

## Water quality criteria and Arpa river water of Bilaspur city (India)

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### ABSTRACT

The present paper aims to study quality of water in the Arpa river of Bilaspur District (C.G.). Standard testing methods have been adopted for the measurement of water quality of Arpa river. Adoption of pollution abatement measures plays a great role in improving water quality<sup>1</sup>.

**Key words:** Water quality criteria, Arpa river.

### INTRODUCTION

Water quality is a terms used to define the physical, chemical biological or radiological characteristics by which a particular type of water may be evaluated to establish its acceptability for various beneficial uses<sup>2-4</sup>.

### MATERIALS AND METHODS

All the chemical used were of AR grade. Double distilled water was used for preparation of reagents. Six strategic locations were chosen for the sampling water. Those are Koni Petrol Pump (Station-I), Indira Setu (Station-II), Old Bridge (Station-III), submersible bridge (Station-IV), Kanoi paper Mill (Station-V) and Near Gatora Bridge (Station-VI). Water samples were collected in one-litre polythene bottles previously soaked with 8N.HNO<sub>3</sub> and cleaned with detergent. The samples were acidified with 6N.HNO<sub>3</sub> (8 ml/L) soon after sampling.

### Analytical Methods

pH of the sample was measured by pH meter (Orion pH meter model 940). Cd and Pb were determined (after complexation and extraction) by AAS (Varion AA model 220). Conductivity of samples have been measured by Digital conductivity bridge (Systronics-304). The operation conditions for AAS have been described below in the Table. 1. Dissolved oxygen (DO) and Biological Oxygen Demand (BOD) were determined by prescribed laboratory titrimetric methods.

### Dissolved Oxygen (Winklers methods)

300ml sample was taken in BOD bottle, then 2ml. MnSO<sub>4</sub> and 1 ml. Alkaline Iodide Azide solution was mixed with it 2ml. H<sub>2</sub>SO<sub>4</sub> acid was added and titrated with 0.025 N Hypo, using starch as indicator. The dissolved oxygen was then calculated using standard formula<sup>5</sup>.

[1ml of 025 N. Hypo solution = 1mg/l of dissolved oxygen]

Table – 1

S.No	Elements	Flame	Slit	Lamp Current	
1.	Pb	217nm	Air+C <sub>2</sub> H <sub>2</sub>	1.0nm	5mA
2.	Cd	228.8nm	Air+C <sub>2</sub> H <sub>2</sub>	0.5nm	4mA

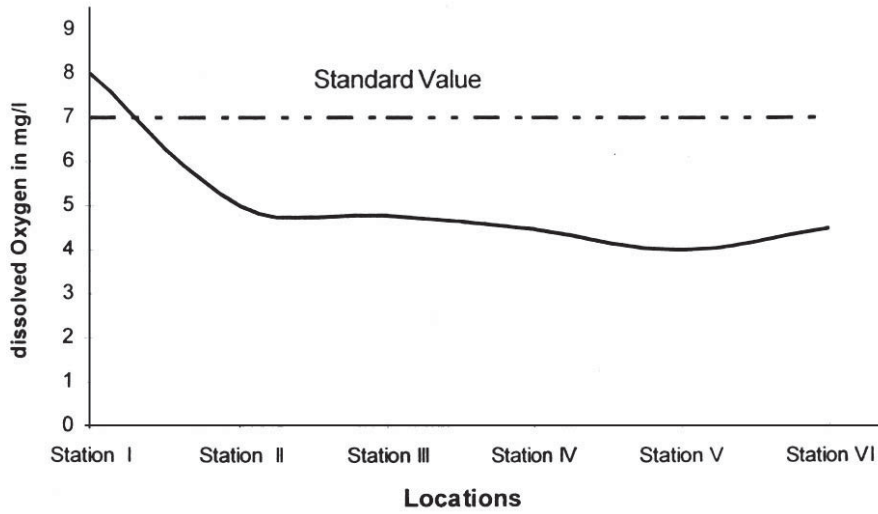


Fig. - 1: Dissolved oxygen at different stations

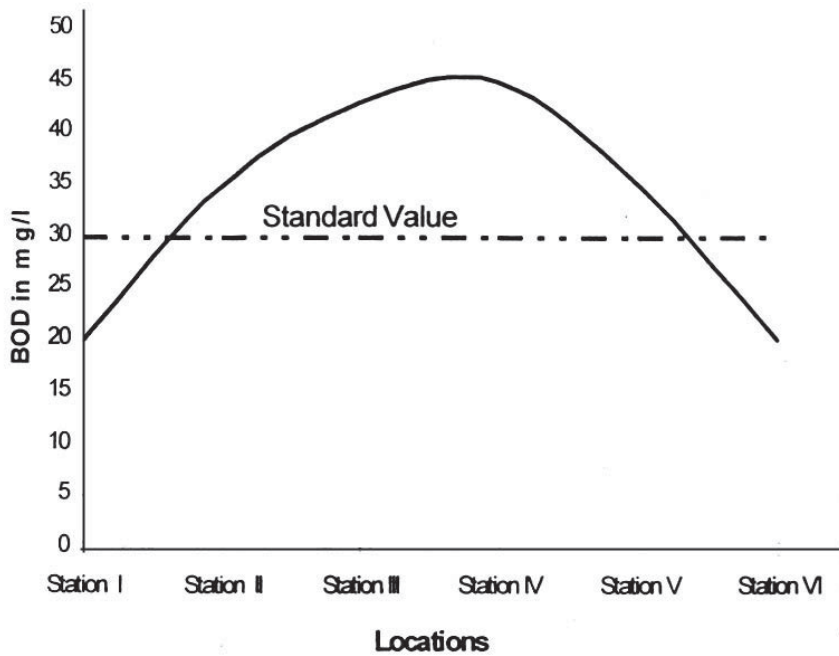


Fig. - 2: Biological oxygen demand

**Biological Oxygen Demand**

Water sample were kept in the dark for five days. The dissolved oxygen was determined using the Winkler's titration method and calculated

BOD using standard formula<sup>5</sup>.

**Chemical Oxygen Demand**

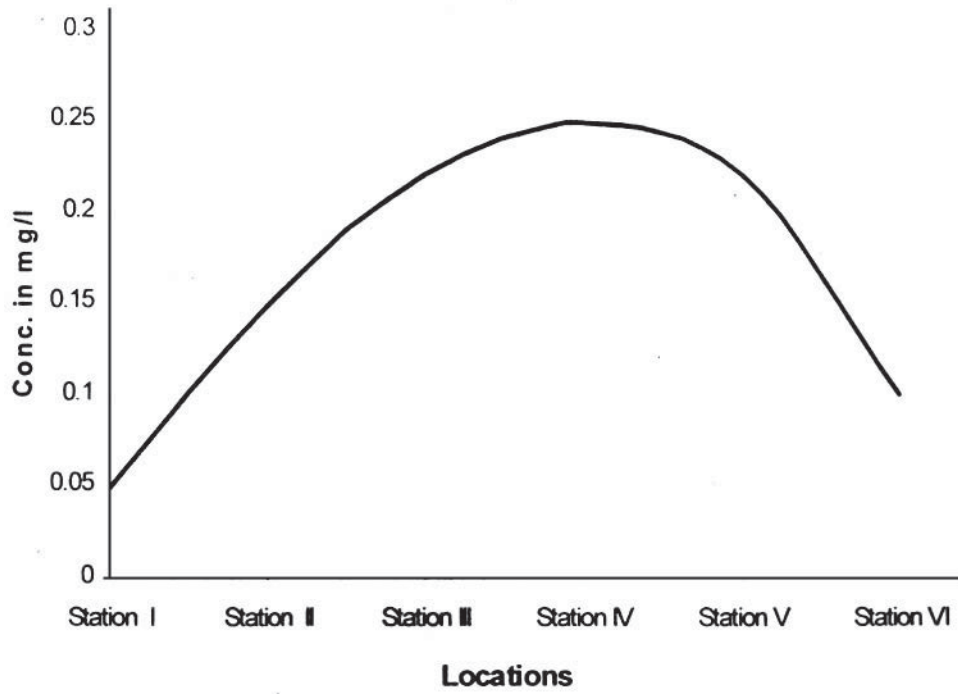
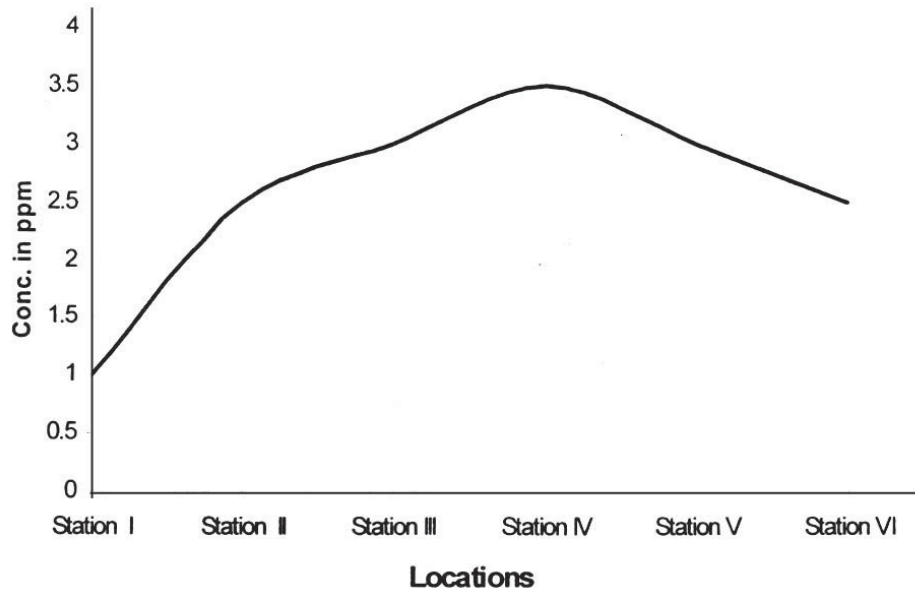
Organic substance in the samples were

**Table - 2: Indian Standard Specifications for Drinking water is (10500-1083)**

S.No	Parameters	Limit	Unit
1.	Colour Hazen Units	10Max	-
2.	Odour	Unobjectionable	-
3.	Taste	Agreeable	-
4.	Turbidity NTU. Max	10 Max	-
5.	pH value	6.5 to 8.5 Max	-
6.	Total Hardness (as CaCo)	300 Max	Mg/l
7.	Calcium (as Ca)	75 Max	Mg/l
8.	Magnesium (as Mg)	30 Max	Mg/l
9.	Copper (as Cu)	0.05 Max	Mg/l
10.	Iron (as Fe)	0.3 Max	Mg/l
11.	Manganese (as Mn)	0.1 Max	Mg/l
12.	Chlorides ( as Cl)	250 Max	Mg/l
13.	Sulphate (as SO <sub>4</sub> )	150 Max	Mg/l
14.	Nitrate (as NO <sub>3</sub> )	45 Max	Mg/l
15.	Fluoride (as F)	0.6-12 Max	Mg/l
16.	Phenolic Compounds asc	0.001 Max	Mg/l
17.	Mercury (as Hg)	0.001 Max	Mg/l
18.	Cadmium (as Cd)	0.01 Max	Mg/l
19.	Selenium (as Se)	0.01 Max	Mg/l
20.	Arsenic (as As)	0.05 Max	Mg/l
21.	Cyanide (as Cn)	0.05 Max	Mg/l
22.	Lead (as Pb)	0.1 Max	Mg/l
23.	Zinc (as Zn)	5.0 Max	Mg/l
24.	Anionic Detergents (as MBAS)	0.02 Max	Mg/l
25.	Chromium (as Cr)	- Max	Mg/l
26.	Polhynecler Atomic Hydrocarbons (as PAH)	- Max	Mg/l
27.	Mineral Oil	0.01 Max	Mg/l
28.	Pesticides	Absent Max	Mg/l
29.	Residual Free chlorine	0.2 Max	Mg/l
30.	Radioactive material	-	-
	a) Alpha emitters uc/ml	10	-
	b) Beta emitters uc/ml	10	-

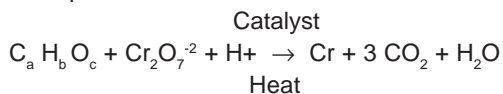
**Table - 3 : Classification of water quality<sup>10</sup>**

S.No	Parameter	Classification		
		Good	Fair	Poor
1.	Temperature	25	27	30
2.	PH	6.5-8.5	6.5-3.5	6.0-9.0
3.	Electrical conductivity	3.25×10 <sup>-3</sup> mhos/cm.	3.5×10 <sup>-3</sup> mhos/cm	4×10 <sup>-3</sup> mhos/cm
4.	Dissolved O <sub>2</sub>	7 mg/l	6mg/l	5.5mg/l
5.	Pb in mg/l	0.01 mg/l	0.01 mg/l	0.05 mg/l
6.	Cd in mg/l	0.003 mg/l	0.004 mg/l	0.005 mg/l

Fig. - 3: Concentration of  $Pb^{2+}$  in mg/l.Fig. - 4: Concentration of  $Pb^{2+}$  in ppm

oxidized by  $K_2Cr_2O_7$  in 50%  $H_2SO_4$  at a reflux temperature.  $Ag_2SO_4$  was used as a catalyst. The excess of  $K_2Cr_2O_7$  was titrated with standard  $Fe^{II}$   $(NH_4)_2(SO_4)_2$  (hypo) using ferroin as an indicator.

Principle reaction is :



### RESULTS AND DISCUSSION

These figure inform about dramatic change in water quqlity parameters. Hence the Arpa river water is rendered unsuitable for drinking in the city area. The Arpa river is shallow but life line of Bilaspur city. Increasing population and rapid industrialization in the last few decades have increased pollution in the potable rive water. Dissolved oxygen decreases from point no. 1 to 4. Paper mill at point 5, throws chemical containing alkali and plant degradation products. In the present study temperature ranged from 25°C to 29.5°C. The pH value ranged from 6.9 (Location) 8.69 (location 5) of the Arpa river. Location 5 and 6 show higher values than the prescribed limit<sup>6</sup>.

Total dissolved solids (TDS) ranged form 230 mg/l (station I) to 1500 mg/l (station 4,5,6). According to and Indian standards as shown in the Table No. 3 TDS should be less than 500mg/l for drinking water (Table No.3). The dissolved oxygen between 4 to 8 mg/l .The standard limit is 7mg/l for drinking water<sup>8</sup>. The BOD ranged from 20mg/l to 45 mg/l. The standard limit is 30mg/l<sup>9</sup>. Chemical oxygen demand (COD) was determined by titrimetric method. COD value informs about organic matter present in the drinking water.

Depletion of dissolved oxygen in water supplies can encourage microbial of  $NO_3^{-1}$  to  $NO_2^{-1}$  and  $SO_4^{-2}$  to  $S^{-2}$  giving rise to odour problem. The Electrical conductivity value ranged between 0.50 to  $6.15 \times 10^{-3}$  mhos/cm to  $6.15 \times 10^{-3}$  mhos/cm in the present work. Higher values are 3.30,  $4.5.2 \times 10^{-3}$  mhos/cm at locations 2,3,4,5 and 6 and water is unfit for drinking.

Standard values Pb and Cd concentrations for potable water are 0.01 mg/l and 0.003mg/l. In the present work higher values have been found in the stations 2,3,4,5 and 6. Classification of water quality has been described in the table No.3 below.

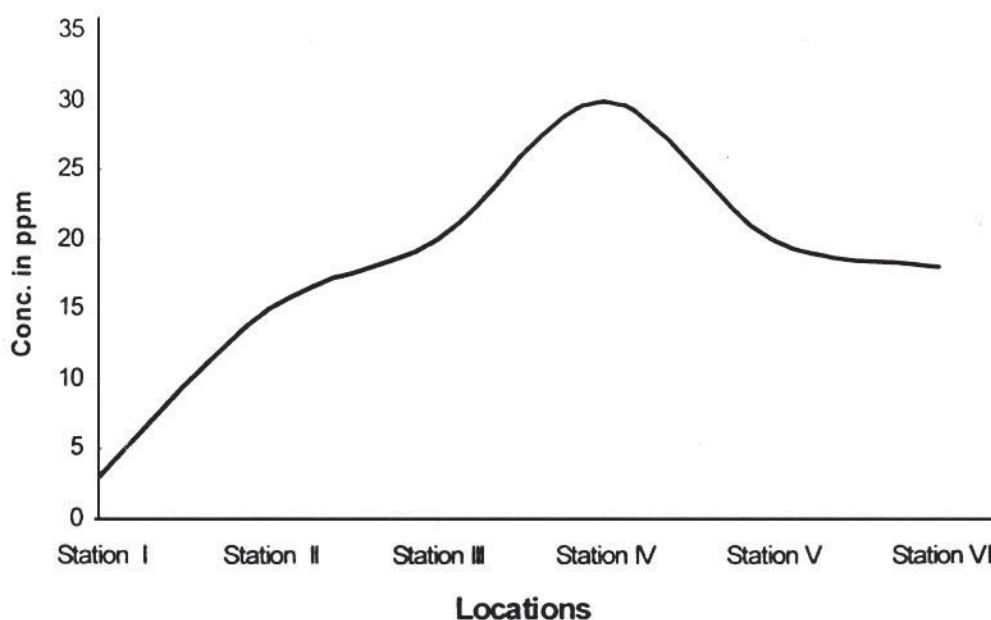


Fig. - 5: Pb+ levels in mg/l

### CONCLUSION

Rapid urbanization and increased anthropogenic activities have deteriorated the water quality parameter of Arpa river water. Therefore the pretreatment is essential before supplying for drinking purpose. (This also applies to ground water). Following methods have been suggested as remedial measures.

#### Remedial measures

1. Flyash, a waste product from coal combustion can be employed as a low cost adsorbent for the<sup>11</sup> treatment of Arpa river water et al have reported that fly ash removes metals, lowers oxygen demand. Some authors have also suggested that it removes colouring material from waste water<sup>12</sup>.
2. We propose treatment of Arpa river water by photo catalytic degradation of BOD, COD, iron and E-Coli bacteria. The solar detoxification is the process in which catalyst, for example TiO<sub>2</sub> is exposed to the sun. The catalyst absorbs high-energy photons from UV. Portion of the solar spectrum and reactive free radicals (OH) are formed. These free radicals are powerful oxidizer and disinfectant. In general a concentration of 0.1 % TiO<sub>2</sub> is quite, effective in killing bacteria<sup>13</sup>. This is quite in agreement with works of Kaushik N.D. et al.<sup>14</sup>.
3. Vermiculite, a type of mica adsorbs fluoride ion<sup>15</sup>. Hence this can be used for treatment of water to remove fluoride ions. These abatement measures play a great role in improving water quality of Arpa river water.

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