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Research Article

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# Quality assessment of drinking water: A case study of Chandrapur District (M.S.)

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**ABSTRACT**

*Chandrapur city is developing rapidly due to industrialization since 2 decades. It is considered being fourth most polluted city in India. The present study was carried out with a view to have an understanding about the pollution status of Chandrapur district, particularly water quality in vicinity of Industrial area. Environmental studies were carried out on ground and surface water to find out the physico-chemical parameters like pH, BOD, COD, DO, hardness, alkalinity, fluorides, chlorides, TDS and turbidity. Seven samples were collected from different sites, in order to evaluate the drinking water quality in and around Chandrapur district. The analysis of various parameters using standard methods (APHA/NEERI) and their comparison with WHO standard values, suggested that most of the parameters were within permissible limit given by Bureau of Indian standards (BIS). Concentration of parameters beyond the limits in some stations could be reduced and could be an invaluable source for domestic purposes in the region. The present paper accounts water quality of various sites situated in Chandrapur and their efficiencies respectively.*

**Keyword:** Surface water, Ground water, Physico-Chemical Parameters, APHA.

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## INTRODUCTION

Environmental pollution is the global concern of the day. The growth of industrial area is rapid and very fast thus related anthropogenic activities have also been increased like waste discharge from industries, transportation and domestic activities. The domestic waste generated is directly enters into the different sites of water bodies without any treatment. Also the continuous flow from agricultural waste water contaminates the water source of surrounding area. This entire problem affects the water resources and ultimately human health. Water is one of the three major components of the environment; therefore, there exists a close linkage between the quality of water and the environment which bears an almost importance for eco-system. Natural bodies of water are not absolutely pure as various organic compounds and inorganic elements remain in dissolved form. Many kinds of macroscopic flora and fauna grow in different types of aquatic habitats. The physical and chemical quality of water vary according to the basin shape and size, depth, light penetration, precipitation, location, temperature, chemical nature of surrounding soil and dissolved minerals, pH, etc, and the biological components of the habitats depend upon them If all the physical, chemical and biological parameters are in optimum condition the balance between these is maintained.

Many people depend on fresh water supplies from groundwater. It provides water for domestic use for a large part of the Indian population. It is one of the major sources of water for irrigation and small scale industries. The availability of groundwater depends on the rate at which it is recycled by hydrological cycle than on the amount,

which is available for use at any moment in time. In most parts of the country finite supply of fresh water is put of heavy use. Industrial water sewage and agricultural run-off can overload groundwater with chemical wastes and nutrients and make the water-supply toxic. Effective management of water resources and control of pollution are becoming increasingly important for sustainable development and human welfare, the term pollution is defined as the deterioration in the chemical, physical and biological properties of water by human and industrial activity. The industrial activity discharges water containing hazardous chemicals on the open ground which may pollute the nearly groundwater.

Water is a prime natural resource and a basic human need. The present work was carried out in vicinity of Chandrapur city in order to study the water quality of seven different sites. Chandrapur district is located in the eastern edge of Maharashtra in Nagpur division and form the eastern part of "Vidarbha" region. It is located between 19.3 degree to 20.45 degree latitude and 18.4 E longitudes. The district is bounded by Wardha, Yeotmal, Nagpur, Bhandara and Gadchilori district on the Eastern side and Adilabad district of Andhra Pradesh located on the southern side of Chandrapur district. District occupies an area of 11443 sq km, which constitutes 3.72 percent of the total area of the state and has population 1,771,994. Chandrapur district is well known for the Coal Mines, Super Thermal Power Station and many Cement industries, Ferro alloys And paper industries.

## EXPERIMENTAL SECTION

**Water Resources :**

Wardha, Wainganga and Penganga are the important rivers surrounded by Chandrapur district. The Wardha River flows into the district from the western boundary and then flows along the boundaries of Warora, Chandrapur, Korapna, Rajura, Ballarpur and Gondpipri Talukas. Penganga and Irai rivers meet the Wardha River. The drinking water supply projects in Chandrapur district includes 203 pipeline schemes, 171 tube wells, 4078 wells and 4514 Bore well/ Hand pumps in the entire district. Besides, the Municipal councils in Chandrapur district is regularly supplying drinking water to local public from Irai river dam.

**Ground water sources:**

About 85% of the state is covered by Deccan basalts whereas the rest of the state is covered by Quaternary alluvium. The total replenishable groundwater resource is of the order of 37.82 BCM/Yr. Provision for domestic, industrial & other uses for Chandrapur district are about 12.40 BCM/Yr and for irrigation purposes is about 25.47 BCM/Yr. Ground water levels declining trend (more than 20 cm per year) in Pre-Monsoon (1995-2004) season in vicinity of Chandrapur district.

**Study area:**

The Chandrapur town is located on 19.57' north latitude and 79.18' east longitudes in the eastern Maharashtra, and situated at 189.90 meter above form the mean sea level. Area of the city region is about 70.02 km². The district is situated on the Wainganga and Wardha river basin. The climate of Chandrapur is mostly tropical. Summer months are mostly hot and humid while the winter season is moderate and pleasant.

Water samples were collected in pre-cleaned polypropylene bottles with necessary precaution from different sites. Samples were collected from Feb 2009 to April 2009 particularly in pre-mansoon season. The studies were carried out for three months during the end of winter season to summer season. Various physico-chemical parameters were analyses as given in standard manual of water and waste water analysis [20]. Selections of seven different stations were identified and water samples were collected at sites and assign as S1, S2, S3, S4, S5, S6, and S7. The main aim of the study was to investigate the physico-chemical characteristics of water samples in Chandrapur district, because most of these samples are located in the vicinity of the city. Sample sites are described in Table 1. Samples were collected from the sites in between 10:00 a.m. to 11:30 a.m. Sample for the analysis of dissolved oxygen was collected in BOD bottle (250 ml), just below the water surface slowly to avoid any air bubble entering into the bottle and fixed by Winkler's 'A' and Winkler's 'B' solution at site.

The parameters like Temperature, pH, Conductivity and Turbidity was analyzed with the help of thermometer and water analysis kit and measurement of transparency by Secchi disc method. For the analysis of other chemical parameters, the samples were collected in plastic can and transported to the laboratory on same day .

**Table 1: Table1. Description of water sampling sites**

| Sampling Code | Source | Location |
|---|---|---|
| S1 | LAKE | Ramala lake (central part of City) |
| S2 | RIVER | Wardha River |
| S3 | RIVER | Irai River (Open cast mine area of WCL) |
| S4 | TUBE WELL | GEC main building |
| S5 | TUBE WELL | GEC hostel building |
| S6 | TAP WATER | Railway station Ballarpur |
| S7 | TAP WATER | Goal Bazaar Central Chandrapur |

The sampling points were chosen to cover the entire radius of 25 km of Chandrapur district after preliminary survey of the area, in order to get a exact evaluation of water quality assessment in and around Chandrapur district. The pH was measured with pH meter. Analysis of DO, COD, alkalinity, chlorides, fluorides total hardness, total solids, turbidity, Iron content were carried out in our laboratory.

Reagents used for the present investigation were A.R. /G.R. grade and double distilled water used for preparing various solutions. All the reagents and calorimetric solution were prepared and purified according to standard method for the examination of water and waste water.

## RESULTS AND DISCUSSION

Analytical results as depicted in Table.2 revealed physicochemical characteristics of water samples from seven locations of study area in the month of February 2009 to April 2009.

**GRAPHICAL REPRESENTATION OF VARIOUS PARAMETERS**

**FIG-1 :- Variation in Chloride at different sampling sites**

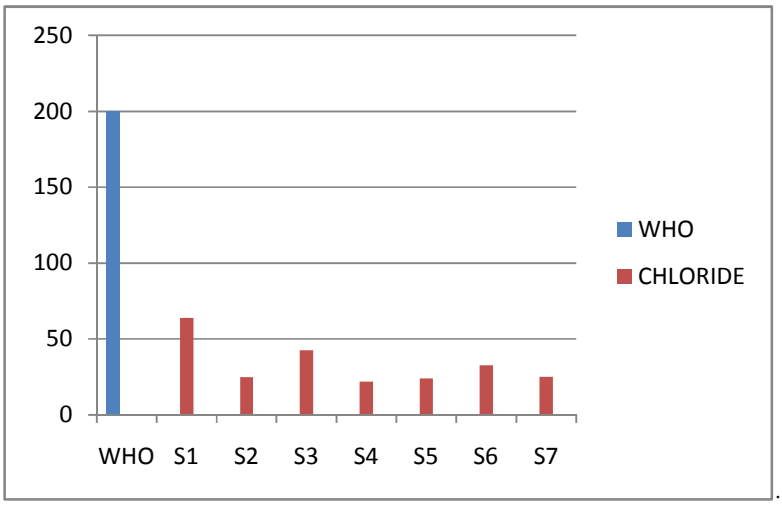


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**FIG-2 :- Variation in Alkalinity at different sampling sites**

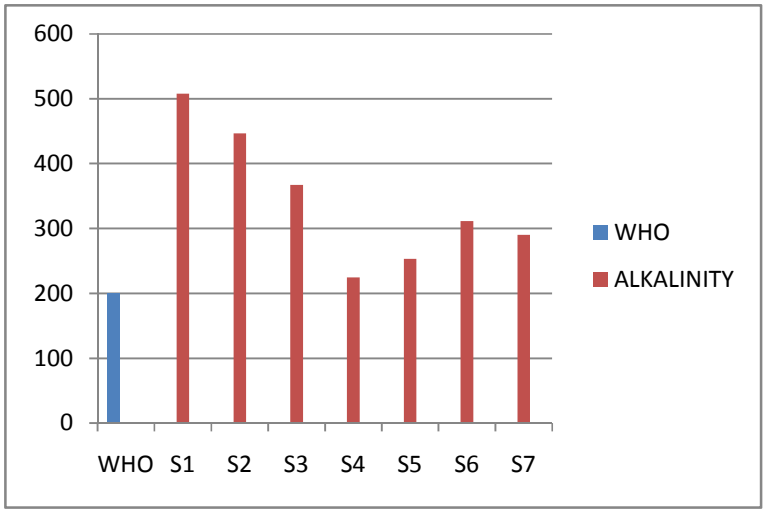


**FIG-3 :- Variation in Total Hardness at different sampling sites**

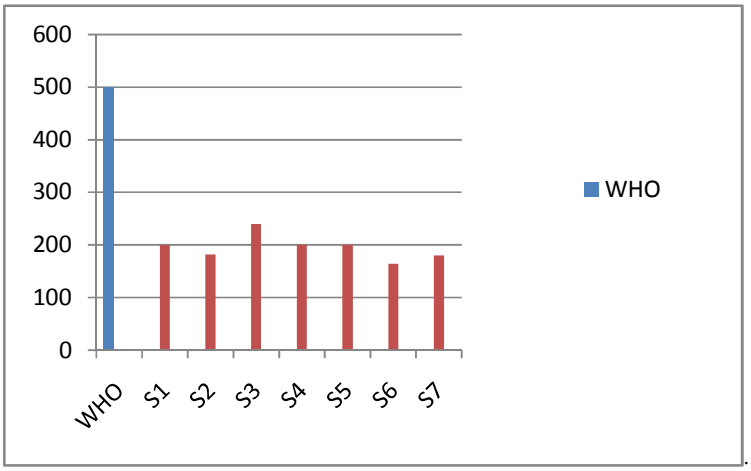

**FIG-4 :- Variation in Total Dissolved solids at different sampling sites**

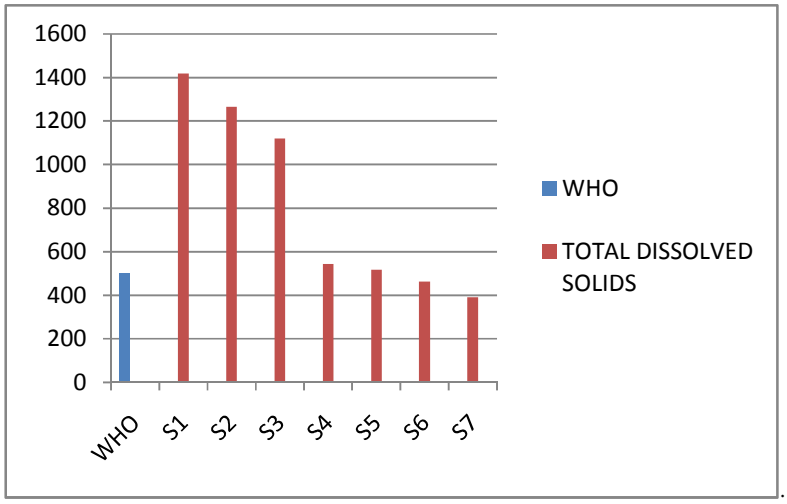


**Table 2: Values of physico-chemical parameters of seven sampling stations of Chandrapur district**

| S.No. | Parameter Studied | Site S1 | Site S2 | Site S3 | Site S4 | Site S5 | Site S6 | Site S7 | WHO/ BIS |
|---|---|---|---|---|---|---|---|---|---|
| 1 | pH | 8.2 | 6.93 | 7.03 | 6.8 | 7.0 | 7.4 | 7.4 | 6.5-8.5 |
| 2 | ALKALINITY (mg/l) | 508 | 446 | 367 | 225 | 253 | 312 | 290 | 200 |
| 3 | COD (mg/l) | 188 | 208 | 195 | 63 | 62 | 80 | 78 | 10 |
| 4 | DO (mg/l) | 6.6 | 6.4 | 4.2 | 3.6 | 3.4 | 5.2 | 4.0 | 4-6 |
| 5 | CHLORIDES (mg/l) | 63.8 | 24.8 | 42.6 | 22.0 | 24.0 | 32.6 | 25.0 | 200 |
| 6 | FLOURIDES (mg/l) | 0.2 | 0.19 | 0.19 | 0.18 | 0.18 | 0.15 | 0.14 | 1.5 |
| 7 | TOTAL HARDNESS (mg/l) | 200 | 182 | 240 | 200 | 200.0 | 164 | 180 | 500 |
| 8 | TOTAL DISSOLVE SOLIDS (mg/l) | 1418 | 1265 | 1120. | 544.0 | 516.0 | 462.0 | 390.0 | 500 |
| 9 | TURBIDITY | 24.65 | 25.64 | 40.3 | 2.0 | 2.0 | 4.2 | 3.8 | |
| 10 | IRON (mg/l) | 0.2 | 0.2 | 0.19 | 0.18 | 0.18 | 0.15 | 0.15 | 0.3 |

The average values of physico-chemical analysis of polluted water samples collected from seven sites is given in Table 2. pH would prove to be ecological factor of major importance in controlling the activities and distribution of aquatic flora and fauna and it is clear that at all seven stations, pH values are well within the range given in the WHO recommendations and permissible limit of pH in drinking water is within 6.5 to 8.5 according to [2], [20] Most of the fresh water reservoirs are alkaline due to inter dependency of factor as carbon dioxide, carbonate and bicarbonate. Generally pH of water is influence by geology of catchments area and buffering capacity of the water. The pH value was found in the range of 8.2 in site S4 indicating slight alkalinity dominance. High pH indicates the free availability of heavy metals as a result of their precipitation in hydroxide form. Alkaline range of pH may be due to occurrences of limestone in the surrounding region of sampling stations. Acid- base equilibrium is also a controlling parameter for change in pH of the sample. In this study it is also observed that station S1, S2 & S3 is highly alkaline because the primary source of water bodies is same. Station S4, S5, S6 & S7 is slightly alkaline compared to WHO permissible limit as all these sources are available after treatment of water. An anionic radical such as carbonates, bicarbonates, hydroxide and phosphate contributes to increase in alkalinity. This phenomenon has also been recorded by [6], [26], and.[8] Variation of alkalinity (mg/l) of different sites in Chandrapur district is varied from 225 to 608 mg/l (ppm). As per the parameter mentioned under analysis of drinking water given by standard BIS IS 13428: 2005[5] the water with hardness below 400 is in a permissible limit and beyond 400 is considered to be very hard water, all the water samples from seven sites showed hardness below 400 ppm, so this concludes that water contains permissible amount of hardness.

The highest value of COD in river and lake water is due to the increase in concentration of oxygen demanding pollutants and also because of high sun radiation and lowering water level. In summer, at high temperature the living planktons require more oxygen to oxidize organic matter mentioned by [17]. Variation of COD (mg/l) of different sites in Chandrapur district is varied from 62.5 to 188 mg/l (ppm). The maximum value of COD in the present study was found to be highest in river water and lake water but the tube well and tap water contain very less but still it is in

excess compared to BIS values. High COD may be due to leaching of chemically degradable organic and inorganic waste matter from intensely populated surrounding area, Similar findings were reported by earlier workers[21].

Dissolved oxygen is an important water quality parameter in assessing water pollution. Oxygen is fixed in water either due to the direct dissolution from the atmosphere or a result of primary production. Monitoring oxygen concentration is a convenient way to feel the clause of the aquatic ecosystem explained by [6] and . Variation of dissolved oxygen (mg/l) of different sites in Chandrapur district is found to be from 3.4 to 6.6 mg/l (ppm). The change in oxygen content leads to undesirable obnoxious odour, under anaerobic conditions. Some samples shows less amount of DO than BIS values.

In potable water the salty taste produced by chloride concentration and it is variable and dependent on the chemical composition on water. Some water containing concentration 25 mg/l chloride may have a detectable salty taste if the cation is sodium. Chloride is one of the major inorganic anion of water. High concentration of chloride indicates pollution due to organic waste. In this study, the chloride was found in the range of 22.0 to 63.85 mg/l. ie, very less than the tolerance limit (200mg/l) as per [4]. Site S1 (Ramala lake) has a high concentration of chloride which may be an indicator of high organic pollution as well as Eutrophication of water.

Fluoride ions have dual significance in water supplies. High concentration of F ion causes dental fluorisis (Disfigurement of the teeth). At the same time a concentration less than 0.8mg/l results in dental caries. Hence it is essential to maintain the fluoride ion concentration between 0.8 to 1.0 mg/l in drinking water. Variation of fluoride ion of different sites in Chandrapur district is found to be varied from 0.14 to 0.2mg/l. As per the [4] desirable to permissible limit is 1.0 to 1.5 Above table show less fluoride ion concentration as compared to permissible limits. Hence the Fluoride ion concentration is less in drinking water sources in Chandrapur district sites which were studied.

Water hardness was understood to be a measure of the soap consuming capacity of water. Hard water causes harmful effect upon the health of consumer. Use of hard water causes excessive soap consumption in home, laundries, textile and paper industries [10]. A positive reaction was observed between total hardness and alkalinity explained by [22]. Total hardness of different sites in Chandrapur district is varied from 164 to 240 mg/l. As per the water and waste water analysis [20] standard report, the water of site S2, S6, S7, is very hard. According to the ICMR standard 1985 hardness of water sample in site S1, S3, S4, S5 is within the permissible limits.

TDS refer to suspended matter for dissolved in water or waste water. Solids may affect water or effluent quality adversely in a number of ways. Water with high dissolved solids generally is inferior quality. TDS at different locations in Chandrapur district is varied from 390 to 1418 mg/l. Water sample of sites S1, S2, S3, (Ramala lake , Wardha river, Irai river) observed with the thick film layer of suspended solid. This may be due to human activity and waste disposal of industries like Chandrapur thermal power station, Western coal field etc. A comparative study suggests that S1, S2, S3 shows high concentration of total dissolved solids as compared to other stations and WHO recommended limits. TDS is a general indicator of overall water quality. It is a measure of inorganic and organic materials dissolved in water. Increased TDS may impart a bad odour or taste to drinking water, as well as cause scaling of pipes and corrosion. High TDS level indicates water hardness in respective sampling station. It reduces the potability for drinking purposes in the region. The EPA's recommended maximum level of TDS in water is 500mg/L (500ppm).

Turbidity in water is caused by suspended matter, such as clay, silt, finely divided organic and inorganic matter, soluble coloured organic compounds, planktons and other microscopic constituents. Turbid water interferes in self purification of water by reducing photosynthesis activity of aquatic plants. Turbidity in Chandrapur district water samples is varied from 2.0 to 40 NTU but in [4] reported desirable limit is 5 NTU and permissible limit is 10 NTU. But the site S1, S2, S3 contains more value than the permissible limit.

Iron is also very important to human and other organisms, as it is partially responsible for transporting oxygen through the bloodstream. Iron is easily dissolved in water and can be found naturally occurring in water bodies. Iron is an essential element for human nutrition and metabolism. But in large quantities results in toxic effect like haemochromoitosis in tissues if more iron accumulation takes place. The maximum permissible limit of Fe in drinking water is 0.3 ppm. Iron content of different sites in Chandrapur district is in the range of 0.15 to 0.20mg/l,

which is well below compared to standard values [5]. Water sample from the sites in Chandrapur district contain less value of Fe. The low concentration of Iron may be due to less percentage of pyrites.

From table 2 it can be concluded that most of the sampling stations shows permissible range of concentration in analysis meanwhile some of them are highly polluted. In mining area the regular monitoring is required because it is situated in populated area and hence can affect the health of local public of Chandrapur. For domestic utility the primary treatment on mining water is an essential step to be taken. It can be an alternative to other water resources in period of water shortage in the region. But treatment on discharge water is an essential aspect for the above purpose.

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