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EFFECT OF PAPER MILLS EFFLUENTS ON GROUND AND SURFACE WATER BODIES OF SOME SELECTED AREAS OF JANJGIR CHAMPA, C.G., INDIA

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ABSTRACT

Analytical studies of some selected physicochemical parameter with metallic elements were made on the surface and underground water bodies of Paper mills industrial areas Janjgir Champa Chhattisgarh. Water samples were collected from eight different selected spot in the month of Oct'2012 to Dec'2012. Temperature, pH, E.C, Turbidity, TDS and D.O were analyzed instantly at the sampling spot while T.S, TSS, TH, Total Alkalinity, BOD, COD, Cl^-, F^-,SO_4^{2-}, NO_3^-, PO_4^{3-}, Na, K, Ca, Mg, Fe, Cu, Zn, Mn and Phenol by the standard method as per IS procedure. The statistical parameters like mean, SD, SE, % CV and Correlation coefficient(r) and WQI were systematically calculated. It was observed that EC, Turbidity, TSS, TH, BOD, COD, PO_4^{3-}, Na and Phenol have been found higher value than the maximum permissible limit of IS: 10500 and WHO standard of drinking water. The elevated values of these parameters are of great concern to public health when the water from these bore wells are consumed by people without treatment.

KEYWORDS : Water Quality, Industrial Effulent, Physico-Chemical Parameter, Statistical Value And Public Health

Water is the most precious and essential compound to sustain the life on the earth. Pure drinking water resources are dwindling due to over deforestation, mining and industrialization. Approximately 71% of the earth surface is covered with water, mainly in the form of oceans. Around 2% of the water is present in glacier and ice caps. The actual fresh water is available for human consumption is near about 1% of the total earth water. Ground and surface water are used by man are of different characteristics. Ground water contains dissolved minerals from the soil layers through which it passes. Surface water contains a lot of organic matter and mineral nutrients (Dhameja, 2006; De, 2006; Pandey and Gupta, 2005). Owing to increasing industrialization on one hand and exploding population on the other, the demand of water supply have been increasing tremendously. Moreover, considerable part of this limited quantity of water is polluted by sewage, industrial wastes and a wide variety of synthetic chemicals. Thus, the quality as well as the quantity of clean water supply is of vital significance for the welfare of mankind (Subramanium, 2007, Masters, 2004; Verma, 2000; Hammer and Hammer, 2000).

Study Area

Champa city is situated on the banks of Hasdeo river and 12 km. away from in Janjgir-Champa district headquarter in the state of Chattisgarh, India. It is located between 22.05° N to 82.65° E latitude. The study area is surrounded by small mild forest, topographically height of the area is 253 meters from means sea level and average temperature 49^0C and average rain fall 1157.1 mm, geologically the study field is high grade area and metamorphic stone of archean age. Many companies big or small have their manufacturing/ production units are located in an around Champa viz. Madhya Bharat Paper Limited (MBPL), Prakash Industries Ltd., CSPGCL's Marwa Power Plant and many mega power projects are in under construction. Due to rapid industrialization; Cement, steel, paper, urbanization and over using of fertilizer, pesticides, have undoubtedly affected different water system. The main causes for the deterioration of water quality in water bodies are entering of pollutants due to discharge of untreated or partially treated waste water from steel plant, paper factory, municipal sewage and domestic effluents, so it is necessary to analyze the extent of pollutant present in the water of this area. We have taken Post - Monsoon (Oct-Dec 2012) assessment of water quality status to check the pollutants. In the present paper we have presented the analysis of post monsoon observations in reference of physicochemical parameters; however coefficient of correlation matrix, % CV and WQI were used for grading water sources.

MATERIALS AND METHODS

In our study, we have selected total eight sampling spots (shown in Figure1) as the basis of environmentally significant in which four from the Hasdeo river at Birgahani

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(MS_1), Deoraha (MS_2), Pithampur (MS_3) and Garapali (MS_4) and the remaining four from the nearby borewell of Birgahani (MG_1), Deoraha (MG_2), Pithampur (MG_3) and Garapali (MG_4) respectively. Both Surface and Ground water samples were collected every month of the post monsoon season (Oct'2012 to Dec'2012). In two liter capacity of polyethylene jerry canes and (one for physical and chemical analysis and another for metal analysis) previously soaked with 8M HNO_3 and clean with detergent followed by rinsing with double distilled water. The collected water sample was preserved in ice cooled chamber and kept in dark room (De, 2006; Rand,et al., 1976). Analysis was carried out by the standard protocol (Ralph, and Blackburn, 1997; APHA, 1995; Clesceri et al., 1991; BIS, 1993; Verma, 2000; De, 2006; Rand, 1976; HACH, 2000; Allen et al., 1974; Ewing, 1972) as per standard method within a short period of time, so as to get more reliable and accurate results.

RESULT AND DISCUSSION

The results are given in the Table,1 while Statistical parameters-Mean, SD, SE, WQI and Correlation matrix are displayed in Table,2 to Table,5.

P^H

In our investigation PH ranges was noted 7.01 at the sampling spot MG_1 (Nov'2012) to 8.10 at the Site of MS_4 (Oct'2012). The above ranging pH indicate water is nutral to basic in nature, which is under the range of acceptable for drinking water suggested by BIS, 1991; 6.5 -8.5.

Electrical Conductivity

For good aquatic life the conductivity value of 150-500 $\mu S\ cm^{-1}$. Minimum conductivity was observed 852 µ mhos/cm at the sampling site MG_3 in the month of Nov' 2012, while maximum EC was found on the sampling point MS_2; 1240 µ mhos/cm, which is slightly above the maximum permissible level as per standard. The high value of the EC in water sample suggested the dissolve of inorganic and organic salt in water in high concentration.

Turbidity

It was detected 3 NTU as low on the investigation site MG_4 in the month of Nov'2012 which is within permissible limit, while 85 NTU reported as the higher value on the MS_2 in Dec'2012. The Maximum value was beyond the acceptable range i.e., 5-25 NTU as set by BIS, 1991.

Suspended and Dissolved Solid

TS was noted in the ranges from 394 to 920 mg/L on the sampling point MG_3 (Dec-2012) and MS_3 (Oct 2012) respectively. TDS only measure of filtrate water sample. 215 mg/L on the sampling spot MS_4 in the month of Oct' 2012 and 750 mg/L of the location site MS_2 in the month of Nov 2012. TSS was noted in the ranges from 70 to 245 mg/L on the sampling point MS_3 (Dec-2012) and MS_4 (Oct-2010) respectively. The values of TS and TDS were within the permissible unit while Maximum TSS value crossed the maximum allowable limit. Although high suspended dissolved particles have not serious health hazard, but those peoples who are suffering from kidney and constipation problems mere affected of these parameters.

Alkalinity

The cause of alkalinity in water is due to the presence of various dissolve ions such as OH^-, HCO_3^-, PO_4^{3-}, BO_3^- etc (Verma, 2000). The desirable and maximum permissible unit is suggested by various water monitoring agencies such as BIS, 1991; 300mg/L to 600 mg/L. In our study minimum and maximum both values were noted in Nov' 2012 as 112 mg/L at the sampling location MS_4 and 672 mg/L of the sampling spot MS_2 (Nov, 2012).

Total Hardness

Total hardness is computed by sum of temporary hardness and permanent hardness. The sources of hardness of water is chiefly due to the dissolve of OH^-, HCO_3^-, Cl^- and SO_4^- ion of Ca^{2+}, Mg^{2+}, Fe^{2+} and Mn^{2+} (De, 2006). In study region its ranges was recorded 180 mg/L to 564 mg/L from sampling point MG_3 (Nov, 2012) and MG_1 (Nov, 2012).

DO

Dissolve oxygen is important water quality parameter which determine organic pollution of water. According to various water monitoring agencies its desirable value is 5 mg/L. In our study 3.46 mg/L to 7.73 mg/L reported as low and high values at the sampling spot MG_4(Oct'2012) and MS_2 (Nov'2012).

BOD

Table 1 : Average Value of Physico-Chemical and Metallic Element Analysis

Parameters / Sampling Spot	MS_1	MG_1	MS_2	MG_2	MS_3	MG_3	MS_4	MG_4
Temperature	24.400	24.466	24.400	24.566	23.300	24.533	24.300	24.633
PH	7.453	7.376	7.640	7.300	7.510	7.386	7.643	7.690
Conductivity	1123.666	1100.333	1100	1083.333	1081.000	954	1049.333	1013.666
Turbidity	17.000	12.000	80.333	22.333	12.333	8.333	55.333	5.000
TS	528.333	418.333	890.333	413.000	516.666	414.667	658.333	632.000
TDS	316.666	294.666	730.000	236.666	419.666	302.666	476.000	522.333
TSS	211.666	123.666	160.333	176.333	97.000	112.000	182.333	109.666
Alkalinity	531.666	623.000	563.333	665.000	343.666	488.000	122.000	336.333
Total Hardness	401.000	384.000	358.000	391.333	332.333	284.666	355.333	341.333
Chloride	152.676	161.770	591.100	487.233	235.186	193.866	70.443	227.263
Fluoride	0.916	0.990	0.810	0.760	1.010	0.940	1.066	0.926
Sulphate	383.000	264.666	435.666	277.000	214.333	219.333	336.666	270.666
D.O	5.653	4.756	6.956	4.970	5.556	4.640	5.250	4.836
BOD	3.560	4.280	4.580	4.340	4.603	4.716	3.630	4.736
COD	123.333	112.333	96.000	64.666	86.666	72.333	69.666	47.000
Nitrate	32.880	24.973	45.430	30.793	38.830	26.990	45.550	23.913
Phosphate	0.160	0.123	0.196	0.133	0.106	0.116	0.126	0.106
Sodium	246.666	400.000	310.000	533.333	243.333	473.333	223.333	430.000
Potassium	7.666	6.000	10.000	5.333	8.666	9.666	9.666	5.666
Calcium	110.966	111.936	98.256	121.656	100.153	106.333	106.306	93.596
Magnesium	23.113	21.733	15.973	10.743	14.696	25.926	11.056	15.443
Iron	0.116	0.316	0.123	0.310	0.113	0.316	0.116	0.353
Copper	0.029	0.030	0.025	0.027	0.028	0.028	0.030	0.029
Zinc	0.096	0.096	0.089	0.080	0.083	0.093	0.093	0.096
Manganese	0.386	0.063	0.076	0.256	0.126	0.163	0.056	0.033
Phenol	0.006	0.012	0.014	0.013	0.013	0.013	0.253	0.240

* All parameters in mg/Lit. except Conductivity (μ mhos/cm), Turbidity (NTU) and pH

MS_1 Birgahani (River Water), MG_1 Birgahani (Borewell Water), MS_2 Deoraha(River Water), MG_2Deoraha(Borewell Water), MS_3 Pithampur (River Water), MG_3 Pithampur(Borewell Water), MS_4 Garapali (River Water) MS_4 Garapali (Borewell Water)

It was noted on ranging from 3.39 mg/L on the sampling point MS_1 in the month of Nov-2012 to 4.98 mg/L in the month of Oct-2012 at the sampling point MS_3. Some water samples were showed below the permissible limit prescribed by ISI, 1993, 5mg/L.

COD

The ranging was obtained from 43 mg/L (MG_4) in the month of Nov'2012 to 140 mg/L (MS_1) in the month of Dec 2012. The higher value is too hold greater than the above permissible value according to standard drinking water agency as per BIS, 1991; 10mg/L. The high value may cause the presence of high content of carbonaceous particle and suspended particles in different water bodies.

Chloride

The potentially of Cl in microbes killing is depended upon the PH and people accustomed to higher chloride in water are subjected to laxative effect (Verma, 2006). In our minor assessment the ranging was found from 67 mg/L to 600 mg/L from in MS_4 (Oct, 2012) and MS_2

Table 2 : Statistical Parameter of Water Quality

Parameters	N	MEAN	S.D	S.E	%CV	MIN	MAX	RANGE	Indian Drinking water Std. IS: 10500, 1993, Edition 2.2 (2003-09)	WHO Rec.1999
Temperature	8	24.324	0.427	8.627	1.757	23.3	24.633	23.3 -24.633	***	27-28
pH	8	7.500	0.145	2.635	1.931	7.3	7.69	7.3 -7.69	6.5-8.5	6.5-8.5
Conductivity	8	1063.166	55.654	397.276	5.235	954	1123.666	954 -1123.666	***	1000
Turbidity	8	26.583	26.833	6.010	100.941	5	80.333	5 -80.333	5-8 NTU	5 NTU
TS	8	558.958	164.597	186.794	29.447	413	890.333	413 -890.333	520-2050	***
TDS	8	412.333	161.689	111.958	39.213	236.666	730	236.666 -730	500-2000	1000
TSS	8	146.625	41.628	74.835	28.391	97	211.666	97 -211.666	20-50	***
Alkalinity	8	459.125	180.577	187.972	39.331	122	665	122 -665	300-600	***
Total Hardness	8	356.000	37.656	141.775	10.577	284.666	401	284.666 -401	300-600	500
Chloride	8	264.942	178.976	53.979	67.553	70.443	591.1	70.443 -591.1	200-1000	200-1000
Fluori de	8	0.927	0.101	0.324	10.941	0.76	1.066	0.76 -1.066	1-1.2	1.5
Sulphate	8	300.166	78.488	135.411	26.148	214.333	435.666	214.333 - 435.666	200-400	250
D.O	8	5.327	0.754	1.999	14.163	4.64	6.956	4.64 -6.956	5	***
BOD	8	4.306	0.468	1.259	10.864	3.56	4.736	3.56 -4.736	5	***
COD	8	84.000	25.594	43.605	30.469	47	123.333	47 -123.333	10	***
Nitrate	8	33.670	8.705	11.625	25.853	23.913	45.55	23.913 -45.55	45	50
Phosphate	8	0.133	0.031	0.057	23.033	0.106	0.196	0.106 -0.196	***	***
Sodium	8	357.500	117.700	87.210	32.923	223.333	533.333	223.333 - 533.333	***	200
Potassium	8	7.833	1.944	2.710	24.813	5.333	10	5.333 -10	***	***
Calcium	8	106.150	8.889	39.232	8.374	93.596	121.656	93.596 - 121.656	75-200	200
Magnesium	8	17.335	5.629	8.172	32.472	10.743	25.926	10.743 -25.926	<30	***
Iron	8	0.220	0.111	0.041	50.504	0.113	0.353	0.113 -0.353	0.1-1.0	0.3
Copper	8	0.028	0.002	0.010	5.908	0.025	0.03	0.025 -0.03	0.05	2
Zinc	8	0.091	0.006	0.034	6.863	0.08	0.096	0.08 -0.096	5	3
Manganese	8	0.145	0.121	0.136	83.744	0.033	0.386	0.033 -0.386	0.1	0.5
Phenol	8	0.071	0.109	0.002	154.203	0.006	0.253	0.006 -0.253	0.001	***

(Oct, 2012) respectively under the desirable limit.

Fluoride

Its desirable amount spread from 1 to 1.5 mg/L is useful for human being. Its concentration is increased beyond the permissible limit 1 to 1.5 mg/L causes health hazardous. In this work ranging was obtained from 0.72 mg/L to 1.1 mg/L for MG_2 (Nov, 2012) and MS_4 (Oct, 2012) respectively. The observed value was within the standard range.

Sulphate

The minimum and maximum value was calculated as 190 mg/L and 447 mg/L from MS_3 (Nov, 2012) and MS_2 (Oct, 2012) respectively.

Nitrate

In study area minimum value was recorded 23.81 mg/L on the sampling point MG_4 in the month of Oct (2012) while 46.51 mg/L as maximum on the location spot MS_2 in the month of Nov-2012.

Phosphate

Domestic sewage and chemical fertilizer are chief source of phosphate in water. In this research work phosphate was obtained in the range of 0.1 mg/L from MS_3 & MG_4 sampling point in the month of Nov, 2012 to 0.21

Table 3 : Correlation Matrix of Water Quality

	Temp.	PH	Cond.	Turb.	TS	TDS	TSS	Alk.	T.H	Cl-	F-	SO42-	D.O	BOD	COD	NO3-	PO43-	Na	K	Ca	Mg	Fe	Cu	Zn	Mn	Ph
Temp.																										
PH	-0.087																									
Cond.	-0.231	-0.091																								
Turb.	0.045	0.462	0.304																							
TS	0.001	0.830	0.190	0.818																						
TDS	-0.084	0.862	0.060	0.718	0.968																					
TSS	0.331	-0.064	0.519	0.446	0.196	-0.058																				
Alk.	0.335	-0.690	0.341	-0.126	-0.301	-0.334	0.109																			
T.H	0.186	-0.193	0.862	0.149	0.008	-0.168	0.686	0.379																		
Cl-	0.120	-0.045	0.253	0.479	0.403	0.387	0.087	0.558	0.149																	
F-	-0.418	0.282	-0.198	-0.199	-0.124	-0.054	-0.279	-0.726	-0.292	-0.874																
SO42-	0.285	0.403	0.538	0.779	0.746	0.571	0.736	0.085	0.502	0.363	-0.325															
D.O	-0.243	0.433	0.530	0.790	0.815	0.743	0.336	0.070	0.202	0.582	-0.318	0.781														
BOD	-0.072	0.023	-0.476	-0.209	0.009	0.221	-0.823	0.219	-0.606	0.444	-0.289	-0.469	-0.068													
COD	-0.170	-0.290	0.686	0.104	-0.032	-0.123	0.352	0.417	0.478	-0.087	0.071	0.399	0.377	-0.450												
NO3-	-0.426	0.452	0.337	0.844	0.676	0.588	0.388	-0.404	0.058	0.235	0.092	0.569	0.751	-0.333	0.129											
PO43-	0.231	0.144	0.531	0.758	0.638	0.491	0.614	0.388	0.404	0.599	-0.536	0.911	0.844	-0.240	0.498	0.517										
Na	0.578	-0.517	-0.431	-0.397	-0.471	-0.409	-0.275	0.558	-0.136	0.340	-0.558	-0.430	-0.533	0.545	-0.452	-0.699	-0.250									
K	-0.327	0.350	-0.201	0.574	0.478	0.474	0.048	-0.406	-0.513	-0.029	0.289	0.294	0.513	-0.077	0.145	0.707	0.345	-0.554								
Ca	0.250	-0.843	0.295	-0.158	-0.636	-0.776	0.499	0.521	0.522	0.031	-0.288	-0.074	-0.330	-0.433	0.253	-0.184	0.032	0.353	-0.368							
Mg	0.204	-0.341	-0.216	-0.401	-0.335	-0.300	-0.159	0.357	-0.250	-0.319	0.123	-0.113	-0.188	0.062	0.511	-0.487	0.036	0.098	0.139	0.006						
Fe	0.582	-0.356	-0.508	-0.579	-0.512	-0.407	-0.440	0.358	-0.178	0.011	-0.236	-0.549	-0.726	0.511	-0.456	-0.867	-0.481	0.904	-0.650	0.172	0.200					
Cu	0.103	0.010	-0.165	-0.503	-0.437	-0.432	-0.052	-0.436	0.073	-0.919	0.748	-0.350	-0.698	-0.437	-0.004	-0.393	-0.626	-0.137	-0.292	0.089	0.172	0.224				
Zn	0.441	0.304	-0.192	-0.158	0.075	0.070	0.025	-0.202	-0.043	-0.611	0.455	0.172	-0.213	-0.265	0.240	-0.332	-0.028	-0.177	0.027	-0.296	0.592	0.150	0.625			
Mn	0.052	-0.563	0.333	-0.240	-0.384	-0.545	0.600	0.431	0.413	0.029	-0.369	0.168	0.030	-0.451	0.430	-0.106	0.257	0.006	-0.133	0.591	0.286	-0.193	-0.126	-0.152		
Ph	0.194	0.709	-0.354	0.103	0.327	0.335	-0.007	-0.797	-0.134	-0.399	0.430	0.027	-0.227	-0.167	-0.622	0.100	-0.342	-0.169	-0.031	-0.422	-0.462	0.065	0.503	0.351	-0.523	1

Significant at 5% level, r > 0.649

mg/L on MS_2 in the month of Dec, 2012.

Sodium

Domestic sewage is chief source for increase the amount of sodium in water. In our investigation observed value was 200 mg/L to 600 mg/L from MS_1 & MS_4 (Nov-2012) and MG_2 (Dec-2012) respectively.

Table 4 : Water Quality Index

Sampling Spot	∑QiWi	∑Wi	WQI = ∑QiWi / ∑Wi
MS_1	19.13	0.196	97.6
MG_1	19.18	0.196	97.866
MS_2	19.13	0.196	97.6
MG_2	19.26	0.196	98.266
MS_3	18.27	0.196	93.2
MG_3	19.23	0.196	98.133
MS_4	19.05	0.196	97.2
$M G_4$	19.31	0.196	98.533

Potassium

Its permissible range in drinking water is 10mg/L as per BIS, WHO and ICMR standard. 4 mg/L was detected as minimum on sampling spot MG_2 in the month of Nov'2012 while 11 mg/L at the sampling spot MS_2 in the month of Oct'2012.

Calcium

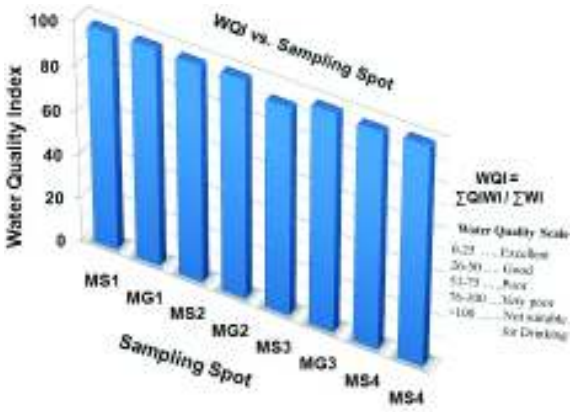

Figure 2 : Water Quality Index

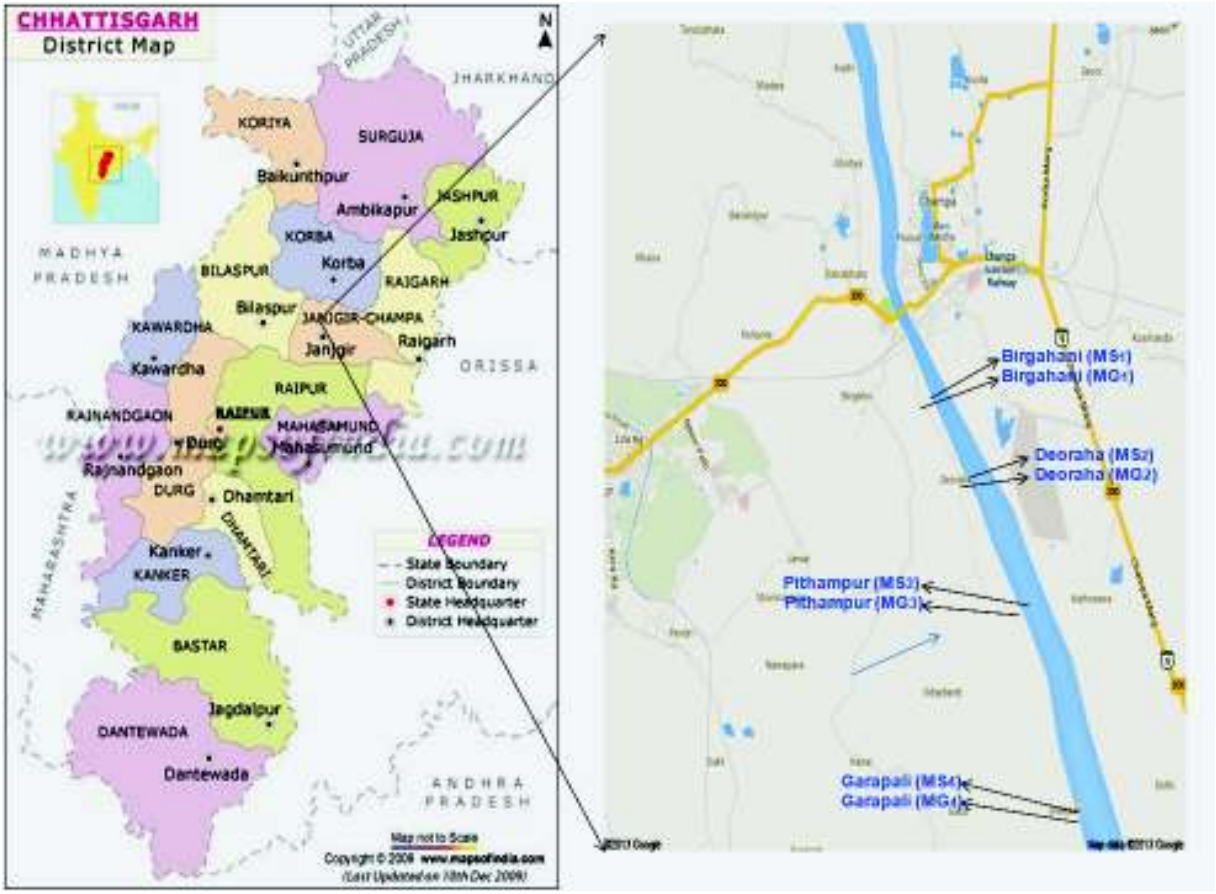

Figure 1: Location of study area

Its compound makes water hard due to high dissociation in water. In our research work the ranging was observed from 8 mg/L to 131.81 mg/L from MG_1 (Oct-2012) and MG_1 (Dec-2012) respectively. The range was under permissible according to standard value.

Magnesium

10.5 mg/L was reported on the sampling spot MG_2 in the month of Dec'2012 while 26.23 mg/L was noted on the sampling location MG_3 in the month of Dec'2012.

Iron

In our study 0.1 mg/L (MS_1, Oct-2012) to 0.37 mg/L (MG_4, Oct-2012) were reported. The amount of iron is high which is above the permissible limit as per drinking water standard.

Copper

In our study minimum amount was detected as 0.025 mg/L on the sampling spot MS_2 in the month of Nov and Dec-2012 while 0.03 mg/L was reported in the month of Oct, Nov and Dec -2012 on the sampling location MG_1 & MS_4 respectively.

Zinc

In our study minimum amount was detected as 0.07 mg/L on the sampling spot MG_2 in the month of Oct-2012 while 0.1 mg/L was reported on MS_1 & MS_4 (in the month of Oct), MS_1, MG_1, MS_4 & MG_4 (Nov) and MG_1 , MG_3 & MG_4 (Dec -2012) sampling location respectively.

Manganese

In our study minimum amount was detected as 0.04 mg/L on the sampling spot MS_4 & MG_4 in the month of Dec-2012 while 0.43 mg/L was reported on MS_1, Dec - 2012 sampling location respectively.

Phenol

In our study minimum amount was detected as 0.009mg/L on the sampling spot MS_1 in the month of Dec-2012 while 0.29 mg/L was reported on MS_4 (in the month of Oct'2012).

Correlation Matrix

The value of 'r' was calculated on the monthly basis as follows:

253 correlation coefficient 'r' among various water quality parameters were observed in which 182 positive (+) while 71 negative () correlation. Higher positive correlation was seen between TDS and TS (r = 0.968) while minimum positive r value was detected between TS and Tempr (r = 0.001). Near about 25 correlations were found above the significant at 5% level (r > 0.649).

Strong positive correlation was calculated between; TS and pH (r =0.830); TS and Turbidity (r =0.818); TDS and pH (r =0.862); TDS and Turdbidity (r =0.718); TDS and TS (r =0.968); TH and Conductivity (r =0.862); TH and TSS (r =0.686); SO_4^{2-} and Turbidity (r =0.779); SO_4^{2-} and TS (r =0.746); SO_4^{2-} and TSS (r =0.736); DO and Turbidity (r =0.790);

DO and TS (r =0.815); DO and TDS (r =0.743); DO and SO_4^{2-}(r =0.781); COD and Conductivity (r =0.686); NO_3^- and Turbidity (r =0.844); NO_3^- and TS (r =0.676); NO_3^- and DO (r =0.751); PO_4^{3-} and Turbidity (r =0.758); PO_4^{3-} and SO_4^{2-} (r =0.911); PO_4^{3-} and DO (r =0.844); K and NO_3^- (r =0.707); Fe and Na (r =0.904); Cu and F (r =0.748); Phenol and pH (r =0.709) etc.

Negative correlation were observed between Ca and pH (r = − 0.843); alkalinity and pH (r = − 0.690); BOD and TH (r = − 0.606); Fe and conductivity (r = − 0.508); Fe and Turbidity (r = − 0.579); Fe and Alkalinity (r = − 0.726); Fe and K (r = − 0.650); Ca and TS (r = − 0.636); Ca and TDS (r = − 0.776); Fe and NO3 (r = − 0.867); Fe and DO (r = − 0.726); Phenol and Alkalinity (r = − 0.797) etc.

The minimum negative correlations was detected between Cu and COD (r = − 0.004).

Water Quality Index

Water quality index was calculated for different sampling locations (Fig.2), the results were found in the ranges of 93.2 at the sampling point MS_3 to 98.53 at the MG_4. The high value of this statistical parameter indicated high loading of various kinds of pollutant. Another investigating points such as MS_1 (97.6), MG_1 (97.866), MS_2 (97.6), MG_2(98.266), MG_3 (98.133), MS_4(97.2) showed less than maximum WQI (<100) but greater than 76 -100 WQI values (very poor water quality) indication of intrusion of pollutants through leaching or percolation of surface water via domestic garbage and paper mill industrial effluent.

CONCLUSION

We have taken minor but deeply month wise

monitoring of Ground and surface water in the eight sampling spots MS_1 to MS_4 and MG_1 to MG_4 in and around the Madhyabharat Paper Mill industry. From the results of experiment it may be concluded that the Ground and surface water is polluted in references of EC (1063.166 μ mhos/cm), turbidity (26.583), TSS (146.625 mg/L), BOD (4.306 mg/L), COD (84.000 mg/L), Phosphate (0.133 mg/L), Sodium (357.500 mg/L), phenol(0.071 mg/L). These qualities were marginally higher than the standard values of drinking water. Higher Positive correlation of significant was calculated out between TDS vs. TS (r = + 0.968) indication that of both parameters are significantly correlated and follow similar kind of pattern together (increasing or decreasing). WQI reported 98.53 at the sample site MG_4, more loading of pollutant in this water source. We have suggested to peoples by comparing prior treatment is necessary before human Consumption for especially potable purpose.

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