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Study of dissolved ions in effluent of orient paper Mill, Amalai and Son River Water in Shahdol district, M.P.

MK Ahirwar and GS Gupta

Abstract

In the present study, dissolved cations in effluents of OPM and Son river water was examined during July to December, 2014. Whole area of effluent running and effluents storing ponds were emits sulphurous smell during the study. The huge insufficiently treated effluents received by Son river and flow towards downstream in west site of Amalai city. The color, odor, and various cations such as sodium, potassium, calcium and magnesium were analyzed during the study. The concentrations of metal cations such as sodium and potassium were analysed with using flame photometer, calcium and magnesium with the help of inductively coupled plasma technique. The result revealed that the concentration of potassium was very high in effluents of OPM at sampling stations SS-04, SS-05 and SS-06. Son river water had lower concentrations of all analyzed metal ions, except at sampling station SS-07.

Keywords: Dissolved ions, effluent, Son River, OPM, ICP

1. Introduction

River water is a valuable resource for irrigation and domestic purpose. Currently, the quality of river water is a matter of serious concern due to rapid increase in the population, urbanization, industrialization and deforestation. Son river water quality is highly affected by the dumping of effluent from OPM in the Shahdol district. Monitoring of monthly changing in Son river water quality was an important aspect for evaluating pollution due to dissolved ions of point sources. Presently, 50-60 m³ of water needs to produce a ton of paper and around 240-250 chemicals have been identified in effluents, which are produced at different stages of paper making in pulp and paper industry (Hossain and Ismail, 2015) [5]. Water quality of Himalayans river steadily deteriorating over several decades due to anthropogenic activities, dumping of treated or untreated effluents, poor structured sewerage and drainage system (Seth *et al.* 2016) [8]. The present study was an attempt to make an assessment of the change in the physicochemical properties of Son river by addition of effluent of OPM, and Soda factory Amalai.

2. Material and Methods

2.1 Study area

Orient paper mill is located inside Amalai and one of the biggest paper mills of Asia. OPM situated at the bank of Son river while distance between Orient paper mill and Son river is 2 km. The Son river is 784 kilometres long and one of the longest river of India. 10 sampling stations were selected for present study out which of 6 sampling stations were effluent running region of the OPM and 4 sampling stations were nearby village area in Son river.

Table 1: Details of sampling stations, region and distance from the OPM.

Sampling region	Sampling Station code	Sampling station details	Distance from OPM (km)
Effluent of OPM	SS-01	Near first paper mill	0.3
	SS-02	Near first boiler tunnel	0.6
	SS-03	Staff colony	0.9
	SS-04	Labour colony	1.0
	SS-05	Pokhrinala	1.2
	SS-06	Near son river	2.0
Son river water	SS-07	Village Bargawan	3.0
	SS-08	Village Jarwahi	5.0
	SS-09	Village Changera	7.0
	SS-10	Village Birhuli	9.0

2.2 Climate

The climate of the Amalai city in Shahdol district is moderate. It rains from June to October in the Shahdol district. The temperature remains the highest in the month of June and lowest in the month of January. The maximum and minimum temperature of the Amalai remains 46°C and -10°C. There are number of coal mines in the district which are situated in southern and eastern part of the district. Wind of Amalai city covered with various gases such as sulphur dioxide, Nitrogen oxides, and carbon oxides due to Amarkantak thermal power plant, Orient paper mill, and other industrial emitted gases in local environment.

2.3 Sampling procedures and Sample analysis

The samples collected from effluents running regions of OPM, and Son river location to include samples at dump site and downstream. Study of dissolved ions in effluent and Son river water conducted during July to December, 2014. At each site samples were collected in clean high density polythene bottles and store below 4°C temperature to slow biological activity until each was analyzed in lab. For each site, the location, date and time of sampling was recorded in a data table. Sodium, potassium were analyzed by flame photometry method. Calcium and magnesium was analyzed with the help of inductive coupled plasma technique. All the analyses in

this report were repeated two or three times until, concordant values were obtained. The water samples analysis was carried out as per standard method of water and wastewater (APHA, 2005) [2].

3. Result and Discussions

3.1 Color: The color was physically identified by visually during the study. The color of effluents samples was milky colloidal at sampling stations SS-01 and SS-02, black brown at SS-04 and yellowish at sampling stations SS-03, SS-05, SS-06 and SS-07. One significant is the persistent dark brown colour due to lignin and its derivatives, such as chlorolignin in the released effluent discharged from the pulp bleaching process (Prasongsuk *et al.* 2009) [7]. The color of Son river water was free from color, except sampling stations SS-07, (Table 2).

3.2 Odour: The odor of effluent from OPM was rotten egg and sulphurous in all over samples. The offensive smell of sewer and decay could result from diethyl sulphide, dimethyl disulphide and methyl mercaptan commonly emitted from paper mill stacks (Chan, 2006) [4]. The Son river water sample was odourless, except sampling station SS-07 during the study.

Table 2: Mean values of physicochemical parameters of effluents at main drain and Son river from downstream Jul. to Dec.2014.

Sampling stations	Physico-chemical parameters					
	Color	Odor	Na	K	Ca	Mg
SS-01	Milky colloidal	Sulphurous	105.7	17.9	172.5	30.2
SS-02	Milky colloidal	Sulphurous	102.2	17.5	164	28.2
SS-03	Light yellow	Sulphurous	65.8	6.7	70.3	13.1
SS-04	Black brown	Sulphurous	119	48.4	92.9	25.2
SS-05	Yellow	Sulphurous	110.2	43.6	92.8	16.7
SS-06	Yellow	Sulphurous	72.4	44	60.8	14.5
SS-07	Light yellow	Sulphurous	55	18	51.3	12.2
SS-08	Clear	Odourless	43.6	7.6	52	11.1
SS-09	Clear	Odourless	43.9	6.8	49.2	10.9
SS-10	Clear	Odourless	41.1	6.4	47.2	7.8
Permissible limit for drinking(BIS,2012)	Unobjectionable	unoffensive	100-200	10-	75-200	75-100

All metals contents expressed in mg/L.

3.3 Sodium: Maximum average value of sodium 119 mg /L was obtained at sampling station SS-04 due to used NaOH in bleaching process, Na₂O₂ (sodium peroxide) Na₂S, Na₂S₂O₃ (Sodium thiosulphate) during paper making process and Na₂Al₂O₄ (Sodium metaaluminat) also used in conjunction with alum to control pH. The average values of sodium at all over sampling stations were under the permissible limits (BIS, 2012) [3] during the study, (Table 2). In general, a considerable decrease in the concentration of calcium, sodium, manganese occurred during the flow of effluents downstream (Alluri *et al.* 2016) [1].

3.4 Potassium: The higher average values of potassium 48.4, 43.6 and 44.0 mg/L were observed at SS-4, SS-05 and SS-06 during Jul. to Dec., 2014. Lower average values of potassium were observed at sampling stations SS-03, SS-09 and SS-10. Potassium in term the magnitude of its content in the earth crust and the solubility of its compounds was very similar to sodium. However it occurs in lower concentration in surface water as it has weak migratory ability. The Son river water had low concentration of potassium, except sampling station SS-07 (Near village Bargawan).

3.5 Calcium: The average concentration of calcium was found under the maximum permissible limits in effluent samples of OPM, while Son river water was below the desirable limit of Bureau of Indian Standard, 2012 [3], (Table 2). The maximum calcium 27.4 mg/l was found in rainy season. The minimum calcium 10.9 mg/l was found in winter season (Joshi *et al.* 2009) [6].

3.6 Magnesium: The average concentration of magnesium was found below the maximum desirable limits in effluent samples of OPM, while Son river water also was below the desirable limit of Bureau of Indian Standard, 2012 [3], (Table 2).

4. Conclusion

From present study we concluded that the dissolved ions in Son river were under the drinking water standard as per BIS, 2012 [3]. Son river water was suitable for irrigation and domestic uses in rainy season. Effluent of OPM was found high concentration of potassium due to dissolved solids. Because of higher concentration of dissolved ions there is potential risk associated to concerning mass. From this

reported values, it is suggested that further improvement is necessary for Son river water near Amalai city.

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