A COMPARATIVE STUDY OF PHYSICOCHEMICAL PARAMETERS OF QUARRY WATER AND DRINKING WATER

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Abstract

Purpose of the study: Purpose behind this study is to get the knowledge of the range of physico-chemical parameters of the quarry water in comparison with the drinking water.

Methodology: With the help of clean and sterilized polyethylene bottles of 1 liter capacity have been used for the collection of quarry water. Total 21 physico-chemical parameters have been analyzed and compared with the values for the drinking water. Analysis of water is carried out in the laboratory with the help of standard methods and techniques.

Main Findings: Presence of mercury in quarry water is very much high i.e. 0.006 mg/liter and coli form bacteria are also numerous in count.

Applications of this study: This study gives us the idea about the range of the parameters of quarry water in comparison with drinking water and after the suitable treatment it could be converted into drinking water or not.

Novelty/Originality of this study: Till the date no work has been done on quarry water like this, present study will help us to understand whether the quarry water could be used as a potable water or not.

Keywords: Quarry Water, Physico-chemical Parameters, Mercury, Coli form Bacteria, Potable Water.

INTRODUCTION

Mining process leads to the formation of quarries. Demand for quarrying products by industries, construction, domestic, agriculture is getting increased to fulfill the needs of the rapidly growing population. Quarrying operations included blasting, drilling, crushing of rocks (Kalu I.E et al (2019). Nowadays some of the quarries are artificially developed for water storage purpose, water from the nearby reservoirs get diverted in these quarries. Naturally these quarries get filled with rain water called quarry water. Quarry water is not good for drinking purposes because of the mineral deposits of the quarry (Tyulenev M et al (2017). These heavy metals from the mining process accumulate in the food chain and enter the body of plants and animals becoming toxic to them (Kalu I.E et al (2019).

All around the world numerous quarry lakes are present which hold a good amount of water. Quarry lakes act as a reservoir of water for wild animals and also this water is used for the plantation and they are providing a large surface area for storage of rainwater. These quarries accommodating rain water should be analyzed, whether the water could be used for domestic purposes or not. Physical, chemical and biological parameters of water indicate the water quality and these parameters fluctuate seasonally and location wise (Okoroafor Isaiah et al (2019) (RAJI, WA et al (2019). Distribution of metals in water is controlled by the interaction of physico-chemical parameters and solubility of these metals is controlled by pH concentration and the type of the metal species, their oxidation state. After the entering of metals in water they get absorbed by organic and inorganic particulate matter and settle down in water and increase the concentration of heavy metals (Keke U.N. et al (2015).

Most of the countries are not getting sufficient amounts of water as per requirement for domestic purpose, sanitation, for industrial and agricultural purpose (WHO, 2017). As per the Central Pollution Control Board water supplied to the towns and cities is 90% polluted (Sivaranjani S et al (2015). Day by day water related problems are getting increased due to increase in population, urbanization, increase in industrial, agricultural activities, mining activities (Marzouk S.H. (2018). This increased population is arising competition for freshwater in urban, agricultural and industrial uses which influence pressure on rural and urban areas (Ashish Kumar Sing et al (2018). Physicochemical characteristics of the water are important for the analysis of drinking water as per WHO and physical parameters that are likely to give rise to complaints from consumers are color, taste, odor and turbidity while low pH causes corrosion and high pH results in taste complaints (Dhote Lina et al (2019). There are various organisms which are used as an indicator to evaluate the microbial contamination of water which include total coli forms count, faecal coli forms, faecal streptococci, E. Coli etc. Total coli form and E.Coli are the best indicator organisms (Joshua N. Edokpayi et al (2018). One of the major causes of water contamination is heavy metals, harmful heavy metals like lead, mercury, arsenic, cadmium etc. causes toxicity in human beings and aquatic life.
Consumption of water containing heavy metals invites the diseases related to the heart, kidney, and blood and most importantly inhalation of arsenic has been closely linked with lung and skin cancer (Odiba John Oko et al (2017)).

In this paper various water parameters of quarry water and drinking water have been compared. This study is carried out to understand the range of the selected parameters of the quarry water in comparison with drinking water, whether they are within the range of drinking water or not.

**LITERATURE REVIEW**

Quarrying operations are the sources of income for many families (Kalu LE et al (2019)). Stone quarrying has become one of the alternative livelihood strategies. Stone quarrying is a form of land use method concerned with the extraction of non-fuel and non-metal minerals from rocks (Bewiadzi S et al (2018)). Quarrying activity provides much of the materials which are used in traditional hard flooring, such as granite, limestone, marble, sandstone and slate (Nethaji V. E et al(2018). Quarrying activities lead to the production of large amounts of quarry wastes. Reuse of the quarry wastes is one of the solutions of this problem, quarry wastes are used for growing material for the plants (Cheng-liang Zhang et al (2017). The issue of wastewater treatment in open pit mining of mineral deposits causes great ecological problems. So it is necessary to implement the new technology of quarry water purifying using filtering arrays with proven efficiency (TYULENEV M et al (2016). The main sources of quarry waters are the waters coming from aquifers (the underground origin of water) and from the surface (atmospheric waters) and the amount of these waters are different (Yury Lesin et al (2018). In present time quarries have been converted into public parks, botanic gardens, natural areas of considerable environmental value, auditoriums, tourism buildings, infrastructures, shopping malls, cemeteries and many other leisure areas(Katia Talento et al (2020).

**RESEARCH METHODOLOGY**

**Study Area**

For this study Bird Valley’s quarry water was selected, a few years ago it was a limestone quarry. At present it holds a very good amount of water by the means of rain and other artificial sources. Now this quarry has been converted into a beautiful garden called “Bird Valley Udyan”. This beautiful garden has a jogging area, boating facilities, and a play area for kids. It is located in PCMC (Pimpri Chinchwad Municipal Corporation) Pune, Maharashtra (India).

**Sample Collection**

This study has been done in the month of December (2019). Water samples were collected by using the polyethylene bottle. Initially, polythene bottles were rinsed with quarry water and then dipped inside the water for the collection. From different points of quarry, water was collected and mixed together to get the same concentration of water.

**Analysis**

For the comparison between the quarry water and drinking water 21 parameters were analyzed which are as follows turbidity, temperature, TDS, pH, total alkalinity, total hardness, dissolved oxygen, COD, BOD, chloride, sulfate, iron, manganese, copper, zinc, mercury, arsenic, barium, nitrate and total coliform. Analysis of all the parameters was carried out by using standard methods and techniques. These parameters were compared with the limits of drinking water prescribed by WHO.

**FINDINGS/ RESULTS**

Following table shows the difference in values for selected parameters of quarry water in comparison with the drinking water.

**Physicochemical Parameters of Quarry Water and Drinking Water**

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Parameters</th>
<th>Quarry Water</th>
<th>Drinking Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Turbidity (NTU)</td>
<td>0.3</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Temperature (°C)</td>
<td>26</td>
<td>32-40</td>
</tr>
<tr>
<td>3</td>
<td>Total Dissolved Solids (mg/liter)</td>
<td>350</td>
<td>300</td>
</tr>
<tr>
<td>4</td>
<td>Electrical Conductivity (µmhos/cm)</td>
<td>625</td>
<td>200-800</td>
</tr>
<tr>
<td>5</td>
<td>pH</td>
<td>7.20</td>
<td>6.5-8.5</td>
</tr>
<tr>
<td>6</td>
<td>Total Alkalinity (mg/liter)</td>
<td>187.5</td>
<td>200</td>
</tr>
<tr>
<td>7</td>
<td>Total Hardness (mg/liter)</td>
<td>176.7</td>
<td>200</td>
</tr>
<tr>
<td>8</td>
<td>Dissolved Oxygen (mg/liter)</td>
<td>6.20</td>
<td>5</td>
</tr>
<tr>
<td>9</td>
<td>BOD (mg/liter)</td>
<td>7.0</td>
<td>30</td>
</tr>
<tr>
<td>10</td>
<td>COD (mg/liter)</td>
<td>33.6</td>
<td>250</td>
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<td></td>
</tr>
<tr>
<td>11</td>
<td>Chloride (mg/liter)</td>
<td>73.92</td>
<td>250</td>
</tr>
<tr>
<td>12</td>
<td>Sulphate (mg/liter)</td>
<td>20.48</td>
<td>500</td>
</tr>
<tr>
<td>13</td>
<td>Iron (mg/liter)</td>
<td>0.17</td>
<td>0.3</td>
</tr>
<tr>
<td>14</td>
<td>Manganese (mg/liter)</td>
<td>0.009</td>
<td>0.05</td>
</tr>
<tr>
<td>15</td>
<td>Copper (mg/liter)</td>
<td>0.005</td>
<td>0.05</td>
</tr>
<tr>
<td>16</td>
<td>Zinc (mg/liter)</td>
<td>0.001</td>
<td>5</td>
</tr>
<tr>
<td>17</td>
<td>Mercury (mg/liter)</td>
<td>0.006</td>
<td>0.001</td>
</tr>
<tr>
<td>18</td>
<td>Arsenic (mg/liter)</td>
<td>0.001</td>
<td>0.01</td>
</tr>
<tr>
<td>19</td>
<td>Barium (mg/liter)</td>
<td>0.02</td>
<td>0.07</td>
</tr>
<tr>
<td>20</td>
<td>Nitrate (mg/liter)</td>
<td>7.56</td>
<td>50</td>
</tr>
<tr>
<td>21</td>
<td>Total Coli form</td>
<td>TNTC</td>
<td>Nil</td>
</tr>
</tbody>
</table>

**Arsenic**

Arsenic which is considered as heavy metal in drinking water, it is carcinogen. Consumption of drinking water containing 0.05mg/L of As per day could be the root of cancer of the lung, kidney, liver etc. Skin Lesions are caused by the intake of As 0.0012 mg/kg/day via drinking water. (Shakhawat Chowdhury et al (2016). Arsenic content in quarry water is 0.001mg/L which is a safe limit for drinking water.

![Arsenic Value](image)

**Figure 1:** Arsenic value in quarry water is 0.001mg/liter and 0.01mg/liter in drinking water

**Turbidity**

Turbidity is an indication of water pollution; turbidity is caused by the presence of suspended matters like clay, silt and micro-organisms which makes water cloudy (Joshua N. Edokpayi et al (2018). Turbidity value for quarry water is 0.3 NTU (Nephelometric Turbidity Unit) which is within the permissible range in comparison with drinking water.

![Turbidity Value](image)

**Figure 2:** Turbidity value for quarry water is 0.3NTU and for drinking water 1NTU
Total Dissolved Solids

Total dissolved solids are related to the presence of solid matter in water. They are inorganic matter and small organic matter present in dissolved form in water (Rahmanian, N et al (2015). High TDS value deteriorates the water quality and could be the cause of various health issues and even not suitable for irrigation purposes (Putaka Ramesh et al (2016). TDS value for quarry water is 350mg/L which is high in comparison with drinking water. This increased value is due to the mineral deposits in the quarry.

![Total Dissolved Solids](image)

**Figure 3:** Total dissolved solids in quarry water is 350mg/liter and for drinking water is 300mg/liter

Mercury

Main sources of mercury in drinking water are industries, waste water, mining, construction etc. (Shakhawat Chowdhury et al (2016). Inorganic mercury compounds show its adverse effects on the kidney in human beings whereas organic mercury compounds affect the central nervous system (CNS) (WHO (2017). Mercury concentration in quarry water is very high in comparison with drinking water. High concentration of mercury in quarry water is due to anthropogenic activities, industries, construction etc.

![Mercury](image)

**Figure 4:** Presence of mercury in quarry water is 0.006 mg/liter and in drinking water 0.001mg/liter

Total Coli form

Total Coli form bacteria are harmless and present in the intestine of warm as well as in cold blooded animals (Okoroafor Isaiah et al (2019). Total coli form bacteria should be absent in drinking water, their presence in water indicates that water is not treated properly and is not suitable for drinking purpose (WHO, (2017). Presence of total coli form bacteria in quarry water is very high i-e TNTC (Too Numerous to Count). Due to various contaminations from the vicinity, this quarry water is loaded with coli form bacteria.

*Graphical representation is not possible here due to absurd values.*
CONCLUSION

From the above study it has been concluded that, most of the physical and chemical parameters of quarry water are within the range in comparison with drinking water prescribed by WHO. Parameters like total dissolved solids are showing high value for quarry water. High TDS value is due to the dissolution of suspended particles in water, which deteriorate the water quality and that water could not be used as potable water. Concentration of heavy metal mercury is very high in quarry water; it is due to the various contaminations from the vicinity. Various forms of mercury are present like elemental form, inorganic form, methyl mercury which is organic form, their degree of toxicity is different but they affect the nervous system, digestive system and our immune system (Pensiri Akkajit et al (2018). Mercury affects the kidney and central nervous system in human beings (WHO, 2017). Total coli form bacteria are also very high in quarry water and for the drinking water total coli form bacteria should be absent. Total coli form bacteria give us information regarding the pollution in water and it is due to faecal contamination, they enter into the water by discharge of waste water into it (Mity Thambi et al (2015). With these high values for TDS, mercury, coli form bacteria, this quarry water is unfit for drinking purpose. Proper treatment is required for the conversion of this quarry water into potable water.

CONFLICT OF INTEREST AND ETHICAL STANDARDS

All the experiments were conducted with the permission of the organization/ institute’s authority. Water samples were collected with the permission of management of the “Bird Valley Udyan”.

ACKNOWLEDGEMENT

I am thankful to my guide Dr. Harsha Chatrath for her immense guidance, Principal of Novel Junior College of Science and Commerce Mrs. Manasi Hasabnis for her cooperation and my husband Sanjay Kokcha for his support and encouragement.

ORIGINALITY

Till the date no work has been done on this quarry water like this. This study will help us to understand whether this quarry water could be used as a potable water.

REFERENCES