

Tap Water Quality Assessment of Pilgrim's Residence Buildings by Using Water Quality Index

Jahan Zeb¹, Omar Bashir Ahmed², Turki Habeebollah¹, Abdullah Othman¹, Ali Sayqal³, Hamza Assaggaf⁴

¹Natural Hazard Research Unit and Water Research Unit, Department of Environmental and Health Research, The Custodian of Two Holy Mosques Institute for Hajj and Umrah Research, Umm Al-Qura University, Saudi Arabia.

²Health and Infectious Diseases Research Unit, Department of Environmental and Health Research, The Custodian of Two Holy Mosques Institute for Hajj and Umrah Research, Umm Al-Qura University, Saudi Arabia.

³Department of Chemistry, Umm Al-Qura University, Saudi Arabia.

⁴Department of Laboratory Medicine, Umm Al-Qura University, Saudi Arabia.

ABSTRACT

Makkah is famous for its religious values and flow of pilgrims throughout a year, especially in Ramadan and Hajj. The focus of the current study is to assess the Water Quality of provided water in hotels and residential buildings of Makkah. The Water Quality Index (WQI), a mathematical model, used to present the quality of water in numbers. The samples were collected and analyzed for pH, TDS, turbidity, EC, free Cl₂, Al, Cd, Cr, Pb, F⁻, Cl⁻, NO₃⁻, SO₄⁻², Na⁺, K⁺, Mg⁺² and Ca⁺². WQI was calculated using 16 physico-chemical parameters. A strong positive correlation was observed between TDS and Cl⁻, SO₄⁻², Na⁺, K⁺, Mg⁺², Ca⁺²; Al is in coordination with SO₄⁻², K⁺, Na⁺ whereas Cl⁻ showed strong correlation with Na⁺, K⁺, Mg⁺²; SO₄⁻² is in good relation with K⁺, Mg⁺², Ca⁺²; Mg⁺² and Ca⁺². Water used in the hotels and pilgrims' buildings were complied with international standards and within the acceptable limit.

Keywords: Water Quality Index, Ramadan, physico-chemical, *E. coli*, *Pseudomonas aeruginosa* and salmonellae.

INTRODUCTION

Makkah, the religious hub for Muslims from all over the world, hosting millions of pilgrims' whole year. Government's departments are well responsible for their duties. NWC (National Water Company), is responsible for water supply in all over the Kingdom. The rapid increase of population density in Makkah during Umrah and Hajj seasons may raise challenges in providing sufficient and clean food, water, and sanitary facilities. The government of Kingdom of Saudi Arabia is committed to provide safe drinking water fulfilling the local and international standard-permissible standards and characteristics. In Makkah, the main source of drinking water is the desalination plants, the average consumption per capita of potable water about 260 L per day [1].

Quality control is designed to ensure that the supplied water meet National and International standards. Assessment of water quality can be assessed for physico-chemical and biological aspects. If organic, inorganic and biological contaminants in water are more than the permissible limit, produce adverse effect on the human environment [2]. The water quality index (WQI) is a tool effective to discuss the quality of water. It is easy to explain the water quality to policymakers. WQI express the quality of water in a single number, after a long calculation based on the water quality variable [3].

OBJECTIVES

The focus of the study is to assess the Water Quality of water provided in hotels and residential buildings of Makkah.

METHODOLOGY

Tap water samples were collected from 4 different districts during Ramadan 1440. The samples were analyzed for pH, TDS, turbidity, EC, free Cl_2 , Al, Cd, Cr, Pb, F, Cl^- , NO_3^- , SO_4^{2-} , Na^+ , K^+ , Mg^{+2} , Ca^{+2} . WQI was calculated using 16 physico-chemical parameters. The Water Quality Index (WQI) is a calculation-based method used to facilitate the quality of water in numbers.

RESULTS

The quality of drinking water in Makkah during the seasons is an important health issue. During Ramadan, an adequate water supply must be provided at building and hotels either for drinking or use there are other purposes must be of potable quality i.e. suitable for human consumption. In addition to be a necessity of life in all known forms, water plays a vital role in human health and nutrition [4]. As shown in Figure 1, 71.4% source of the selected sampling locations were Municipal Network whereas rest of the 25.4% brought water tankers, which is also supervised by the Makkah Baladiyah. Figure 2 shows that besides other uses, 71.4% of the selected building used the water in the kitchen and 15.9% were used in the kitchen and for drinking (water coolers), as well.

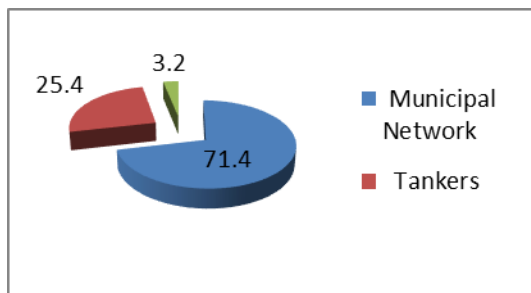


Figure 1. Different sources of water.

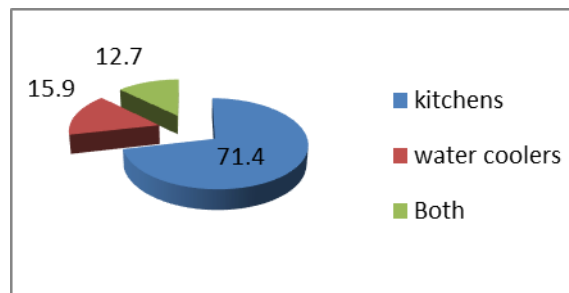


Figure 2. Uses of water.

We calculate the WQI in the available water in different hotels and residential buildings in Makkah (Figure 3). This WQI calculation is based on 16 different parameters (pH, TDS, Free Cl_2 , turbidity, F, Cl^- , NO_3 , SO_4^{2-} , Na^+ , K^+ , Mg^{+2} , Ca^{+2} , Al, Cd, Cr and Pb). WQI in all analyzed samples were found in the Class I category, which is the best quality. Slightly variation in WQI values was because of the water storage and piping conditions inside the hotels.

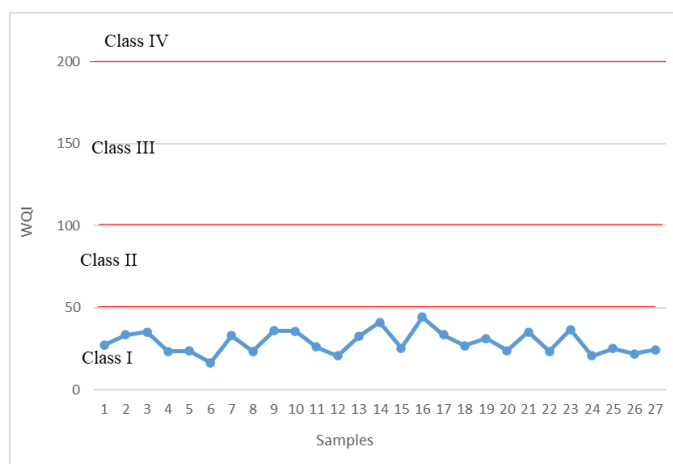


Figure 3. Water Quality Index of water samples in Makkah.

CONCLUSION

The results showed that 26 samples were considered Excellent and 1 sample was considered as Good. A strong positive correlation was observed between TDS and Cl^- , SO_4^{-2} , Na^+ , K^+ , Mg^{+2} , Ca^{+2} ; Al and SO_4^{-2} , K^+ , Na^+ ; Cl^- and Na^+ , K^+ , Mg^{+2} ; SO_4^{-2} and K^+ , Mg^{+2} , Ca^{+2} ; Mg^{+2} and Ca^{+2} . The water used in the hotels and pilgrims' buildings is in accordance with international standards and within the acceptable limit [5].

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