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Study of Free CO_2 and Fluoride Level From the Ground Water of Amtem Village, Tal. Pen, District Raigad (M.S.), India

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Abstract : *Groundwater is an important source of drinking water in rural areas and its quality has a direct impact on human health. The present study entitled was undertaken to evaluate the concentration of free carbon dioxide (Free CO_2) and fluoride in groundwater samples collected from five borewells of Amtem Village. The analyzed values were compared with the permissible limits recommended by the Bureau of Indian Standards (BIS) and the World Health Organization (WHO).*
The concentration of free CO_2 varied from 0.54 to 2.26 mg/L, while fluoride concentration ranged from 0.00 to 0.50 mg/L. The highest free CO_2 concentration was observed in the Priyanka Borewell (2.26 mg/L), whereas the lowest concentration was recorded in the Manoj Borewell (0.54 mg/L). Fluoride was not detected in four groundwater samples and was detected only in the Priyanka Borewell at a concentration of 0.50 mg/L. All observed values of free CO_2 and fluoride were well within the permissible limits prescribed by BIS and WHO.The findings indicate that the groundwater of Amtem Village is chemically safe with respect to free carbon dioxide and fluoride content. The water is suitable for drinking from the perspective of these two parameters.

Key Words: Free CO2, Fluoride, Water quality, Human Health.

1. INTRODUCTION

Water is the major element required by an individual for survival. The daily consumption of water from different sources exposes an individual to various elements present in water which can be either beneficial or harmful. The various parameters of drinking water are monitored on regular basis to ensure consumption of water with permissible limits of various elements present in the water. The fluoride level in drinking water is an important parameter and has to be controlled to prevent dental and skeletal fluorosis. (Chandio TA et al., 2015).

Dissolved CO2 in groundwater is frequently supersaturated relative to its equilibrium with atmospheric partial pressure. Processes contributing to CO2in groundwater include terrestrial respiration, the oxidation of buried organic matter in shallow sediments gives acid neutralization reactions with carbonate minerals (Choi et al., 1998), and migration from magma bodies (De Gregorio et al., 2011; Nordstrom et al., 2005; Ray et al., 2009). The upward migration of fossil fuel-derived CO2 from proposed deep subsurface geologic disposal sites may also intro-duce exogenous CO2 to groundwater aquifers in the future (Kharaka et al., 2010).

Carbon dioxide (CO2) released into the oceans as a result of water pollution by nutrients which is a major source of this greenhouse gas that gets little public attention. It is enhancing the unwanted changes in ocean acidity due to atmospheric increases in CO2. Atmospheric levels of CO2, the main greenhouse gas, have increased by about 40 percent since the industrial revolution due to the burning of fossil fuels and land-use changes. The oceans absorb about

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one-third of that CO2, which results in acidification from the formation of carbonic acid. However, pollution of ocean water with nutrient runoff from fertilizer, human and animal waste and other sources also is adding CO2 via the biological breakdown of organic matter formed during algal blooms which also depletes oxygen from the water.

Fluoride ion in traces in drinking water helps in growth and development of healthy, resistant teeth, and bones. The concentration of fluoride in drinking water is one of the factors strongly influencing the dental caries situation globally. Fluoride levels are monitored in drinking water supplies to achieve the required safety. (Rajkovic MB et al. 2007)

Free carbon dioxide in groundwater acts as a major driver of mineral weathering and fluoride mobilization. When dissolves in groundwater, it forms carbonic acid, which increases water acidity and alkalinity, thereby breaking down fluoride-bearing minerals to release toxic fluoride ions into drinking water supplies.

II. RESEARCH METHODOLOGY

Study Area: Amtem village is situated in Pen Taluka, Raigarh district, Maharashtra and is characterized by moderate population density with agriculture as a key part of the local economy, though 47% of the working population is involved in marginal activities.

Water Sampling: Water samples were collected from 4-5 different source located in Amtem village

Laboratory Analysis: Analysis of physiochemical parameters like Free CO2 – (Titrimetric Method) and Fluoride level – (SPADNS Spectrophotometric Method) were analyzed by NEERI (1988) water analysis manual.

III. RESULTS

Table No.1:- Free carbon dioxide and fluoride of ground water samples from Amtem Village

Sr.No	Parameters	GMB	GCB	GKB	GPB	GMB
1.	Free Co2 (mg/Lit)	0.97	1.53	0.69	2.26	0.54
2.	Fluoride Level (mg/Lit)	0	0	0	0.5	0

GMB : Ground water Sample from Manchkar Borewell
GCB : Ground water sample from Chetan Borewell
GKB : Ground water sample from Kashinath Borewell
GPB : Ground water sample from Priyanka Borewell
GMB : Ground water sample from Manoj Borewell

Table No.2:- BIS and WHO standard values for Free carbon dioxide and fluoride of ground water samples

Sr.No	Parameters	BIS	WHO
1.	Free CO2 (mg/Lit)	10-20	10-20
2.	Fluoride Level (mg/Lit)	1.0	0.5-1.5

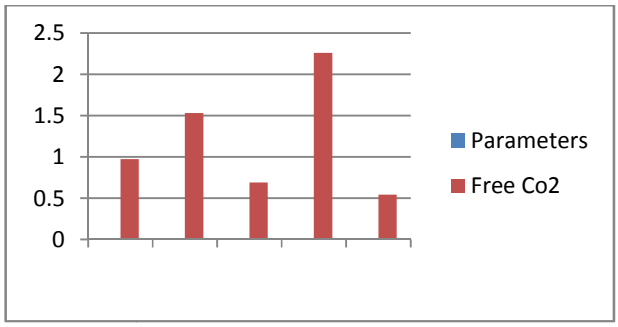
IV. DISCUSSION

Groundwater quality plays a significant role in determining its suitability for drinking and domestic purposes. In the present investigation, free carbon dioxide and fluoride concentrations were analysed in groundwater samples collected from five borewells located in Amtem Village, Taluka Pen, District Raigad.

Free (CO2) carbon dioxide:-

It exists in varying amounts naturally in water. Most well waters will contain less than 50 ppm of carbon dioxide in drinking water. Carbon dioxide can exist in waters with pH values from 3.6 to 8.4, but will never be present in waters having a pH of 8.5 or above. The pH value is not a measurement of the amount of carbon dioxide in the water, but rather the relationship of carbon dioxide and bicarbonate alkalinity. The gas expansion from release of dissolved CO2 in carbonation can lead to the distension of the stomach (Jadhavar, 2013). Aside from the less serious case of triggering hiccups, irritable bowel syndrome (IBS) can also be aggravated. Furthermore, the stomach distension may reduce the effectiveness of stomach acid to digest food that requires sufficient acidity.

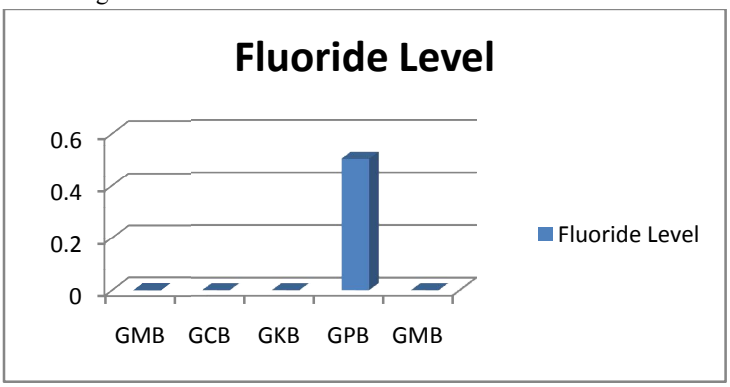
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The concentration of free carbon dioxide present in the study area was ranged from 0.54 mg/L to 2.26 mg/L. The highest concentration was observed in the Priyanka Borewell (2.26 mg/L), while the lowest value was recorded in the Manoj Borewell (0.54 mg/L). Free CO_2 is naturally produced by the dissolution of atmospheric carbon dioxide and the decomposition of organic matter in soil before groundwater infiltrates underground. The concentrations observed in all borewells were considerably lower than the recommended BIS and WHO range of 10–20 mg/L, indicating that the groundwater is non-corrosive and free from excessive carbon dioxide. The low free CO_2 content also reflects limited organic contamination and stable groundwater chemistry.

Fluoride Level :

Fluoride is an essential trace element for maintaining healthy teeth and bones when present in appropriate concentrations. However, excessive fluoride intake may lead to dental and skeletal fluorosis, while insufficient fluoride may reduce its protective effect against dental caries.



In the present study, fluoride was absent in four borewell samples and detected only in the Priyanka Borewell at 0.50 mg/L. This concentration is within the WHO recommended range (0.5–1.5 mg/L) and below the BIS permissible limit of 1.0 mg/L, indicating that fluoride contamination is not a concern in the study area.

The absence or very low concentration of fluoride in most groundwater samples suggests that the geological formations surrounding Amtem Village contain only limited fluoride-bearing minerals. The groundwater chemistry therefore appears to be minimally influenced by fluoride-rich rocks or anthropogenic contamination. Although the current fluoride levels do not pose any health risk, prolonged consumption of water containing no fluoride may provide less protection against dental caries. Hence, fluoride intake through dietary sources may be beneficial where groundwater fluoride is absent.

Therefore, the analysed groundwater samples exhibited excellent chemical quality with respect to both free carbon dioxide and fluoride. The observed values indicate that groundwater from the selected borewells is suitable for drinking and domestic use. Nevertheless, routine monitoring should be continued to detect seasonal variations and to ensure sustainable management of groundwater resources in Amtem Village.

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V. CONCLUSION

The present investigation demonstrates that the groundwater quality is satisfactory with respect to the analysed parameters. Free carbon dioxide concentrations ranged from 0.54 to 2.26 mg/L, which are significantly lower than the permissible limits prescribed by BIS and WHO, indicating chemically stable groundwater with no evidence of excessive carbon dioxide contamination. Fluoride analysis showed that four groundwater samples contained no detectable fluoride, while only one sample (Priyanka Borewell) contained 0.50 mg/L fluoride, which falls within the acceptable limits recommended by WHO and below the BIS permissible limit. Based on the analysed parameters, all groundwater samples collected from the selected bore wells of Amtem Village are suitable for drinking and domestic purposes. Regular groundwater quality monitoring is recommended to ensure continued safety, detect seasonal changes, and support the sustainable management of groundwater resources in the study area.

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