Water Quality Analysis of Various Surface Water (Rivers, Streams and Jhors) in Angul –Talcher Industrial Area of Odisha

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Abstract

River Brahmani is one of the significant sources of water supply for domestic, agricultural and industrial usage in the state of Odisha which flows through the industrial area of Angul –Talcher. This industrial township is reputed due to its vast coal mines, three Thermal power plants (two are owned by NTPC and one owned by NALCO) one aluminum smelter plant (of NALCO) and many Ferro alloys industries. This town lies between latitudes 20^o 37$^{'}$ N to 21^o 10'N and longitudes 84^o 53'E to 85^o 28' (fig.1) and situated at an average height of 139 meters above mean sea level. Two major small rivers like Tikira and Nandira confluence with the river Brahmani in the study area.

About sixty water samples were collected during pre monsoon and post monsoon period for the year 2012 .The physico- chemical parameters such as pH, Electrical conductivity, Total Dissolved Solids Alkalinity, Hardness, Fluorides, Chlorides, Sulfates, Nitrate –N, Ammoniacal -N, Phosphates, DO, BOD, COD and some heavy metals concentration like Pb, Cd, Hg , Total Cr, As etc were analyzed. The analytical results were compared with the Indian standard (BIS) and international standard (WHO) to assess the suitability of water for drinking and extent of deterioration for other usage.

Key words: surface water pollution; physico-chemical parameter; seasonal variation; Brahamani River.

1. Introduction

The quality of water is of main concern for mankind since it is directly related to human welfare for healthy living. Surface water is mainly used for domestic need, industries and agriculture purposes in most parts of the world as it is a replenishable resource. Due to unprecedented rapid population growth, urbanization and industrialization, water pollution problem have become increasingly evident and have led to serious ecological and environmental problems. In most cities urban and industrial wastes are generally disposed of without adequate treatment and management.

The scope of present study is limited to water quality of Angul-Talcher industrial area which is a highly polluted and sensitive zone in the state of Odisha. This township is located between latitudes 20^o 37$^{'}$ N to 21^o 10$^{'}$ N and longitudes 84^o 53$^{'}$ E to 85^o 28$^{'}$ E and at an elevation of about 139 meters above mean sea level (MSL).This industrial belt is flanked with a lot of villages surroundings and within the periphery of the industries like Thermal power plant, Aluminum smelter plants, Ferro alloy industries and vast coal mines. Two major small rivers like Tikira and Nandira which carry the urban and industrial wastes, confluence with river Brahmani in the study region.

2. Methods and Procedures of Investigation

The samples were collected from six different locations of the flowing surface water i.e. Tikira (up-stream and down-stream) Nandira (up-stream and down-stream) and river Brahmani (up-stream and down-stream). The present study was carried out for the year 2012, corresponding to pre-monsoon and post-monsoon seasons at a regular interval of 10 samples in a month for each sampling station. Accordingly from six sampling stations, a total of 60 samples were collected in a month. (Location map figure-1)

Water samples were collected in air tight polypropylene sampling bottles having double stopper facility to its full capacity without entrapping air bubbles inside. The bottles were sterilized before the collection of samples. The temperatures of different water samples were determined at the site by sensitive Red mercury thermometer. The pH was measured by digital pH meter, sodium and potassium by flame photometer (Systronic digital). Total dissolved solid (TDS) was estimated by taking dried weight of the sample in platinum dishes and conductivity was measured by conductivity meter (Elico Make) [4]. Analysis of calcium, magnesium and total hardness were done by EDTA method. Sulphate was determined by gravimetric method. Chloride by Mohr's method. Fluoride concentration was measured using Orion ion analyzer EA-940 with chloride ion selective electrode. Dissolve oxygen (DO), COD and BOD were estimated by standard procedure methodology of American Public Health Association (APHA, 1998)[1]. Heavy metals like Pb, Zn, Cr, Cd, As, Hg, concentration were determined by AAS (Model Perkin Elmer -303) after $HClO_4$, HNO_3 and HCl digestion. Standard procedure was adopted using desiccators to find the faecal coli form and total coli form[3]. The average value of the analysis result for different physico- chemical parameters have been tabulated in table- 1 and table -2 for pre-monsoon and post monsoon seasons respectively.

Table -1 water quality Analysis of various surface water of the study area in pre-monsoon season (Feb-May-2012)

Parameter	Sample Location with Code					
	S_1	S_2	S_3	S_4	S_5	S_6
pH	6.44	7.75	6.24	7.80	8.12	8.24
Elect. Conduct. µmhos /cm	224	545	107	608	411	610
TDS (mg/l)	116	262	52	314	184	360
Fluoride (mg/l)	0.40	2.24	0.60	1.62	1.84	2.24
Chloride (mg/l)	10	28	06	37.5	10	28.6
Sulphate (mg/l)	24.22	146.6	10.24	160.6	124	186
Nitrate –N (mg/l)	1.24	0.001	0.02	0.01	011	0.32
Phosphate as PO_4 (mg/l)	1.14	0.08	0.94	1.24	0.60	0.64
Na(mg/l)	4.5	6.8	2.8	4.6	12.6	13.20
K (mg/l)	0.9	1.4	0.8	1.24	2.46	2.89
Ca Hardness (mg/l)	85	110	54	120	124	136
Mg Hardness (mg/l)	64	84	32	86	98	90
Total Hardness (mg/l)	250	314	146	218	224	256
DO (mg/l)	8	7.2	6.8	4.8	3.7	4.3
BOD (mg/l)	1.4	0.8	1.24	<1	1.6	<1
COD(mg/l)	22.6	28.64	6.26	9.32	36.2	45.5
Pb (mg/l)	<0.01	<0.04	<0.01	<0.8	<0.06	1.24
Cd (mg/l)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Hg(mg/l)	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006
Cr-Total	0.04	0.8	0.002	0.07	0.63	0.34
Ammoniacal-N as NH_3	0.08	1.4	0.85	1.06	2.1	2.24
Faecal coli form as MPN / 100ml	22	64	46	88	280	1640
Total coli form as MPN /100ml	48	96	74	126	420	1880

Table -2 water quality Analysis of various surface water of the study area in post-monsoon season (Oct--Dec2012)

Parameter	Sample Location with Code					
	S_1	S_2	S_3	S_4	S_5	S_6
pH	6.7	7.5	6.32	8.54	7.74	8.26
Elect. Conduct. µmhos /cm	202	414	198	556	364	448
TDS (mg/l)	88	224	48	296	158	326
Fluoride (mg/l)	0.6	2.16	0.8	1.54	1.66	1.94
Chloride (mg/l)	16	38	14	34.8	18	26.2
Sulphate (mg/l)	18.8	128.2	8.4	144.6	122.7	166.8
Nitrate –N (mg/l)	1.2	0.001	0.001	0.02	0.14	0.28
Phosphate as PO_4 (mg/l)	1.10	0.06	0.76	1.16	0.8	1.18
Na(mg/l)	3.8	5.42	2.24	3.84	12.24	16.46
K (mg/l)	0.6	1.62	0.8	1.36	2.24	2.66
Ca Hardness (mg/l)	76.0	98	58	118	138	168
Mg Hardness (mg/l)	62.0	80.4	44.6	78	104	116
Total Hardness (mg/l)	210.0	278.0	142.0	224	246.6	262.6
DO (mg/l)	6.4	6.28	6.2	4.22	3.24	3.96
BOD (mg/l)	1.12	0.68	1.16	0.42	1.18	0.48
COD(mg/l)	18.4	26.62	5.84	16.4	34.16	42.46
Pb (mg/l)	<0.01	<0.02	<0.01	1.22	<0.08	1.28
Cd (mg/l)	<0.004	<0.004	<0.004	<0.008	<0.004	<0.006
Hg(mg/l)	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006	<0.0006
Cr-Total	0.06	1.28	0.06	0.12	0.54	1.22
Ammoniacal-N as NH_3	0.04	0.98	0.08	1.78	1.78	2.14
Faecal coli form as MPN / 100ml	18	56	42	82	244	1264
Total coli form as MPN /100ml	38	104	66	124	414	1684

S_1–Up-stream of river Tikira
S_2– Down-stream of river Tikira
(Near the confluence point of river Brahmani)
S_3- Up-stream of river Nandira (Jhor)

S_4-Down-stream of river Nandira (Jhor)
(Near the confluence point of river Brahmani)
S_5–Up-stream of river Brahmani near Samal Barrage
S_6- Down-stream of river Brahmani (Near Kamalanga)

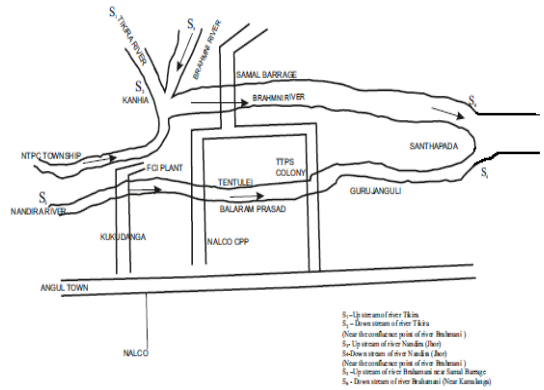
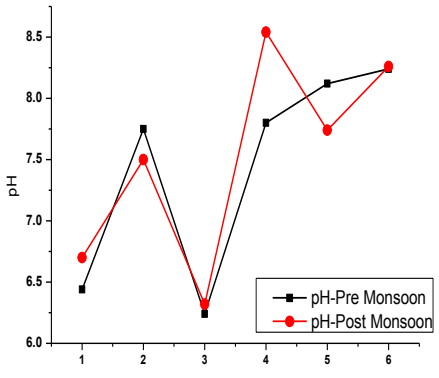


Fig: Sketch of study area

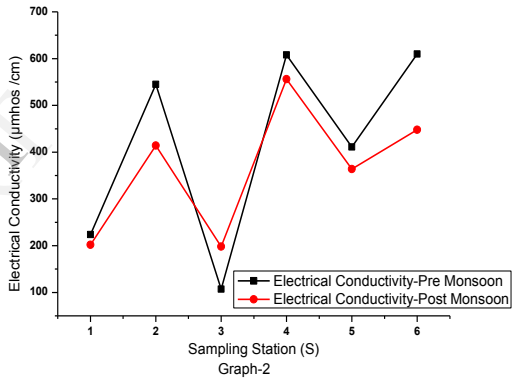
3. Results and Discussions

Water samples at six monitoring stations signify a clear picture of physico-chemical characteristics of surface water. The overall concentration of all the parameters given in table -1 and table-2 shows that except some parameters like Electrical conductivity, TDS, Fluoride, Total Hardness and COD at some monitoring station (i.e. down-stream of Brahmani near Kamalanga) remains below the permissible standard. The variation of pH at different monitoring station at downstream of Kamalanga and Brahmani may be due to mixing of industrial effluent from Thermal power plant. A little higher value of Electrical conductivity, TDS, Fluoride, BOD and COD, above permissible limit may be account for the mixing of industrial effluent. But low value of BOD may be due to presence of pathogenic bacteria due to mixing of domestic wastes and waste water runoff directly from Headquarter medical Hospital, Talcher, situated close to river Brahmani. Moreover the faecal coli form and total coli form level were found to higher than the permissions able limit[5]. Within the analysis of some heavy metals like Pb, total Cr, the concentration remains higher than the permissible limit at down-stream of the river gives clear sign of effluent water from coal mines drainage and Thermal power plant mixing at different confluence of river Brahmani from small rivers like, Tikira, Nandira. Moreover the study of seasonal variations of pre-monsoon and post-monsoon shows that the higher value of different parameters in pre-monsoon periods and lesser value in post-monsoon may be due to dilution factor in rainy season.

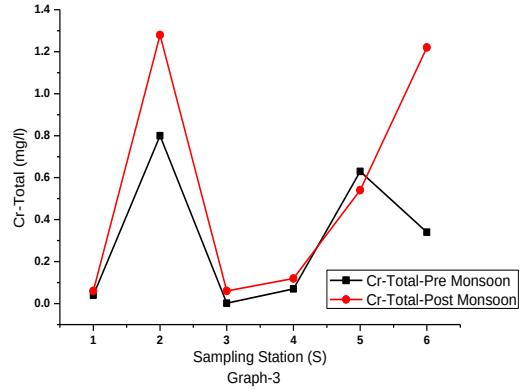
4. Graphs



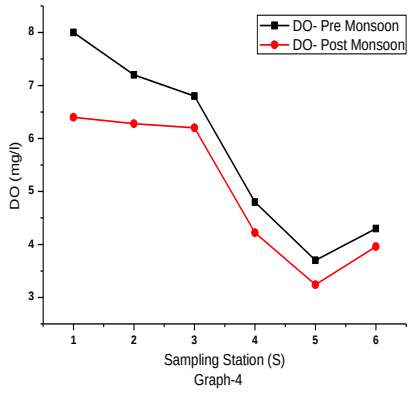
Graph-1



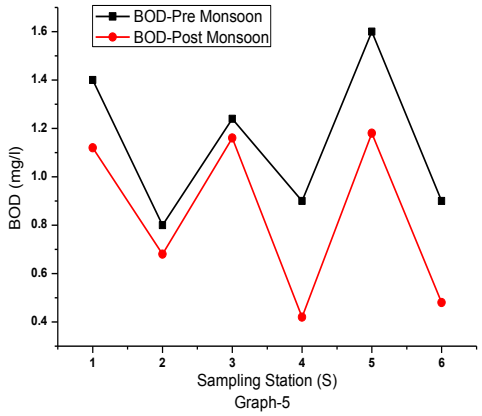
Graph-2



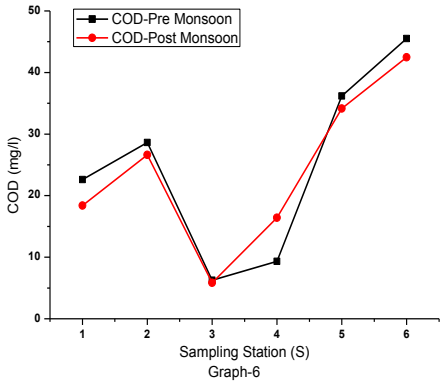
Graph-3



Graph-4



Graph-5



Graph-6

5. Conclusion

Out of all these different physico-chemical parameters analyzed, some parameters like BOD, COD, faecal coli form, and some heavy metals like Pb and total Cr beyond permissible limit shows that the river water is deteriorated at the downstream after mixing of effluent of Talcher industrial complex. A detailed studies of all these parameter in every month and seasonal variation has already been under taken for a more clear picture of surface water quality and ground water quality (near the ash pond of different Thermal power plants, coal mining drainage and smelter plant) of the most sensitive industrial zone of the country.

6. References

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