCB, 1995) were shown in Table: 2 and wastewater Quality Standards[8].

pH: The pH values ranging between 7.1-7.9 was within the permissible limits of pH for irrigation which varies between 6 to 9 as laid down in IS:3307-1977[1,11]. In the present study pH varied between 6.23 - 8.14.

Electrical Conductivity: Electrical Conductivity (EC) estimates the amount of total dissolved salts, or the amount of dissolved ions[7]. The EC was found to the highest for S3 with 530 µS/cm and least for sample S1 with 408 µS/cm (micro siemens per centimeter).

Total Solids: Determinations of suspended solids, total, volatile and fixed, are indispensable in practically all sewage work[3]. Total solids analysis has great implications in the control of biological and physical Wastewater treatment processes[12]. Total Solids varied between 880 mg/l to 410 mg/l for S1 and S4 respectively.

Total Dissolved: The total dissolved solids were higher for sample no S1 with 630 mg/l and least for sample S4 with 220 mg/l. The TDS was beyond the maximum recommended limit (1500 mg L^{-1}) for land irrigation as reported by Juwarkar[13].

Total Suspended Solids: Although Total Suspended Solids determinations are not always of value as an index of concentration, they are necessary for computations of sludge removal, sludge digestion and clarity of effluent[3]. In the present study S1 has the highest TSS i.e. 250 mg/l and S4 i.e. 100 mg/l is found to be the least.

Alkalinity: Alkalinity was observed in the range of 301 – 444 mg/l[6]. In the present study it varies between 350 - 380 mg/l for S1 and S7 respectively and it was found to be zero for the samples S2, S3, S4 as the pH was found to be slightly acidic.

Total Hardness: Similar pattern i.e. 215.5 - 487 mg/l was observed by J. K. Sial[6]. For the sample S6 it was found to be 370 mg/l which is the highest value, S4 is reported as 215 mg/l which is the lowest value.

Calcium & Magnesium: The Calcium was observed in the range of 75 – 152 mg/l for sample S4 and S6 and the Magnesium was observed in the range of 116 – 252 mg/l for sample S1 and S5 which is bit higher in the present working samples. The similar range was observed by Abdullah Laghari[8], for calcium i.e. 59 – 148 mg L^{-1}, and magnesium 30 – 81.6 mg L^{-1}.

Chlorides: In the present study it varied between 84.983 to 177.445 mg/l. Same trend ie 166.2 - 396 mg/l was observed by J. K. Sial[6]. Chloride was at toxic level in all the points in post monsoon on the basis of maximum permissible limit for irrigation[11, 14].

COD and BOD: The ratio of biochemical oxygen demand to chemical oxygen demand is often used to choose an appropriate treatment regime for a particular wastewater. The higher the BOD/COD ratio the

more amenable the wastewater is to biological treatment[4]. Biochemical Oxygen Demand and Chemical Oxygen Demand varied between 204 - 768 mg/l, 1056 – 2860 mg/l for S3 and S7 respectively. This is in agreement with the finding of O.P. Sharma[1]. Incubation for 5 days at 20^{o} C seems to be the most satisfactory procedure. It would be desirable to obtain the complete 20days demand if possible but we have not found it practicable to use such long incubation periods, due to incubator fluctuations, secondary reactions etc. COD and BOD patterns in various samples are represented graphically in Fig 1.

Sulphates: The values of sulphate ranged within 8 to 30 mg/l for S4 and S1 respectively. Sulphate may have laxative effect if magnesium is present at an equivalent concentration[15].

Phosphates: Phosphates are not toxic and do not represent a direct health threat to human health or other organism. But excess of phosphorous promotes the abundant growth of algae and leads to eutrophication of water bodies. [7]. The phosphate values of the present study varied from 11 – 26 mg/L.

Nitrates: In urban and periurban areas, the problem of dealing with NO_3 concentrations mainly entails identifying nitrate sources from the excessive use of fertilizers, or leaks from the sewage network and old septic systems[16]. In the present study S7 has the highest levels of nitrate that is 64 mg/l and S4 has the least levels of nitrate that is 22 mg/l. Fig: 2 show the patterns of Sulphates, Phosphates and Nitrates.

CONCLUSIONS

The direct use of wastewater not only caused salinity problem but also affected the groundwater quality by increasing its sodicity[6]. The use of wastewater without treatment and proper dilution can create serious problems for the soil as well as for workers. Its use for the crops, which are eaten raw or uncooked, should be avoided. It is recommended that the wastewater can be used after primary treatment and appropriate dilution for the cultivation of the crops Abdullah Laghari[8].

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Table-1: The Physico-Chemical Parameters of Wastewaters of Selected Areas of Visakhapatnam

Sl. No.	Parameters	Units	Sampling Sites						
			S1	S2	S3	S4	S5	S6	S7
1	pH	---	7.99	6.89	6.23	6.9	8.09	8.1	8.14
2	Electric Conductivity	µS/cm	408	430	540	450	440	490	470
3	Total Solids	mg/l	880	520	640	410	490	480	860
4	Total Dissolve Solids	mg/l	630	340	400	220	320	360	620
5	Total Suspended Solids	mg/l	250	180	240	100	170	120	240
6	Alkalinity	mg/l	350	-	-	-	370	370	380
7	Total Hardness	mg/l	240	285	260	215	350	370	295
8	Calcium	mg/l	124	88	116	75	98	152	137
9	Magnesium	mg/l	116	197	144	140	252	218	158
10	Chlorides	mg/l	122.465	102.486	159.95	119.962	102.468	84.983	177.445
11	COD	mg/l	2400	1560	1056	1167	1680	1645	2860
12	BOD	mg/l	566	384	204	372	528	506	768
13	Sulphates	mg/l	30	14	19	8	20	15	17
14	Phosphates	mg/l	26	24.5	20	14	19.5	11	21
15	Nitrates	mg/l	34	38	32	22	36	38.16	64

Table-2: General Standards for Discharge of Effluents (CPCB, 1995)

Sl. No.	Parameter, Units	Standards			
		Inland Surface water	Public sewers	Land for Irrigation	Marine coastal area
1	pH value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
2	TDS mg/l	2100	2100	2100	----
3	TSS mg/l	100	600	200	For process wastewater-100
4	Chlorides mg/l	1000	1000	600	---
5	COD mg/l	250	---	---	250
6	BOD mg/l	30	350	100	100
7	Sulphates mg/l	1000	1000	1000	----

Table-3: Wastewater Quality Standards (Abdullah Laghari[8] *et. al.,* 2004)

Sl. No.	Parameters with units	National effluent quality standards (NEQ's)	WHO standards
1	pH value	5.5 to 9.0	5.5 to 9.0
2	COD (mg L^{-1})	150	---
3	BOD (mg L^{-1})	80	350
4	TDS (mg L^{-1})	2000	-
5	TSS (mg L^{-1})	150	-
6	Temperature (^oC)	40	-
7	Chlorides mg/l	1000	-
8	Hardness as $CaCO_3$ (mg L^{-1})	500	-
9	Conductivity $mScm^{-1}$	3.1	-

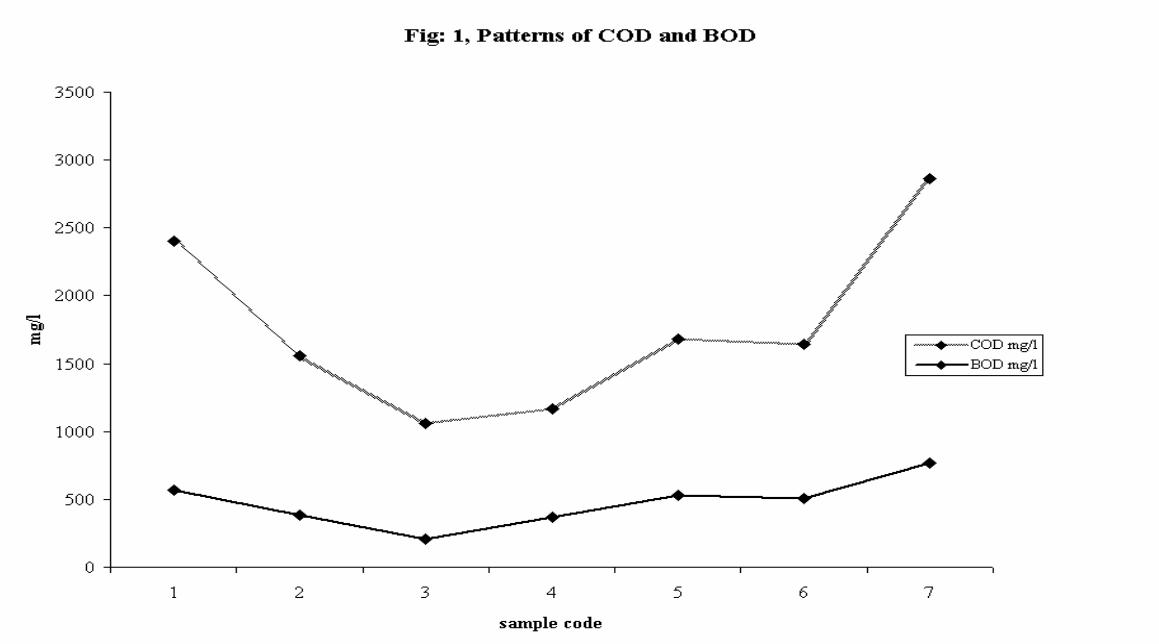

Fig.-1

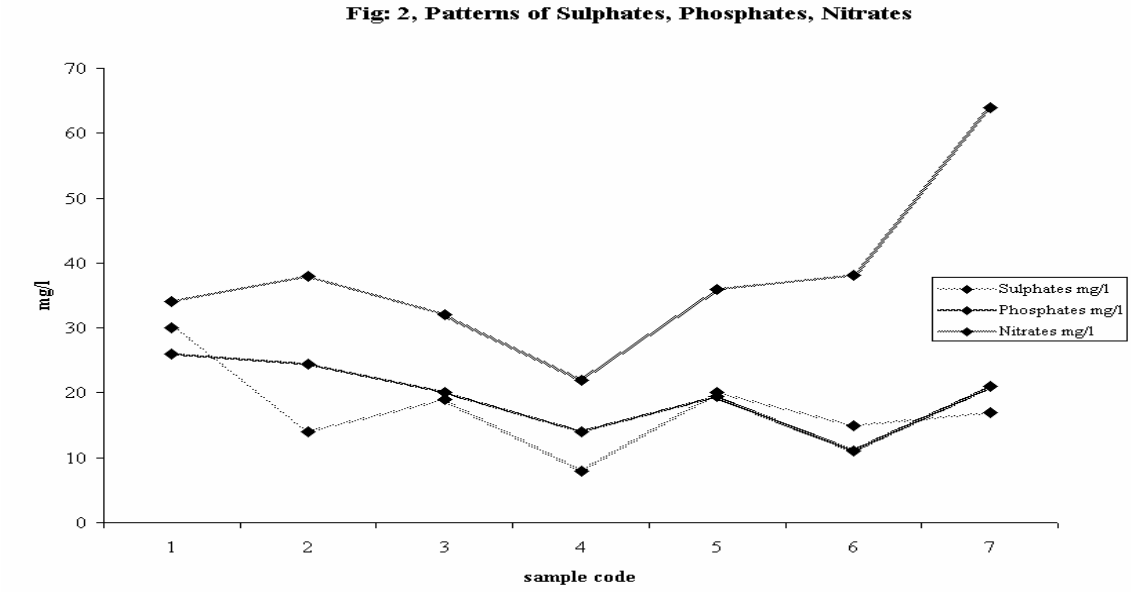

Fig.-2

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