



## STUDY OF PHYSICO-CHEMICAL CHARACTERISTICS OF BIRD VALLEY'S QUARRY WATER PCMC, MAHARASHTRA

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### *Abstract*

**Purpose of the study:** The purpose of this study is to make sure that the Bird valley's quarry water is suitable for drinking purposes or not and to monitor the seasonal variations in the physico-chemical parameters of this quarry water.

**Methodology:** Water samples from the quarry were collected in clean and sterilized polyethylene bottles. Water samples were collected from different points and mixed together to get an integrated sample. Some of the selected physico-chemical parameters of the quarry water have been analyzed. Results were compared with standard limits of IS: 10500-2012. All the parameters were analyzed in the laboratory by using standard methods and techniques.

**Main Findings:** As per the obtained results this quarry water contains a very large number of Coliforms detected in the months of September and December and in June month Coliform count was 33 CFU/ml. This overall result for coliform is making this quarry water unfit for domestic purposes.

**Applications of this study:** This study helps us to understand the current condition of this quarry water and also enables us to know whether the quarry water is fit for drinking purposes. It also enables us to know whether this quarry water can be used for domestic purposes after the treatment.

**Novelty/Originality of this study:** Bird valley's quarry water has not been analyzed from this point of view till date. This study will help us to understand the present condition of the water.

**Keywords:** *Bird Valley, Quarry Water, Physico-chemical Parameters, Pre Monsoon.*

### INTRODUCTION

Water plays a very important role in all living organisms. We cannot imagine life without water. Nearly 71% of the earth's surface is covered with water, but out of that 2.5% water is fresh and only 1 % fresh water is accessible, the rest of the freshwater is locked in as glacier water. According to WHO (World Health Organization) and UNICEF nearby 11% of the total world's population is not getting safe drinking water. Most of the countries are not getting sufficient amounts of water as per requirement for domestic purposes, sanitation, for industrial and agricultural purposes ([WHO, 2017](#)). Day by day water-related problems are getting increased due to an 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 Singh et al \(2018\)](#)). By considering all these problems, we need to utilize the other available sources of water. Through this study, I have tried to find out a new source of water.

The Quarry is a place, typically a large, deep pit, from which stone or other materials have been extracted. Quarrying products are very useful for industries, constructions, for domestic purposes, and for other various purposes ([Kalu I.E et al. \(2019\)](#)). Quarrying activities lead to the extraction of nonmetallic rocks and aggregates, this extraction is used for various purposes in our life ([Tahseen Sayara et al \(2016\)](#)). Open-pit mining is generally preferred in mining operations due to its applicability in all operable areas of exposed rock, minimum production loss, and high production rate, especially for ores such as limestone, granite, and iron ore that are exposed at the surface ([Hanxun Wang et al \(2018\)](#)).

Bird valley is a limestone quarry, but it is popularly known as 'Bird Valley Udyan' It was converted into a garden a few years ago and opened to the public as a recreational garden with boating and the walking track facilities. The main constituents of mine (quarry) waters are the waters coming from aquifers (the underground origin of water) and from the surface (atmospheric waters) ([Yury Lesin et al \(2018\)](#)). Quarries could be used as a reservoir of water as they provide a large surface area for the collection of rainwater. This quarry is a good source of water as it contains a good amount of stored water. Due to the high mobility of people, the anthropogenic activities in the water are getting polluted. The water quality is deteriorating due to contamination caused by human activities and this contaminated water creates health issues in humans and also affects flora and fauna. Contamination of water also depends on the interaction of the strata of rocks. Initially, contamination is mainly determined by the degree of mineralization of the waters of the underground horizons, as well as suspended particles of surface and groundwater. ([Yury Lesin et al \(2018\)](#)) Water quality term gives us an idea about the

suitability of water for human consumption. [\(Sajitha V et al \(2016\)\)](#) Utilization of water is based on its quality parameters such as pH, turbidity, dissolved oxygen, electrical conductivity, total hardness, total dissolved solids, and other parameters. Examination of these parameters forms a base of water for drinking, industrial, aquatic organisms, and agricultural purposes. [\(Priya T. Dharani and A. K. Vidya \(2019\)\)](#) There are various factors that directly or indirectly affect the water quality. Hence it is essential to check the physical, chemical, and biological parameters of water.

The objective of this paper is to get information regarding the physicochemical characteristics of this quarry water in order to check its suitability for domestic consumption. Water quality directly affects the health of human beings and it also causes ill effects on aquatic life. So, it is essential to check the quality of water before its use [\(Faiza Tawati et al \(2018\)\)](#). Regular monitoring of water gives us the idea about the contamination level of water, which helps us to select the procedure for proper treatment of water to improve its quality. The degree of pollution is generally assessed by studying the physical and chemical characteristics of the water bodies [\(Prasad Hari K. et al \(2016\)\)](#). Analysis of different physical, chemical, and microbial parameters are included in the procedures and safe limits of these parameters have been set by WHO and regulatory bodies. Hence it is essential to carry out the regular inspection of drinking water quality should be done by the researchers and governmental bodies

## LITERATURE REVIEW

A quarry is an open-pit mine from which rocks, minerals, sand, etc have been extracted; these quarries are generally used for the utilization of building materials [\(Bewiadzi S et al \(2018\)\)](#). The largest number of raw materials are extracted from quarries which are used as a raw in many industries [\(Nwachukwu MA et al \(2018\)\)](#). Due to the rapid increase in population, demand for quarry products have been increased [\(Dr. Kalu, Ezichi \(2018\)\)](#). These quarries are proved as a huge source of various raw materials used in the industries, construction, etc. but on the other hand, they have a negative impact on the environment due to the use of explosives, heavy machines for the extraction which are the causes of noise pollution, air pollution and indirectly biodiversity is also getting affected in addition to water and soil [\(Tahseen Sayara et al \(2016\)\)](#).

The mining process leads to the formation of quarries and quarry operations include blasting, drilling, and crushing of rocks. These operations affect the soil, air, water, and even the flora-fauna and human beings also get affected [\(Kalu I.E et al \(2019\)\)](#). Around the world, numerous open-pit mines are built like the Kalgoorlie Super pit open-pit gold mine in Western Australia, the Chilean Chuquicamata open-pit coppers mine, and the Bingham Canyon Copper Mine. These quarries provide a good amount of high-quality minerals but destroy the environment also [\(Hanxun Wang et al \(2018\)\)](#). Quarries get filled with rainwater. These quarries that accommodate rainwater 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 \(2019\)\)](#). Quarry water is not good for drinking purposes because of the mineral deposits of the quarry [\(Tyulenev M et al \(2017\)\)](#). The distribution of metals in water is controlled by the interaction of physico-chemical parameters and solubility of these metals in water [\(Keke U. N. et al \(2015\)\)](#).

## RESEARCH METHODOLOGY

### Study area

Bird valley which is a quarry located in PCMC (Pimpri Chinchwad Municipal Corporation) Pune, Maharashtra (India). Around 10-15 years ago it was a limestone quarry. Now, it has been converted into a beautiful recreational garden which is popularly known as “Bird Valley Udyan”.

### Sample Collection

Bird valley’s Quarry water was examined every quarter i.e. in the month of June (pre monsoon) and September (post monsoon) and December (winter). Water samples were collected in the clean and sterilized polyethylene bottles. Initially, the prewashed bottles were rinsed with sample water. The closed bottle was dipped in the quarry water at the depth of 0.5 m, and then the bottle was opened inside and was closed inside the water body before bringing it to the surface of the water, again to bring it out to the surface. Water samples were collected from different points and mixed together to get an integrated sample.

### Analysis

Following parameters of the water sample were analyzed: Electrical Conductivity, pH, TDS, DO, temperature, turbidity, BOD, Total hardness, Total alkalinity, Magnesium, Calcium, Chloride, Sodium, Phosphate, and Nitrate to determine the quality of water. Results were compared with standard limits of IS: 10500-2012. All the parameters were analyzed in the laboratory by using standard methods and techniques.

## FINDINGS / RESULTS

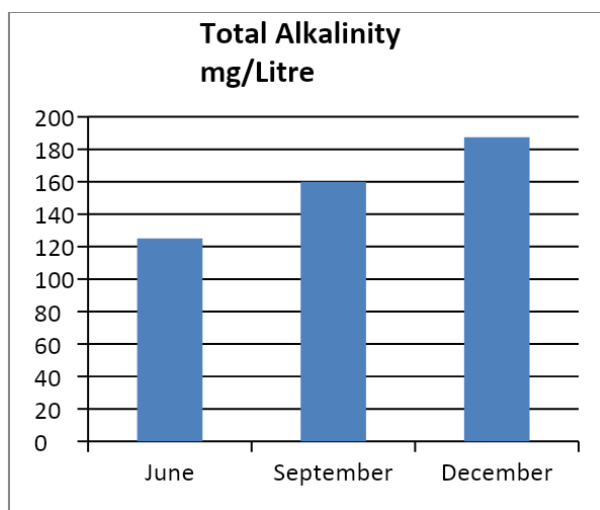
The following table shows the values of Electrical Conductivity, pH, TDS, DO, temperature, turbidity, BOD, Total hardness, Total alkalinity, Magnesium, Calcium, Sodium, Phosphate, and Nitrate. These parameters have also been analyzed graphically for Bird valley's quarry water PCMC, Pune (Maharashtra), to find out the season when the quarry water is most suitable for drinking purposes.

### Physico-Chemical Parameters of Bird Valley's Quarry Water

Sr.No.	Parameters	June	September	December	Standard limits of IS: 10500-2012
1	Temperature (°C)	29	28	26	
2	pH	7.49	6.95	7.20	6.5-8.5
3	Electrical Conductivity(µmhos/cm)	656	660	625	200-800
4	Total hardness( mg/Litre)	192	180	176	200
5	Total alkalinity(mg/Litre)	125	160	187.5	200
6	Total Dissolved solid( mg/Litre)	380	330.1	350	500
7	Dissolved oxygen (mg/Litre)	7.50	5.80	6.20	5
8	Turbidity (NTU)	1	0.8	0.3	1
9	BOD( mg/Litre)	7	2	7	50
10	COD(mg/Litre)	31.2	10	33.6	250
11	Magnesium (mg/Litre)	25.01	22.35	21.11	30
12	Calcium( mg/Litre)	31.70	32.47	30.91	75
13	Sodium (mg/Litre)	57.01	57.43	47.05	200
14	Nitrate ( mg/Litre)	0.10	0.66	7.56	45
15	Coliforms(CFU/ml)	33.0	TNTC	TNTC	Nil

### Total Alkalinity

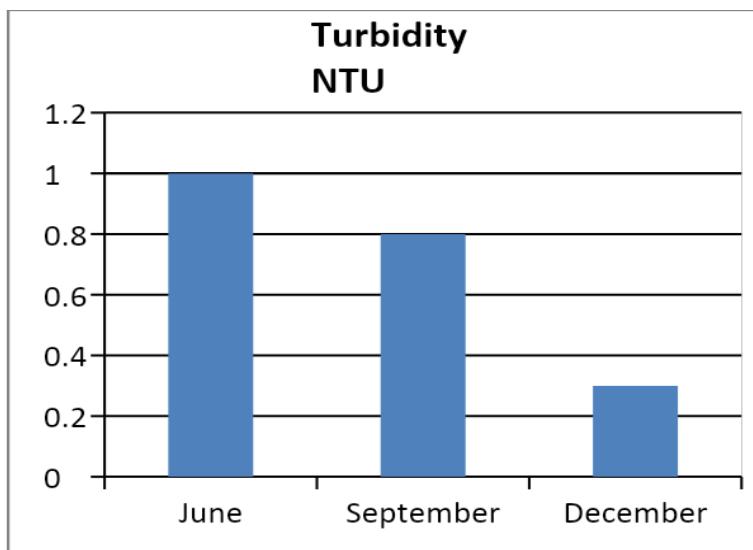
The alkalinity of water is related to the hardness of the water. Hardness depends on the amount of calcium and magnesium ions present in the water. Bird valley being a limestone quarry, is a good source of CaCO<sub>3</sub>. Hence the values for hardness and alkalinity are of this quarry water less than the standard value.



**Figure 1:** Quarry water is showing Total Alkalinity value in the month of June (125mg/L), (160mg/L) in the month of September, and (187.5mg/L) in the December

### Turbidity of Quarry water

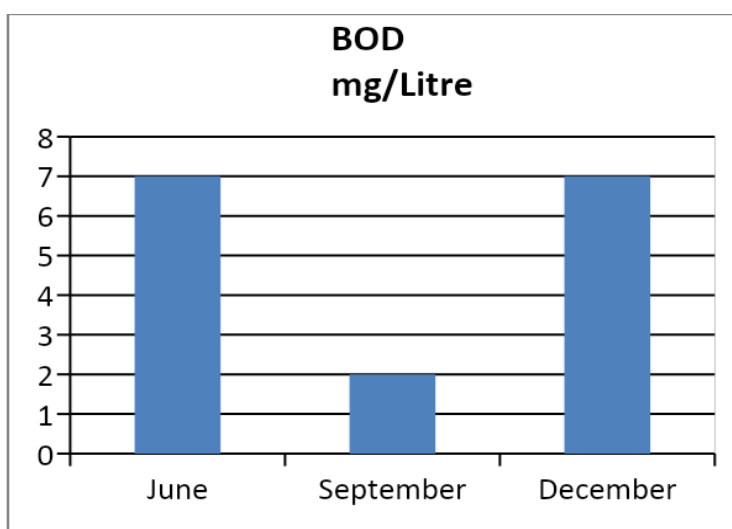
Turbid water is milky in color, more turbidity makes water unfit for drinking. Various factors are responsible for the dullness of water like suspended particles which may include organic, inorganic, microbial, sand, clay, slit, etc. In quarry water maximum turbidity has been recorded in the month of June (pre-monsoon) as the rate of evaporation is high in June month which results in the higher concentration of suspended particles. Minimum turbidity is recorded in the month of December (winter). Post monsoon there is an increase in the water level which results in the decrease of quarry water turbidity.



**Figure 2:** Quarry water is showing Turbidity value (1 NTU) in June month, (0.8NTU) in September and (0.6NTU) in December month

### BOD of Quarry Water

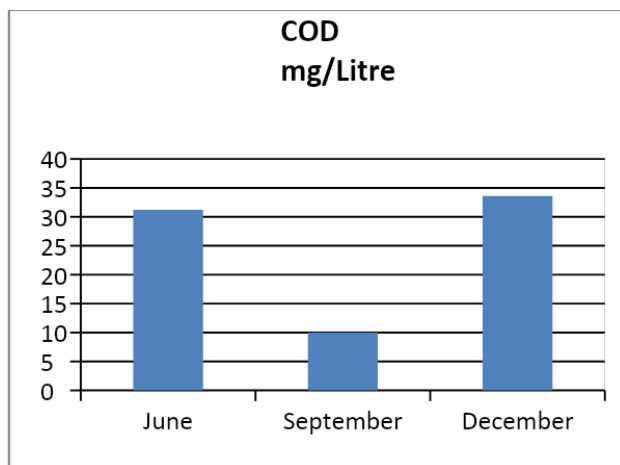
Biological Oxygen Demand refers to the dissolved oxygen required by micro-organism to break down the organic matter. In the month of September, BOD value was recorded as 2mg/liter because of less concentration of organic matter in the rainy season whereas BOD value recorded in the month of June and December has been found to be much higher due to increased concentration of organic matter in the pre monsoon and post monsoon period due to windy conditions.



**Figure 3:** In the June and December months BOD value is the same (7mg/L) and in September month BOD is (2mg/L) for the Quarry water

### COD of Quarry Water

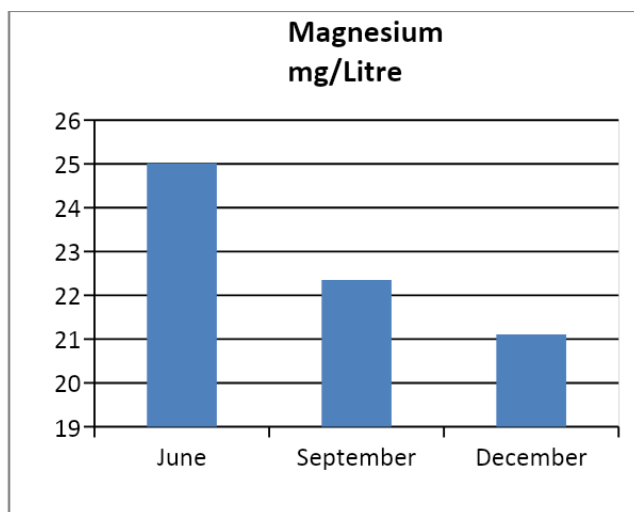
COD is the amount of oxygen consumed during the chemical oxidation of organic matter present in the water by using a strong oxidizing agent like acidified potassium dichromate ([Dr. Harsha Chatrath\(2017\)](#)). Concentration of organic matter generally decreases during the end of monsoon season and the beginning of autumn due to seepage and overflow of water due to heavy rains. The value of the COD value of quarry water has been recorded as 10mg/liter in the September month due to less concentration of organic matter in water.



**Figure 4:** COD value for quarry water in the June month is (31.2mg/L), (10mg/L) in the September, and (33.6mg/L) in December

### Magnesium contents present in quarry water

Magnesium is often associated with calcium in all kinds of waters, but its concentration remains generally lower than the calcium. Magnesium is essential for chlorophyll growth and acts as a limiting factor for the growth of phytoplankton (Qureshi Matva Umar Faruq M and Solanki HA (2015) High value of magnesium indicates the hardness of the water. The maximum value for magnesium is recorded in the month of June and September and less in the month of December because magnesium value increases in the wet months and decreases in the dry months.



**Figure 5:** Presence of Magnesium in quarry water in the June month is (25.01mg/L), (22.35mg/L) in September, and (21.11mg/L) in December

### Coliforms Present in Quarry Water

Coliform bacteria are present in the environment and they have characteristics of dissolving in water easily. Though they are not harmful but their presence in water indicates the presence of disease-causing microbes. In the quarry water, a large number of colonies of coliform bacteria are present which multiply on a faster pace. Their presence in quarry water makes it unfit for drinking. *Graphical representation for coliform is not mentioned due to absurd values.*

### CONCLUSION

It has been observed that only a few analyzed parameters of Bird Valley's Quarry water are within the permissible range of standard limits. Parameters like Total alkalinity, turbidity, BOD, COD, and magnesium are varying with seasons. Large numbers of coliform bacteria are present in quarry water which indicates that this water is not potable water. This water cannot be used for drinking purposes without proper treatment.



## CONFLICT OF INTEREST AND ETHICAL STANDARDS

All the above experiments have been conducted with the permission of the organization/ institute's authority. Water samples have been collected with the permission of the management of the "Bird valley Udyan", all water samples were collected after the regular intervals of time and by using the same container.

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## ORIGINALITY

Till today no research has been done on this quarry water. This study helps us to get the knowledge of the current situation of the quarry water and the suitability of this water for domestic purposes.

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