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Research Article

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Analysis of physicochemical features of a polluted sewage disposal in Ludhiana

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ABSTRACT

Sewage drains are the main sources to transport domestic, agricultural, sewer, slaughter houses, industrial pollutants, etc. Rivers are being polluted through various agencies mainly by municipal sewage, effluents from automobile service stations, discharge from cottage industries, bathing and washing of clothes etc. To study the impact of sewage water on the chemistry of rivers in an industrial city, Ludhiana; estimation of physico-chemical characteristics was done on the most polluted drain that carries a major amount of domestic and industrial run-off towards the rivers. Standard methodologies adopted for the analysis indicate that the sewage discharged into the river increases its pH, acidity, alkalinity, B.O.D, C.O.D, chloride, nitrate, phosphate and content of heavy metals like iron, and zinc. With domestic wastes, several nutrients also come into the river. These nutrients play an important role in aquatic eco-system.

Key words: Municipal sewage, physicochemical, acidity, alkalinity, heavy metals.

INTRODUCTION

With increasing industrial growth, mushrooming population, expanding fashion and socio-economic horizon, agricultural revolution and tremendous human activities, the pollution factors in semi-urban areas are becoming more and more effective. The drains carry some hazardous effluents along with some nutrients useful to plants. The physical, chemical and biological characteristics of river water are adversely affected by pollutants and put impact on aquatic ecosystem and quality of water. Sediment pollution causes problems by reducing light penetration, covering aquatic organisms, bringing insoluble toxic pollutants into the water and filling waterways. Sediments can envelop coral reefs and shellfish beds and clog the gills and feeding structures of many aquatic organisms. Most components of industrial effluents are toxic to ecological systems even at low concentrations, and many are non-biodegradable. Much work has been done on pollution parameters and biodiversity of rivers, lakes, ponds and their marginal wet lands [3], but an inadequate or almost no attention has been paid to physicochemical investigations of drain water except a few [4]. The present investigation has been conducted on a sewage drain which was one of the most polluted one in Ludhiana. Several physico-chemical parameters have been considered for the study. These parameters are temperature, pH, acidity, alkalinity, D.O, B.O.D, C.O.D, chloride, nitrate, phosphate, iron and zinc. Through the study an attempt had been made to estimate the severity of pollution level in the drains which ultimately is been discharged into rivers without proper treatment and costs the lives of aquatic organisms as well as humans beings.

EXPERIMENTAL SECTION

2.1 Sample collection and preservation

In the present paper the emphasis is on study site located in Ludhiana where a heavily polluted sewage drain is discharged in river. For sewage water analysis, samples where collected in two liters plastic container in triplicate in the first week of each month during March 2014 to October 2014. Physico-chemical properties of sewage water have been studied and analyzed by selecting standard and suitable methods described in APHA [1], [2] for the study site.

2.2 Analysis of physico-chemical parameters

The temperature of sewage water was recorded with the help of 'Celsius Thermometer' and expressed in degree Celsius (^oC), pH (the negative logarithm of hydrogen ion activity) was determined in the laboratory with the help of 'Electronic digital glass electrode pH meter', using standard buffer solution of pH 7.0.'Potentiometric titration method' was adopted to detect the acidity and alkalinity of the sewage water samples. D.O content of samples was analyzed by using 'Winklers' iodide azide method'.

'Dichromate reflux method' was used for the estimation of Biological oxygen demand (B.O.D) and chemical oxygen demand (C.O.D) of the water samples. 'Mohr's argentometric method' was adopted for determination of chloride of sewage water. 'Phenol di-sulphide acid method' was used for the detection of nitrate - N of sewage and water samples and 'Stannous chloride method' was applied for estimation of phosphate-P content of samples [1], [2].

RESULTS AND DISCUSSION

The physico-chemical parameters of sewage water include the month-wise analysis for temperature, pH, acidity, alkalinity, B.O.D., C.O.D., D.O., chloride, nitrate, phosphate, iron and zinc (Table 1).

3.1 Temperature- The temperature of drain water of the study site during March '14 to October'14 ranges between 24.3^0C to 27.5^0C. It is highest in May and June and lowest in Sept. with a constant value. Due to non-static nature of drain water the fluctuation in the temperature are minute which limits the biodiversity around it [5].

3.2 pH- As indicated in table1, the pH value shows slight fluctuation throughout the study period. It ranges from 7.0 to 7.8 with the lowest value in Aug. and highest in June. It may be due to variation in temperature of the climate, which results in the variation of biotic decomposition and fermentation of the drain disposal.

3.3 Acidity- The acidity value is found minimum in Aug. (18.2 mg/L) and maximum in May (32.1 mg/L). It might be due to more availability of water in rainy season which results in dilution of drain water and decrease in acidity value.

3.4 Alkalinity- Alkalinity value is highest in June (242.3 mg/L) and lowest in Aug. (124.6 mg/L) due to more decomposition of human and animal excreta at the site, as this site is located in rural area. In June the alkalinity is maximum which indicates the severity in the pollution level of drains in summers.

3.5 Dissolve Oxygen- The D.O. level in drain water affects the aquatic life to a large extent. The decomposition and oxidation of organic material reduce the solubility of oxygen in water [6]. The level of dissolved oxygen does not fluctuate much throughout the whole session. It is lowest in June due to high consumption of oxygen for biotic decomposition.

3.6 Biological oxygen demand- In June the B.O.D. level is maximum (175.3 mg/L) and it is lowest in Oct (112.3 mg/L). As mentioned above, in summer consumption of D.O. is higher and as a result the demand of biological oxygen is increased, as B.O.D. is inversely proportional to D.O [6].

3.7 Chemical oxygen demand- The C.O.D. values are highest in June (259.5 mg/L) and lowest in Aug (203.6 mg/L). The low value of C.O.D. in winter is due to low temperature, which decreases the rate of decay of organic matter and provide favorable environment to living organism.

3.8 Chloride, Nitrate and Phosphate- The variation of concentration of Cl^- in drain water increases gradually from rainy season. From May the Cl^- concentration suddenly drops down and from June onwards it gradually increases. The variation may be caused by the variability of Cl^- inputs in the drain with temperature variation.

The NO_3^- show great variation throughout the period. These changes are mainly due to high evaporation rate and less availability of water in the catchment area of the drain.

The mode of variation of PO_4^{---} concentration in drain water is quite complicated. This may be due to innumerable factor namely, input source, deposition, solubility, vaporization and meteorological [4]**.**

3.9 Iron and Zinc- Iron is an essential micro-nutrient and heavy in nature and shows less solubility in water that makes it retainable in soil [3]. Slight fluctuation was seen in iron concentration in winter and rainy season and in summer the concentration is higher due to less availability of water.

Concentration of zinc is minute in initial months and it suddenly rises up in July and Aug. The zinc content in soil may be preserved by water harvesting in weeds and checking of water flow through them.

Table 1: Physico-chemical analysis of sewage water at the study site (March '14 – Oct'14)

Month	Temp. (°C)	pH	Acidity (mg/L)	Alkalinity (mg/L)	D.O. (mg/L)	B.O.D. (mg/L)	C.O.D. (mg/L)	Chloride (mg/L)	Nitrate (mg/L)	Phosphate (mg/L)	Iron (mg/L)	Zinc (mg/L)
March (2014)	25.3	7.2	30.6	236.4	2.21	158.3	236.5	34.1	0.26	3.92	1.33	0.12
April	26.5	7.3	30.2	238.2	2.03	160.2	255.2	35.3	0.25	3.43	1.40	0.14
May	27.4	7.6	32.1	240.5	1.92	170.5	263.4	35.6	0.94	3.46	1.46	0.15
June	27.5	7.8	31.3	242.3	1.81	175.3	269.5	25.6	0.98	2.96	1.43	0.16
July	26.5	7.1	21.3	125.2	1.93	162.4	211.4	26.7	1.03	1.32	0.75	0.92
August	25.3	7.0	18.2	124.6	1.99	158.2	203.6	28.5	1.06	1.24	0.72	0.73
September	23.3	7.4	19.1	138.2	2.03	132.4	213.2	29.3	0.98	2.45	0.70	0.63
October (2014)	25.5	7.3	20.2	146.3	2.15	112.3	211.5	31.5	0.83	3.63	0.67	0.62

CONCLUSION

The present study clearly reveals the toxicity and pollution level of sewage water being discharged in the rivers. It has been found that discharged sewage water adds its harmful inputs along with some hazardous chemicals and heavy metals. As a result it contributes to the pollution to the river water that is directly and indirectly being used for various purposes. So keeping in view the threatening impact of sewage water, it is required to be treated before being disposed off in rivers.

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