



BIOREMOVAL OF WATER POLLUTANTS FROM THE EFFLUENTS OF TIFRA INDUSTRIAL AREA IN BILASPUR (C.G.)

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ABSTRACT

Analytical studies of some selected physicochemical parameters were done on the surface water bodies of Tifra industrial areas Bilaspur Chhattisgarh. Water samples were collected in May'2018, were explored for physicochemical and heavy metals as per IS procedure. More than 70% of these parameters were exceeding the permissible limit of BIS: 10500 and WHO standard of drinking water. The higher values of these parameters are of great concern to public health. Removal of water pollutants has been done by preparing bio-adsorbents from local plant origin. Adsorption capacity of different adsorbents has been established and compared for the removal of various pollutants.

Keywords: Industrial effluent, physico-chemical parameter, water quality, public health and bio-adsorbent.

1. Introduction

Water is the most precious constituent of environment for the existence of life. Pure drinking water resources are diminishing due to man-made activities like deforestation, mining and industrialization etc. Approximately one third of the earth surface is covered with water, mainly in the form of oceans. The actual fresh water is available for human consumption is around 1% of the total earth water. Ground and surface water have different characteristics. Ground water contains dissolved minerals from the soil layers through which it passes [1-3]. Owing to natural weathering and anthropogenic activities all these parts of universe has been deteriorated the water quality. Moreover, considerable part of this limited quantity of water is polluted by sewage, industrial wastes and a wide array of synthetic chemicals. Thus,

the quality as well as the quantity of clean water supply is of vibrant importance for the wellbeing of mankind [4-7].

1.1 Study area

Bilaspur city is the district head quarter of Bilaspur district, is the second largest city of Chhattisgarh state. It is situated on the banks of river Arpa. Bilaspur district is located between 21°47' to 23°08' North latitudes and 81°14' to 83°15' East latitudes, with a height of 262 meters from the sea level. The average rain fall in this area is 1220 mm. Many companies big small have their manufacturing or production units are located in an around Bilaspur. Due to huge industrialization of Bilaspur city and its surrounding air, water and soil are continuously polluted, so it is necessary to analyse the extent of pollutant present in the water of this area [8-9].

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 these industries, municipal sewage and domestic effluents, so it is necessary to examine the extent of pollutant present in the water of this area. In this present paper we have presented the analysis of water quality in May'2018 of pre-monsoon season in reference of physicochemical parameters and explored removal techniques of water pollutants by locally based bio-adsorbents.

2. Material and Method

In order to determine the water chemistry, four surface water samples were collected in a plastic high density polyethylene jerry canes of two liter capacity (one for physical, chemical analysis, metal analysis and another for treatment with bio-adsorbents) previously soaked with 8M HNO₃ and clean with detergent

followed by rinsing with double distilled water in the month of May'2018 of pre monsoon season. The surface water samples were collected Azad Nagar (TS₁) and Nullah near DPS School (TS₂) nearby the Bilaspur, Tifra industrial area, are shown in Fig.1. The collected water sample was preserved in ice cooled chamber and kept in dark room [10-11]. Analysis was carried out by the standard protocol [10-20] as per standard method within a short period of time, so as to get more reliable and accurate results. *In situ* measurements like Temperature, pH, EC, Turbidity, TDS etc. were measured by Water analyzer kit and colour was measured by visual comparison method. TS and TSS were measured gravimetrically. Cl⁻, TH, TA were measured by titrimetrically, Dissolved oxygen was measured by DO meter, COD by digestion and BOD in an incubator. The anions (F⁻, NO₃⁻, PO₄³⁻ and SO₄²⁻) were analyzed by spectrophotometrically. The major cations were measured by flame photometer. Trace elements namely Fe, Zn, Mn, Al were analyzed by Atomic Absorption Spectroscopy. The values of physicochemical parameters of surface waters are given in Table 1.

Bio adsorbents were prepared in the laboratory with the help of fresh dried wood of *Cassia torra* and *Albizia amaraby* activating in muffle furnace at a moderate temperature. The Polluted water samples are fed into the bio-adsorbents by column operation techniques [21-25]. Physico-chemical analysis of the treated effluents were done after running off through the column to compare the untreated effluents by water quality monitoring agencies like WHO (2011) and BIS (2012) which are tabulated in Table 1 & 2.

3. Result and Discussion:

The results of physico-chemical parameters such as Colour, Temperature, pH, EC, Turbidity, Total Solid (TS), Total Dissolve Solid (TDS), Total Suspended Solid (TSS), Total alkalinity (TA), Total Hardness (TH), Chloride, Fluoride, Sulphate, Nitrate, Phosphate, Dissolved oxygen (DO), Biochemical Oxygen demand (BOD), Chemical Oxygen Demand (COD), Sodium, Potassium, Calcium, Magnesium, Iron, Manganese, Zinc, Aluminum and WQI for various Surface water samples collected in month of May' 2018 from two sites around Tifra industrial area, Bilaspur. The untreated and treated effluents with different water quality standards e.g., BIS

(2012) and WHO (2011) are given in the Table-1 and II respectively.

The obtained result of all the samples pH are in the range of 7.72 to 7.56, Colour are in the range of 10 to 11 Hazen, EC are in the range of 1231 to 1343 $\mu\text{S}/\text{cm}$, Turbidity are in the range of 25 to 26 NTU, TS are in the range of 874.43 to 910.34 mg/L, TDS are in the range of 752.76 to 806.22 ppm, TSS are in the range of 121.67 to 104.12 mg/L, Total Alkalinity are in the range of 441 to 467 mg/L, Total hardness are in the range of 492 to 379 ppm, Chloride are in the range of 642.26 to 586.55 mg/L, Fluoride are in the range of 1.02 to 1.13 mg/L, Sulphate are in the range of 572 to 644 ppm, DO are in the range of 3.8 to 4.5 ppm, BOD are in the range of 4.34 to 4.60 ppm, COD are in the range of 34.2 to 31.02 ppm, Nitrate are in the range of 51.14 to 54.5 ppm, Phosphate are in the range of 0.08 to 0.12 ppm, Sodium are in the range of 271.4 to 277 ppm, Potassium are in the range of 25 to 29 ppm, Calcium are in the range of 275.22 to 263.6 ppm. Magnesium are in the range of 34.6 to 39.2 ppm. Iron are in the range of 3.4 to 3.52 ppm. Manganese are in the range of 0.17 to 0.15 ppm. Zinc are in the range of 0.53 to 0.26 ppm. Aluminum are in the range of 1.09 to 0.68 ppm and WQI are in the range of 122.8 to 123.2.

Analysis of Industrial effluents (surface water) gave following parameters: Colour, 10 Hazen; Turbidity, 25 NTU; TSS, 134.2 mg/L; Sulphate, 562 mg/L; DO, 3.7 mg/L; BOD, 4.72 mg/L; COD, 32.3 mg/L; Nitrate, 52.7 mg/L; Phosphate, 0.13 mg/L, Na, 268 mg/L; K, 26 mg/L; Ca, 252.42 mg/L; Mg, 35.7 mg/L; Fe, 3.35 mg/L; Al, 1.12 mg/L and WQI, 122 which is higher than the permissible limit of BIS (2012) and WHO (2011). DO and BOD level indicate too much water pollutant present in the sampling point which is unsuitable for aquatic life. All the investigating points showed greater than maximum WQI (>100); 76-100 WQI values (very poor water quality); indication of intrusion of pollutants by domestic garbage and industrial effluent which is great concern of health.

Considerably high reduction in all physicochemical parameters was observed when the effluent was treated with activated charcoal from biological sources i.e., bio-adsorbents (Tables 2 & Fig.1). Relatively greater efficiency of bio-adsorbent was due to its organophilic character. It has matrix of micro-

pore, which yields relatively greater active surface area and thus making it suitable for adsorption [26-28]. However, exact mechanisms governing initial rapid rate for the pollutant removal due to surface adsorption followed by intra-particle diffusion, which

appears to be the rate governing steps in this experiment. Besides, phenomenon of adsorption can be attributed to various mechanisms such as electrostatic attraction and repulsion, chemical interaction and ion exchange etc.[29-30].

Table 1: Physico-chemical constituents and WQI analysis of different water samples

Parameters/ Sampling Spot	TS ₁	TS ₂	Indian Drinking water Std. IS 10500: 2012	WHO Rec. 2011
Colour	10	11	5 Hazen	15 TCU
Temperature	30.7	30.8	-	27-28
pH	7.72	7.56	6.5-8.5	6.5-8.5
Conductivity	1231	1343	750-2250	400-2000
Turbidity	26	25	5-8 NTU	5 NTU
TS	874.43	910.34	520-2050	500-1500
TDS	752.76	806.22	500-2000	500-1500
TSS			20-50	-
Alkalinity	441	467	300-600	200-600
Total Hardness	492	379	300-600	100-500
Chloride	642.26	586.55	200-1000	200-1000
Fluoride	1.02	1.13	1-1.2	1-1.5
Sulphate	572	644	200-400	200-600
D.O	3.8	4.5	5	5-6
BOD	4.34	4.60	5	5
COD	34.2	31.02	10	10
Nitrate	51.14	54.5	45	50
Phosphate	0.08	0.12	0.1	0.1
Sodium	271.4	277	75-200	200
Potassium	24	28	10	25
Calcium	264.64	257.5	75-200	25-200
Magnesium	34.6	39.2	30	30
Iron	3.4	3.52	0.3-1.0	0.3-1.0
Manganese	0.17	0.15	0.1 - 0.3	0.5
Zinc	0.53	0.26	5	3
Aluminium	1.09	0.68	0.03 - 0.2	0.2
WQI	122.8	123.200	50-75	-

* All parameters in mg/L except Colour (Hazen), Conductivity (μ mhos/cm), Turbidity (NTU) pH and WQI

TS₁– Azad Nagar and TS₂– Nullah near DPS School.

Table 2: Average value of physicochemical characterization of treated and untreated effluents with bio-adsorbents

Parameters	Untreated effluents	Treated effluents with bio-adsorbents			
		<i>Cassia torra</i>	Adsorption Capacity (%)	<i>Albiziaamar a</i>	Adsorption Capacity (%)
Colour	10.50±0.71	3.00±0.33	71.43	3.50±0.41	66.67
Temperature	30.75±0.07	29.12±0.10	-	29.60±0.15	-
PH	7.64±0.11	7.05±0.16	-	7.12±0.20	-

Conductivity	1,287.00±79.20	489.50±22.00	61.97	532.30±28.10	58.64
Turbidity	25.50±0.71	4.00±0.11	84.31	5.70±0.14	77.65
TS	892.39±25.39	236.17±9.00	73.54	284.20±12.00	68.15
TDS	779.49±37.80	112.50±7.00	85.57	164.52±10.00	78.89
TSS	112.90±12.41	18.60±9.41	83.53	30.50±11.06	72.98
Alkalinity	454.00±18.38	148.00±10.38	67.40	193.00±14.20	57.49
Total Hardness	435.50±79.90	98.30±4.56	77.43	160.50±7.22	63.15
Chloride	614.41±39.39	158.25±2.87	74.24	199.64±4.98	67.51
Fluoride	1.08±0.08	0.42±0.04	61.11	0.55±0.06	49.07
Sulphate	608.00±50.91	124.50±2.52	79.52	226.00±6.03	62.83
D.O	4.15±0.49	9.36±1.16	55.66	8.42±1.87	50.71
BOD	4.47±0.18	8.98±3.04	50.22	8.44±3.65	47.04
COD	32.61±2.25	8.99±3.84	72.43	9.86±3.96	69.76
Nitrate	52.82±2.38	13.56±1.74	74.33	22.65±2.77	57.12
Phosphate	0.10±0.03	0.05±0.02	50.00	0.06±0.01	40.00
Sodium	274.20±3.96	73.56±1.51	73.17	91.50±0.99	66.63
Potassium	26.00±2.83	8.23±1.06	68.35	9.65±1.50	62.88
Calcium	261.07±5.05	71.48±2.08	72.62	93.37±1.48	64.24
Magnesium	36.90±3.25	11.00±1.05	70.19	15.12±1.55	59.02
Iron	3.46±0.08	0.44±0.45	87.28	1.02±0.89	70.52
Manganese	0.16±0.01	0.04±0.01	75.00	0.06±0.03	62.50
Zinc	0.40±0.19	0.10±0.09	75.00	0.20±0.88	50.00
Aluminium	0.89±0.29	0.02±0.06	97.75	0.45±0.09	49.44
WQI	110.94±9.19	47.36±3.04	-	51.20±6.03	-

* All parameters in mg/L except Colour (Hazen), Conductivity (μ mhos/cm), Turbidity (NTU) pH and WQI

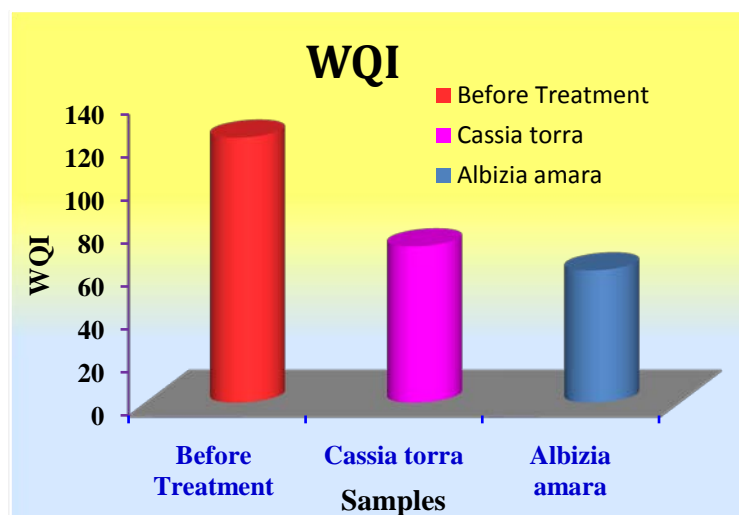


Fig 1: WQI before and after treatment with bio-adsorbents

4. Conclusion:

The present study has been made to evaluate the pollution load on surface water around the Balco industrial area and its removal techniques by locally based bio-adsorbents. The water

qualities were marginally higher than the standard values of drinking water, higher values than the standards means very poor water quality; indication of intrusion of pollutants by domestic garbage and industrial effluent. On the

basis of the above experiment, it is found that bio-adsorbent from *Cassia torra* act as more potent bio-adsorbent for the removal of hazardous water pollutants from industrial waste water comparative to the *Albiziaamara*.

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