Preliminary Investigation of Groundwater Quality of Abha, Kingdom of Saudi Arabia

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Abstract: **Abha is one of the top destination for tourists attraction in the Kingdom of Saudi Arabia, which has resulted in exponential growth in development in terms of buildings, roads etc. This development has added to the ever growing water demand in the area. The study is a preliminary investigation into the present groundwater quality of the Abha City, further study will be under taken on the basis of the current study results. The samples have been collected from the farm wells situated in the city along the rain water streams. The samples were analysed in terms of pH, conductivity, Dissolved Oxygen and Solids. The study determined the pH value to be within the permissible range while other three parameters were not conforming to the permissible limits needing further research work to determine their causes.**

Keywords: **Water demand, farm-wells, pH, conductivity, Dissolved Oxygen.**

1.0 INTRODUCTION

Water is the most precious natural resource available in the universe and that life without water is impossible. The demand for good quality drinking water has increased with the increasing development in the human community. At the beginning of civilization non turbidity and free flow were the only parameters of concern but with the growth of population there has been an increase in global attention focused on resolving water quality issue [1].

Water is an essential element of nature for the sustenance of life on the planet earth. It is available in the forms as surface water and sub-surface water or groundwater. Surface water is predominantly used for public water supply systems. However, the rapid growth of population and the resultant increased demand of water, necessitated for the usage of groundwater to augment the existing water supply systems, in most of the cities in the country. Secondly, the growing urbanization and industrialization and the consequent pollution of surface water sources, also increased the necessity of using groundwater for various domestic and industrial purposes.

2.0 STUDY AREA

Abha is a famous hill station in the Kingdom of Saudi Arabia. It is mainly known for its cold climate during hot summers, ample amount of rainfall and green landscape as compared to the hot, dry and barren desert in the majority of Kingdom area. The town has a population of about 450,000. On account of it being a major tourist attraction in the Kingdom the development of the region is exponential so is the water demand.

Figure 1 Map of Abha

3.0 WATER SUPPLY AND SANITATION

The water supply of the city if managed by the municipality of the City. The major source of water supply is the water Desalination plant situated at Shaqeq on the coast of Red Sea lying about 125 kms west to the city. The groundwater available is managed and controlled by the municipality mostly to maintain a reservoir to meet up the demand of the city habitant and their activities.

The city has been laid down with an excellent sewer system leading to the wastewater treatment plant at the outskirt of the city. The treated wastewater from the plant is used by the municipality for the development of parks, gardens and other Greenification activities.

4.0 METHODOLOGY

The study is a preliminary investigation of the groundwater quality in the city as there is no other research data available. The study is attempting to make a base for full scale groundwater quality assessment not only for the Abha city but also for the whole region of Asir. The water samples were collected from the wells situated along the rainwater stream passing through the heart of the city and also from the nearby wells. Overall 8 samples were collected for analysis. The water samples were analysed on the basis of pH, Conductivity, Dissolved Oxygen (DO) and Total Solids. pH meter, conductivity meter and DO meter

were used for analysing pH, conductivity and Dissolved Oxygen respectively, while Total Solids were determined using the hot dry air oven and mass balance with accuracy up to four decimals.

5.0 RESULTS AND DISCUSSION

5.1 pH

The pH of water is a measure of the acid–base equilibrium and, in most natural waters, is controlled by the carbon dioxide–bicarbonate–carbonate equilibrium system. An increased carbon dioxide concentration will therefore lower pH, whereas a decrease will cause it to rise. Temperature will also affect the equilibria and the pH. In pure water, a decrease in pH of about 0.45 occurs as the temperature is raised by 25 °C. In water with a buffering capacity imparted by bicarbonate, carbonate, and hydroxyl ions, this temperature effect is modified. The pH of most raw water lies within the range 6.5–8.5.[1]

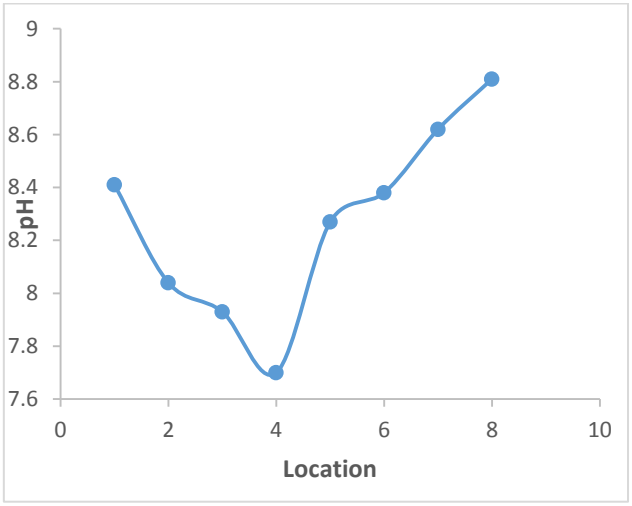

Figure 2 the pH of the water samples

The graph represents the pH values of the water samples. The maximum being 8.87 while the minimum value of pH is 7.7. The average pH value for the water samples is 8.27. The pH value for all the water samples is within the permissible range of 6.5-8.5 pH for drinking water quality.

5.2 *Conductivity*

Conductivity is a measure of the ability of water to pass an electrical current. Conductivity in water is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate anions (ions that carry a negative charge) or sodium, magnesium, calcium, iron, and aluminum cations (ions that carry a positive charge). Organic compounds like oil, phenol, alcohol, and sugar do not conduct electrical current very well and therefore have a low conductivity when in water.

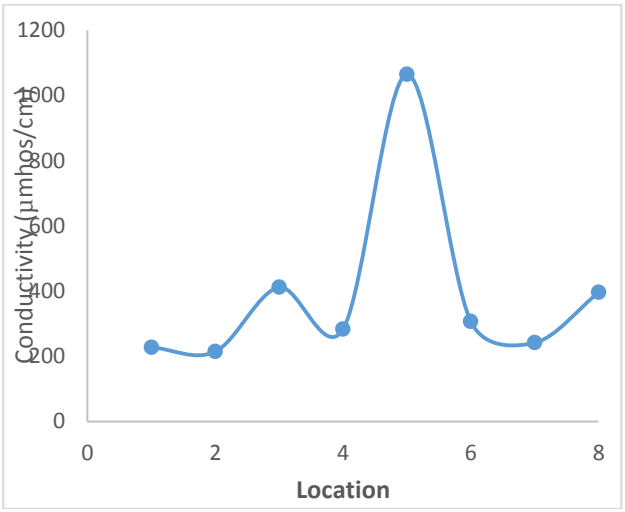

Figure 3 Conductivity of water samples

The graph represents the values of conductivity for water samples. The maximum value is 1065 µmohs/cm while the minimum is 212 µmohs/cm. the average conductivity value is 394 µmohs/cm.

5.3 *Total Dissolved Solids*

Total dissolved solids (TDS) are the term used to describe the inorganic salts and small amounts of organic matter present in solution in water.

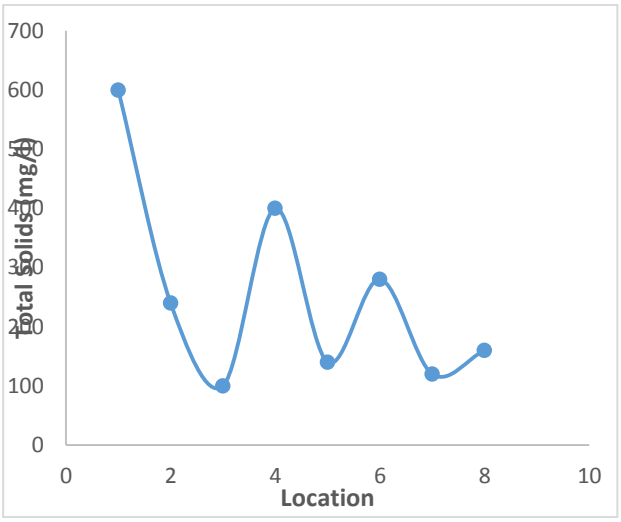

Figure 4 Total Solids concentration in water samples

The graph represents the total solid concentration of the water samples. The maximum concentration is 600 mg/l while minimum concentration is 120 mg/l. the average concentration value is 255 mg/l.

5.4 *Dissolved Oxygen*

Oxygen is measured in its dissolved form as dissolved oxygen (DO). If more oxygen is consumed than is produced, dissolved oxygen levels decline and some sensitive animals may move away, weaken, or die.

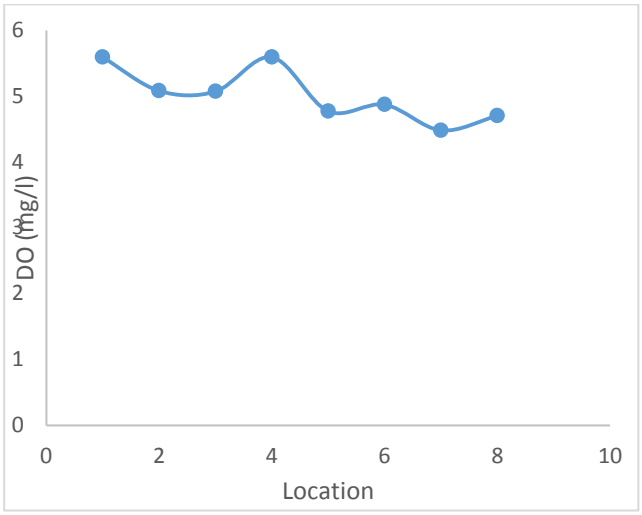

Figure 5 Dissolved Oxygen concentration in water samples

The graph represents the Dissolved Oxygen of water samples. The maximum Dissolved oxygen value is 5.59 mg/l while the minimum oxygen value is 4.7 mg/l. the average DO value is 5 mg/l.

CONCLUSION

The pH value of the water samples is well within the permissible limits. Further analysis is required to determine the variation of pH for each location.

The conductivity parameter does not represent a relevant result as the difference between locations is considerably high. More research work is needed to determine the ion concentration in water samples to understand the results of conductivity parameter.

The solid concentration is too high as compared to the permissible limits. The much needed research analysis for the concentration of Calcium and Magnesium salts can help in explaining the high solid concentration.

The DO level is below the required level in drinking water. This can be because of the low atmospheric pressure in the city of Abha which allows the Oxygen to escape into the atmosphere quickly. More research is needed to determine the low DO concentration, whether the low atmospheric pressure is responsible for it or the groundwater level itself is depleted of oxygen.

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