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Impact of industrial effluents on water quality of Kali river in different locations of Meerut, India

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Water covers approximately 70.9% of earth's surface and is a vital source for all known forms of life. The study highlights the pernicious elements present in water of Kali River. Various physico-chemical parameters, like Biological Oxygen Demand (BOD), Total Dissolved Solids (TDS), Total hardness, Chemical Oxygen Demand (COD), pH, Calcium, Magnesium, Chloride, and Sulphate were undertaken during present study. It has been found that Kharkhoda point is highly polluted causing severe water pollution as it has a contamination with BOD (90 mg/L), TDS (1036 mg/L), total hardness (418 mg/L), COD (420 mg/l), Ca (252 mg/L), Mg (218 mg/L), Cl (138 mg/L), Sulphate (120 mg/L) and pH (7.5) as compare to other three points of Kali river.. The entry point of the Kali Nadi in Meerut region that is Daurala, is least contaminated because none of industries are located in this area, only some of the waste is dumped into the river. Thus, the water from this area can be treated by some of the waste water treatment methods and can be used for irrigation purposes.

Key words: Water pollution, industrial effluents, Kali river, physico-chemical parameters, waste water treatment.

INTRODUCTION

Water is one of the most common yet the most precious resources on earth without which there would be no life on earth. Pollution is a serious problem as 70% of India's surface water resources and as growing number of its ground water reserves have been contaminated by biological, organic and inorganic pollutants. Life cannot exist without water because it is the major component of all living things. It is important both physiologically and ecologically as it plays an essential role in temperature control and also is the medium in which many organisms live. Nowadays, due to rapid growing urbanization, the quality of land water is being deteriorated by mixing up of industrial wastes and domestic sewage in our rivers (Abida et al., 2009). Especially in urban areas, the careless disposal of industrial effluents and other wastes contributes greatly to the contamination of the water (Islam et al., 2010). Increased pollution load in fresh water bodies increases the nutrient level of water (Raja et al., 2008) and causes a violent alteration in pH, reduction in oxygen content and high osmotic pressure. A study on the impact of industrial effluents on water quality of Kali River in Meerut district (India) was carried out which showed physico-chemical parameters above the permissible limits (Yadav et al., 2011). Most of the rivers

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Table 1. Physico-chemical parameters of Colour, Odor, pH, TDS, BOD, COD, Total Hardness, Calcium, Magnesium, Chloride, and Sulphate of Kali nadi water at the Four locations in Meerut District.

Parameters/Location	Daurala road	Mawana road	Garh road	Kharkhoda road	Standard value ISO : 10500-1991
Colour	Turbid	Turbid	Turbid	Grayish	Transparent
Odor	No specific odour	Foul	Foul	No specific odour	Unobjectionable
pH	7.0	7.5	7.1	7.5	6.5-8.5
TDS (mg/L)	680	792	972	1036	30-380
BOD (mg/L)	20	40	76	90	2-8 (moderate)
COD (mg/L)	196	296	288	420	300-500
Total Hardness (mg/L)	212	400	406	418	185-350
Ca (mg/L)	128	212	200	252	75
Mg (mg/L)	84	188	148	218	50
Cl (mg/L)	70	96	116	138	200
Sulphate (mg/L)	68	90	110	120	250

All values are mean ±SE, n=3 (Duncan's new multiple test range). All the parameters were carefully studied.

flowing in urban areas are at the end point of effluent discharge and if not treated and properly controlled can also pollute the ground water (Moscow et al., 2011).

Industrial effluents entering the water bodies is one of major sources of environmental toxicity. It not only affects the quality of drinking water but also has deleterious impact on the soil micro flora and aquatic ecosystems. Soil is the most favourable habitat for a wide range of microorganisms that includes bacteria, fungi, algae, viruses and protozoa. More than a million microorganisms represent the population per gram of the sample studied with bacteria and fungi being the prominent species prevalent. Industries keep on releasing effluents which is quite toxic whether its sugar mill or fertilizer industries, or chemical treatment given to the fields also cause problems for the survival of the soil micro flora. For mills that have an attached distillery, the numerous distillation stages produce a highly contaminated effluent, with BOD and COD concentrations of about 40,000 - 100,000 mg/1, called stillage. In general, sugar mill effluents contain acidic and alkaline compounds, a significant concentration of suspended solids and a high BOD, COD, and sugar concentration (Verma and Shukla, 1969; Behra and Mishra, 1969; Roy, 2007).

MATERIALS AND METHODS

Water samples were collected in monsoon season of year 2011 for the analysis of physico-chemical parameters from four sampling sites in the early hours (7.00 A.M. to 10.00 A.M.). A careful water sampling was made in iodine treated polyethylene bottles free of air bubbles. Some of the physico-chemical characteristics of water measured at the sampling sites, while others were analyzed in the laboratory according to standard method (Trivedi and Goel, 1986; APHA, 1995) at the Department of Biotechnology, Meerut Institute of Engineering Technology, Meerut. The pH was measured by using digital pH meter with an accuracy of ± 0.01. Total hardness, calcium, magnesium were measured by EDTA titration method (Honda, 1986) Chloride was measured by volumetrically by silver nitrate titrametric method using potassium chromate as indicator and was calculated in terms of mg/L (Manivasagam, 1984).

RESULTS AND DISCUSSION

Obviously industrial effluents spoil the water quality of river Kali causing unfavorable changes in phsico-chemical parameter. In the present investigation, wide range of variations was recorded in TDS, COD, biological oxygen demand (BOD), Colour, Odor, Total hardiness, pH, Calcium, Magnesium, Chloride, and Sulphate etc (Table 1). In this study, we have collected water samples of river Kali Nadi from different areas of Meerut region and compared the different physio-chemical parameters like Biological Oxygen Demand (BOD), Total Dissolved Solids (TDS), Total hardness, Chemical Oxygen Demand (COD), pH, Calcium, Magnesium, Chloride, and Sulphate etc. We have concluded that the decreasing contamination of water as follows: Kharkhoda > Garh road > Mawana road > Daurala road. We observed that the water sample of the Kharkhoda is highly polluted as it has a contamination with BOD = 90, TDS = 1036 mg/L, total hardness = 418 mg/L as shown in Figure 1

The entry point of the Kali Nadi in the Meerut region i.e. Daurala Road is least contaminated because none of the industries are located nearby to this area, only some household waste is dumped into the river. Thus, the water from this area can be treated by some of the wastewater treatment methods and can be used for irrigation purposes. It shows that the contamination of water increases respectively as industries increases from Daurala road to Kharkhoda. Thus, sample water from Kharkhoda is highly contaminated because of many industries, located in this region, released waste into the Kali Nadi.

Effluents from sugar industry may have different amounts of solid particulate matter either as suspended solids or total dissolved solid that affect the light intensity

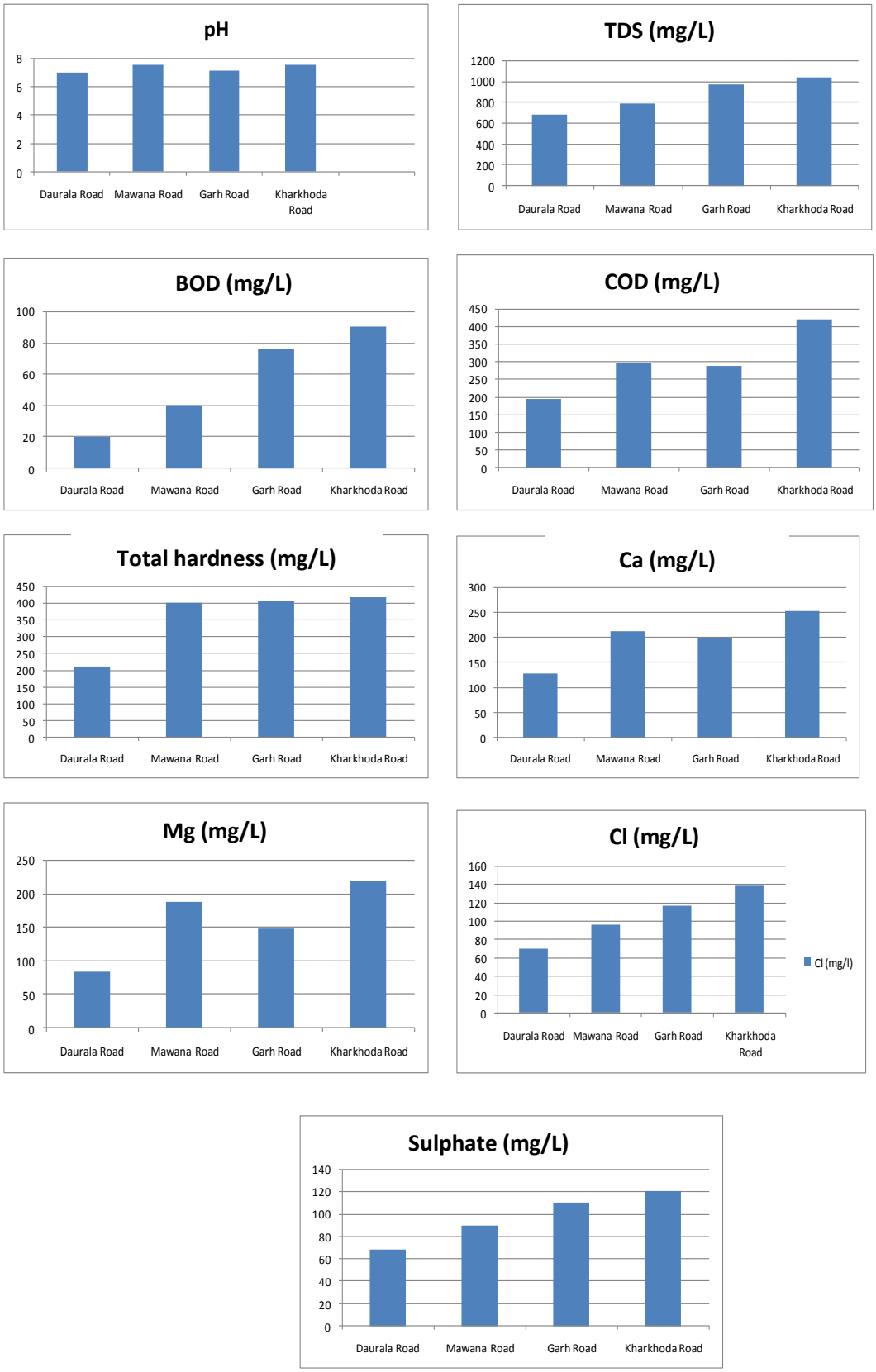

Figure 1. Shows a summarized result of physico-chemical parameters of pH, TDS, BOD, COD, total hardness, calcium, magnesium, chloride, and sulphate of Kali Nadi water at the four locations in Meerut district.

of water. pH of collected samples have varied from 7.0 to 7.5. It is evident that the pH of water body is very important in determination of water quality since it affects other chemical reactions such as solubility and metal toxicity (Sayyed and Bhosle, 2010)

The huge accumulation of inorganic elements such as sulphate (68 to 120 mg/l), has created condition for eutrophication resulting in reduced dissolved oxygen. The other important physicochemical parameters of water namely total hardness (212 to 418 mg/l) total TDS (680 to 1036 mg/l) were significantly found beyond normal limit.

Total dissolved solids (TDS) refers to all dissolved materials present in the water. Combined sugar mill effluents generally do not have a TDS measure high enough to have an adverse environment impact. Discharge of water with a high TDS level would have adverse impact on aquatic life, render the receiving water unfit for drinking, reduce crop yields if used for irrigation, and exacerbate corrosion in water systems and Industrial effluents generally change the natural pH level of the receiving water body to some extent. Such changes can tip the ecological balance of the aquatic system, excessive acidity particularly; can result in the release of hydrogen sulphide to the air (Verma and Shukla, 1969; Behra and Mishra, 1969; Roy, 2007).

The values of BOD and COD exceed the limit. A high COD, a measure of the inorganic and partly organic non-biodegradable content of the effluents, has effects on the receiving water body similar to that of a high BOD. Suspended solids reduce light penetration and, as a result, plant production in the receiving water body by increasing turbidity and can also clog fish gills. Benthic decomposition of components can decrease oxygen availability while anaerobic decomposition can produce hydrogen sulphide and release by-products that increase BOD. The results of previously published (Ashok et al., 1988; Baruah et al., 1993; Kaushik et al., 2013) are in correlation with our observation of the impact of industrial effluents on water quality of Kali River in Meerut district (India). The Industrial effluent should be treated, the hazardous substances should be reduced before the effluent are discharged into the kali river and open environment so as to circumvent their adverse effect on aquatic life and human beings. In addition, industrial effluents as well as domestic and hospital wastes are properly treated before dumping them into Kali river because the Kali river water utilized for irrigation purposes in some places of Meerut district which, will be a boon to the farmers.

Conclusion

Industrial activities contribute a lot to toxic wastes to the environment in general, hence this study was conducted to investigate the effects of industrial effluents on water quality of Kali river in Meerut. Obviously, India is a developing country where industrial units mainly sugar, leather and textile industry form a major part and effluent treatments are not taken care of. The costs of water treatment add to woes of the ailing smaller units. Hence, the values pH, TDS, BOD and COD are above the permissible limits. These effluents have deleterious effects on flora and fauna of our ecosystem. The high level of TDS and TSS are of major cause of concern due to the increased incidences of cancer. Hence, the effluent should be treated, the hazardous substances should be reduced before the effluent are discharged into the environment so as to circumvent their adverse effect on aquatic life and man further if the industrial effluents as well as domestic and hospital wastes are properly treated before dumping them into river. The river water can be utilized for irrigation purposes which will be a boon to the farmers.

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Conflict of Interests

The author(s) have not declared any conflict of interests.

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