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Assessment of Surface Water Quality of Gonda Nallah and River Kharashrota Near Kalinga Nagar Industrial Complex in Jajpur District of Odisha

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***Abstract* - An attempt has been made to assess the surface water quality of Gonda nallah and River Kharashrota so as to determine the safety level of their uses by the local people in the vicinity of an industrial climate. The study area is present in the Sukinda block of Odisha in India. The pollutant level in the surface water of these water-bodies is estimated by following the standard methods of APHA. The analysis of results expresses significantly higher oxidizable pollutants levels at all the twelve sampling stations during Pre-monsoon, Monsoon and Post-monsoon than the limits prescribed by World Health Organization. It indicates that surface water of the studied water bodies is polluted and is unsafe for use without treatment due to the presence of excessive quantity of oxidizable pollutants. Further study is needed in this context to reduce the pollutant load of these surface water bodies.**

Keywords-Chemical oxygen demand, Effluents, Industrial, Pollution, River

I. INTRODUCTION

The people of the modern civilization are mostly depending on river water for meeting the demands from domestic, industrial, agricultural and energy sectors. All these activities exploit the river water resources of the country. The situation is alarming with the increase in population and industrialization. The surface water pollution is at high risk in the present scenario. Ninety percent of total drinking water is severely polluted [1]. The situation is compounded by the fact that the common man in most of these countries does not have access to potable water and in many instances; raw river water is used as the source of drinking water [2]. The chemical oxygen demand level of the surface water-bodies is one of the most important parameters that provide information regarding surface water pollution.

The River Kharashrota, a branch of River Brahmani after Chakua is passing nearer to the Kalinga Nagar Industrial Complex in the Sukinda block of Jajpur district in Odisha. This Industrial Complex is promoting the steel production in the north-eastern Odisha in India. It is situated at a distance of 110 kilometres from Bhubaneswar, the capital city of Odisha. The river Kharashrota flows from west to east on the southern side of this Industrial Complex. Many people of the villages such as Jokadia, Marthapur, Nelibari, Nuagaon and others are depending on the surface water of this river Kharashrota for multiple daily activities.

Most of the rivers are constantly fed by drains carrying industrial effluents affecting the growth and germination of crop plants [3]. The Gonda nallah receives a number of small drainage channels from this industrial complex on both of its banks. The direction of flow of Gonda nallah is from north to south and it drains directly into river Kharashrota at Jokadia. Below the confluence, river Kharashrota heads its way in southeast direction up to the Bay of Bengal.

The effluents have high salt concentration and toxic elements [4]. Heavy metals from compounds in the body can be carcinogenic and mutagenic even at very low concentration [5]. The major source of waste water during steel making is the cooling water that contains hexavalent chromium. Hexavalent form of chromium is more hazardous to biological activities [6]. These are extremely persistent in the environment, as these are non-biodegradable and non-thermo degradable and thus, readily accumulate to toxic levels [7], [8]. The contaminants are assimilated inside the living plants and animals quickly through the food chain, affecting the health of the animals and human beings [9]. Some of the contaminants such as domestic wastes, industrial wastes, fertilizers are man-made pollutants of water [10].

This study area is covered under the Survey of India toposheet No. 73 L / 1. This area is bounded between the latitudes 20° 57' N - 21° 3' N and longitudes 85° 59' E - 86° 5' E.

II. MATERIALS AND METHODS

Survey was done to locate the sampling sites. The sampling sites were selected on the basis of suspected critical pockets of pollution in the vicinity of the Kalinga Nagar Industrial Complex. The station codes and description of the water sampling stations of the study area are presented in Table 1. In the current study, the

assessment of surface water quality of Gonda nallah and River Kharashrota near Kalinga Nagar Industrial Complex in Jajpur district of Odisha was done by determining the chemical oxygen demand (COD) contents of these surface water-bodies. Water samples were collected from six locations each of Ganda nallah and River Kharashrota. Seasonal water samples were collected during Pre-monsoon, Monsoon and Post-monsoon seasons for three consecutive years from February, 2012 to January, 2015.

The monitoring months in relation to the representative seasons are Pre-monsoon (February – May), Monsoon (June – September) and Post-monsoon (October – January).

Seasonal water samples were collected in pre-sterilized 2 litres capacity polythene bottles, (soaked overnight in 2 percent nitric acid and washed well in distilled water) from each location at 11A.M. and the COD of the surface water samples were estimated following standard methods for the examination of water and wastewater [11].

TABLE.1: Table showing the station code and description of the water sampling stations of the study area

Station code of water sampling sites	Description of the sampling station	Distance from the previous water sampling station in the upstream
SW 01	Gonda nallah	First sampling station
SW 02	Gonda nallah	500 metres
SW 03	Gonda nallah	500 metres
SW 04	Gonda nallah	500 metres
SW 05	Gonda nallah	500 metres
SW 06	Gonda nallah	500 metres
SW 07	River Kharashrota	500 metres
SW 08	River Kharashrota	500 metres
SW 09	River Kharashrota	500 metres
SW 10	River Kharashrota	500 metres
SW 11	River Kharashrota	500 metres
SW 12	River Kharashrota	500 metres

III. RESULTS AND DISCUSSION

The chemical oxygen demand values of surface water of Gonda nallah and River Kharashrota during Pre-monsoon, Monsoon and Post-monsoon seasons at twelve sampling stations and their interactions is presented in Table 2.

The analysis of variance indicates that the values for the seasons, surface water sampling stations and their interactions in respect of chemical oxygen demand of the water samples are significant (Table 2).

The mean value of chemical oxygen demand of the surface water samples was found to be more during monsoon (46.708 mg/l) followed by pre-monsoon (45.492 mg/l). The level is at minimum during post-monsoon (42.570 mg/l). The maximum value during monsoon may be due to increase in the amount of pollutants with run-off water. The higher mean value of chemical oxygen demand of the surface water samples during pre-monsoon than that in the post-monsoon may be due to decrease in dilution with the evaporation of water.

TABLE 2.: Table for seasons, surface water sampling stations and their interactions in respect of chemical oxygen demand (mg/l) of the water samples of the study area

	Pre-monsoon	Monsoon	Post-monsoon	Mean
SW 1	72.640	73.900	69.430	71.990
SW 2	68.670	69.840	65.300	67.937
SW 3	66.580	67.400	62.820	65.600
SW 4	63.550	64.620	60.760	62.977
SW 5	63.200	63.750	60.000	62.317
SW 6	62.920	63.490	59.670	62.027
SW 7	29.340	31.200	27.000	29.180
SW 8	27.100	28.100	23.880	26.360
SW 9	25.330	25.920	21.930	24.393
SW 10	22.590	24.630	20.740	22.653
SW 11	22.020	23.930	19.790	21.913
SW 12	21.970	23.720	19.520	21.737
Mean	45.492	46.708	42.570	
SE(m) (±) for seasons				0.038
CD(0.05) for seasons				0.231
SE(m) (±) for sampling stations				0.076
CD(0.05) for sampling stations				0.236
SE(m) (±) for interactions of seasons and sampling stations				0.132
CD(0.05) for interactions of seasons and sampling stations				0.386
CV (%)				0.72

Maximum permissible value for COD as prescribed by WHO is 10 mg/l. Higher the level of chemical oxygen demand indicates higher the load of pollution in the river [12].

The mean value of chemical oxygen demand of the surface water samples is more at water sampling station SW 1 (71.990 mg/l), followed by SW 2 (67.937 mg/l), SW 3 (65.600 mg/l) and SW 4 (62.977 mg/l) on Gonda nallah. The minimum value 21.737 mg/l was recorded at SW 12 which is on River Kharashrota. The chemical oxygen demand levels of the surface water samples from sampling stations on Gonda nallah is more than that of River Kharashrota. It may be due to accumulation of non-degradable chemical pollutants. Exposure to these non-degradable chemical pollutants may affect the local people. Singanan *et al*. (2006) reported the toxicity of higher level of hexavalent chromium[13].

The values of the interactions of the seasons and sampling stations in respect of chemical oxygen demand of the surface water samples range between 72.640 mg/l (SW 1) and 21.970 mg/l (SW 12) during pre-monsoon. During monsoon the interaction values range from 73.900 mg/l (SW 1) to 23.720 mg/l (SW 12) and during post-monsoon the interactions values range from 69.430 mg/l (SW 1) to 19.520 mg/l (SW 12).

The variation in the mean values of chemical oxygen demand in respect of seasons and sampling stations indicate the amount of oxygen equivalent of the oxidizable organic matter present [11], [14]. Recorded higher value of chemical oxygen demand in the present study may be due to the entry of effluents from Kalinga Nagar Industrial Complex, which is supported by the findings of [15]Nayar *et al.* (2007); [16]Rajurkar *et al.* (2003) and [17]Dubey and Ujjania (2013) in the similar context.

IV. CONCLUSION

Surface water pollution of major rivers in our country is caused by the discharge of untreated or partially treated effluent from industries. Probably the industrial wastes are discharged into the receiving water bodies without adequate treatment. The accidental release and deliberate discharge of partially treated effluents has the potentiality to disrupt the structure and function of the biological system as many effluents are complex in nature. Hence, the regulation of quality of industrial effluents is of utmost necessity in order to protect the aquatic environment from adverse effects caused by effluent discharge [18]. If this will continue for a longer period without any remedial measure, it is likely to accumulate in the nearby soil and water resources, leading to undesirable adverse effects on the living system in and around the industry. The living organisms take in water directly or indirectly for various metabolisms. In the words of Chakraborty *et al. (*2013) if the intake water is polluted, very seriously it will do harm to them ultimately affecting the food chain and ecosystem [10]. Further study is needed in this context to reduce the pollutant load of these surface water bodies.

Deteriorating water quality of rivers is of major concern in India, which is especially true for rivers being used as drinking water sources. The main causes of deterioration in water quality were high interference of anthropogenic activities, lack of proper sanitation and industrial and domestic waste water inflow [19]. The present study indicates that the surface water of the studied water bodies is polluted and is unsafe for use without treatment due to the presence of excessive quantity of oxidizable pollutants.

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