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COD, BOD and Heavy Metal Removal FromGround Water Treatment By Using WASRA System: A Case Study On Universiti Malaysia Pahang Mosque

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ABSTRACT

Background: Development of a user friendly technology water supply system in the rural Area (WASRA) functioning to treat the groundwater with low cost and economical based on pre-treatment process and membrane technology. This study analyzed the quality of water sources and determine the effectiveness of WASRA System as water supply at UMP Mosque. The effect of WASRA System was evaluated through Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), Manganese and Ferumtesting. Based on the testing of untreated water illustrates that BOD value exceeds the value in CLASS II, which is not suitable for ablution purpose. Meanwhile, the treated water shown that all the parameters achieved the CLASS I standard except for COD which still remain in CLASS II. Therefore, it is concluded that the treated water from WASRA System can be channelled for ablution purposed in the UMP mosque.

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INTRODUCTION

Rapid population growth rates in rural and urban area of Malaysia have exacerbated water supply and water demand.Shiklomanov has stated that one of the world's most critical resources is water that placed under the global stress due to competing requirements by agriculture, industry, and municipal needs [1]. Therefore, this issue has drawn heavily on the natural resource which is ground water. Ground water is a vital component of the nation's water resources and in fact, it gives the benefit towards public health, environment and the economy. Ground water can be used for drinking purposes, recreation, agriculture and industry[2].About 25 percent of the earth's total fresh water supply is stored as ground water, while less than 1% is stored in surface water resources, such as soil moisture, river and lake [2]. However, utilization of ground water resource as the water supply has created a few issues such as high concentrations of iron and manganese. With high concentrations of iron and manganese can give water an unpleasant taste, odor and color.

A user friendly technology water supply system in the rural Area (WASRA) has created to solve the high concentration of iron and manganese and screened material included contaminated materials such as heavy metals, organic and inorganic materials and even micro- organisms that can be harmful to humans. The treated water from WASRA System can be used for ablution. The ritual of ablution is a symbolic cleaning process instituted by God and mentally helps in the preparation of prayer. For this ritual, God has decreed four steps as adequate [2]. Ablution should be done preferably in a clean condition. Meanwhile, the steps of ablution are a combination of physical actions that must be fixed in a particular sequence. Indeed, those who reverence the rites decreed by GOD demonstrate the righteousness of their hearts [3].

Most contemporary mosques in Malaysia use tap water for ablution purpose. Tap water from surface water are applicable after filtered and disinfected. To overwhelm the usage of surface water for ablution, ground water was the best alternative. Therefore, this research was determining the quality of treated water by WASRA System for ablution usage in the Universiti Malaysia Pahang Mosque.

Research Methodology:

Study Area:

This study was conducted at the Universiti Malaysia Pahang (UMP) mosque campus Gambang, Pahang which is 32.2km from Kuantan. The mosque belongs to JabatanPenilaianPengurusanHarta (JPPH)

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UniversitiMalaysia Pahang. This mosque consists of two places for ablution which is separately for males and females by using tap water. Although the price rate of raw water is cheaper, but it's good if used ground water as the replacement of ablution water. Figure 1 shows the pump house of WASRA system.

Fig. 1: Pump House of WASRA System

Procedure of Sampling:

The raw water sample was taken from the groundwater tank inside the pump house of WASRA system. Meanwhile, the treated water was collected from an ablution area inside the UMP mosque. All the samples were placed in the plastic bottles and taken week by week started from December 2013 until April 2014.

Data Collection Technique:

All the samples are analyzed in the Environment laboratory according to the method recommended in the Standard Methods for Examination of Water and Wastewater, published by the American Public Health Association or any Standard Methods recommended by the Department of Chemistry. Preservation are needed for holding longer time based on Guidelines of Environmental Protection Agency.

Sample Testing:

The effect of WASRA System was evaluated through four parameters which are Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), manganese and ferum. Meanwhile, One-Way ANOVA was used to ensure the accuracy of data.

RESULT AND DISCUSION

Interim National Water Quality Standards (INWQS) was used as a guideline to determine the current value of the standard of parameters in six classes based on the usage of water resources. It was used to improve the water quality gradually and meet the standards of water class. For the body contact purpose, the water should be at least in the Class II in INWQS.

Chemical Oxygen Demand (COD):

Chemical Oxygen Demand test was done to determine the amount of organic compounds present in the samples. The amount of chemicals in the water can be oxidized by oxygen. It is important for the evaluation of the quality of effluent and waste water. Figure 2 demonstrated the graph of COD versus number of samples. It's shows the value of parameters based on the experiments performed by comparing with the Interim National Water Quality Standard (INWQS). Based on INWQS, the limit value of COD in water is 25 mg/L. However, the treated water has decreased the value below the INWQS value with an average value of untreated water is 25.63 mg/L while treated water is 11 mg/L. Table 1 shows the summary of One way ANOVA for COD. Based on the result tabulate in Table 1, treated water has a lower value than Interim National Water Quality Standard (INWQS) as the analysis result is rejected the null hypothesis where the critical value is 0.05 which is higher than the P-value which is 6.52×10^{-39}. Therefore, it can be concluded, at 95% confidence level, there is a significant difference between the result of treated water and Interim National Water Quality Standard (INWQS).

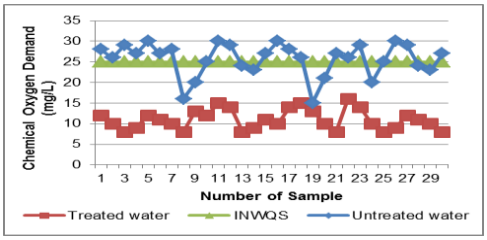

Fig. 2: Graph of COD Versus Number of Sample.

Table 1: Summary of One-Way ANOVA for COD.

Source of Variation	SS	F	P-value	F crit
Between Groups	4105.36	284.836	6.522E-39	3.1013
Within Groups	626.967			
Total	4732.32			

Biochemical Oxygen Demand (BOD):

Biochemical oxygen demand testing is to determine the quantity of oxygen used by microorganisms in the oxidation of organic matter. Both COD and BOD have a similar purposed which is both measure the amount of organic compounds in the water. Figure 3 shows the graph of BOD versus number of samples. The average value of the treated water is 0.84 mg/L which is lower than INWQS, 3 mg/L. It shows that the treated water from WASRA system can reduce the value of BOD.

The summary of One-Way ANOVA for BOD is presented in Table 2. Based on the result illustrated the null hypothesis which is there is no significant difference between the BOD value of treated water and INWQS was rejected where the critical value is 0.05 which is higher than the P-value which is 1.94 x 10-45. Therefore, it can be concluded, at 95% confidence level, there is significant value between the BOD value of treated water and INWQS.

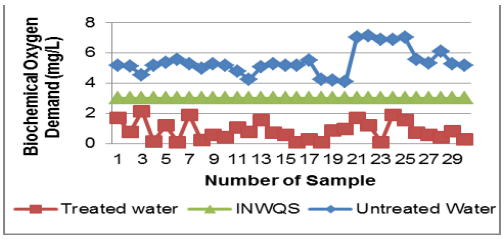

Fig. 3: Graph of BOD Versus Number of Samples.

Table 2: Summary of One-Way ANOVA for COD.

Source of Variation	SS	F	P-value	F crit
Between Groups	40424.41	15971.	2.4E-112	3.1012
Within Groups	110.1011			
Total	40534.51			

Manganese:

Figure 4 shows the Manganese content in the sample. According to the result, it shows that WASRAsystem is effective to remove manganese from the groundwater. This is because, the limit value of untreated water is 0.38 mg/L and decreases to 0 mg/L after treated by WASRA System which is lower than INWQS, 0.1mg/L.

Table 3 shows the summary one-way ANOVA of manganese. Based on the result tabulate in Table 3, treated water has a lower value than Interim National Water Quality Standard (INWQS) as the analysis result is rejected the null hypothesis where the critical value is 0.05 which is higher than the P-value which is 3.32 x 10^{-56}. Therefore, it can be concluded, at 95% confidence level, there is a significant difference between the result of treated water and Interim National Water Quality Standard (INWQS).

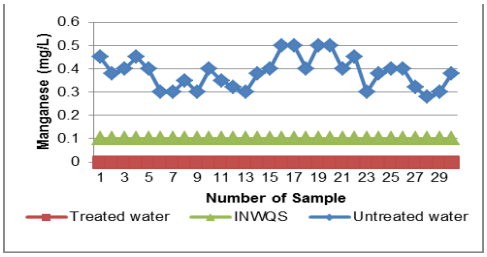

Fig. 4: Graph of ManganeseVersus Number of Samples.

Table 3: Summary of One-Way ANOVA of Manganese.

Source of Variation	SS	F	P-value	F crit
Between Groups	2.36778	776.58	3.32E-56	3.1013
Within Groups	0.13263			
Total	2.50041			

Ferum:

Ferum (Fe) is a major constituent of the earth's crust. It is commonly found in citrus and spent etching bath of plating shops, steel mills, foundries, chemical manufacturing, and wire drawing operations and it occurs naturally in groundwater and surface waters. Water that containslots of ferum can cause harmful effects in

humans, especially in drinking water. Figure 5 illustrated the Ferum content in the sample. The results show that the untreated water is 0.88 mg/L and decrease to 0 mg/L which is lower than the limit value INWQS BOD, 1 mg/L. Therefore, WASRA system has the availability to reduce the Ferum content in ground water.

The summary of one-way ANOVA of ferum was tabulated in Table 4. From the table shows that there is significant differences of the value between treated water and Interim National Water Quality Standard (INWQS) with 95% confidence level limit as the critical value is 0.05 which is higher than the P-value which is 1.39×10^{-39}. Therefore, the null hypothesis is rejected.

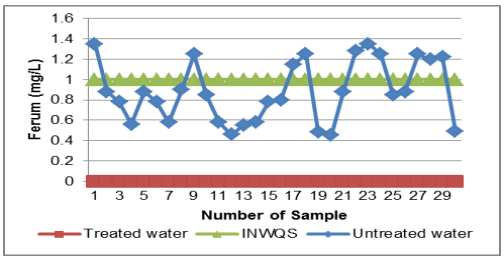

Fig. 5: Graph of FerumVersus Number of Samples.

Table 4: Summary of One-Way ANOVA of Manganese.

Source of Variation	SS	F	P-value	F crit
Between Groups	17.9594	296.71	1.39E-39	3.1012958
Within Groups	2.63295			
Total	20.5923			

Interim National Water Quality Standard (INWQS):

National Water Quality Standards used to determine the current value of the standard 72 parameters in six classes based on the use of water resources. It is used as a guidelineto improve waterquality gradually and meet the standards of water. Based on the Table 5, the untreated water shows that three of the parameters whichis COD and BOD value exceeds the value in CLASS II. CLASS II is a class that requires conventional treatment to ensure the water is safely to use. High level of COD inwateroften correlates with threats to human health and reduce the amount of dissolved oxygen available to organisms soluble for aquatic organisms. Meanwhile, when high levels of BOD, it leads to increase the anaerobic bacteria.

For treated water, it shows that all the parameters achieved standard CLASS I except for COD which is in CLASS II. Therefore, the treated water from WASRA System can be used as ablution.

Table 5: Summary of Comparison with INWQS.

Water Parameter	Untreated Water (Average)	CLASS	Treated Water (Average)	INWQS	CLASS
COD (mg/L)	25.63	CLASS III	11	25	CLASS II
BOD (mg/L)	5.39	CLASS III	0.84	3	CLASS I
Manganese (mg/L)	0.38	CLASS V	0	0.1	CLASS I
Ferum (mg/L)	0.88	CLASS I	0	1	CLASS I

Conclusion:

From the results, it shows that the quality of water supply from WASRA system is complying with INWQS. Manganese had shown the improvement from CLASS V to CLASS I while BOD has changed from CLASS III to CLASS I accept for COD changed from CLASS III to CLASS II. In WASRA, the system was only focused on removing iron and manganese. Therefore, it can be concluded that WASRA System was able to generate clean water for the ablution in UMP Mosque.

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