HORIZONTAL COLLECTOR WELL AS ALTERNATIVE FOR CONVENTIONAL RAW WATER INTAKE

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ABSTRACT

Water plays an important role in supporting and maintaining human health and sustainable ecosystem development. However, climate change from dry season to rainy season and vice versa are causing stress among water supply agencies and impose pressure to look for an alternative supplementary source. Therefore, this study evaluates water samples from Horizontal Collector Well (underground water) as optional water resources compared to the Conventional Raw Water Intake (surface water) at Sekor river, Pekan Pahang. A number of tests were conducted based on turbidity, iron, manganese, aluminium and pH from January 2016 until December 2016 and results from water samples were compared with Recommended Raw Water Quality Criteria. From samples tested, the turbidity of the underground is seen relatively better compared to surface water, average pH value is 6.8 more acidic than surface water with average pH value of 7.18 and underground water contains higher Iron and Manganese compared to surface water. Therefore, from the results, there is a need to study on effectiveness of using conventional water treatment to treat underground water. Some modifications were done on aerator and changes in the type of chemical used to achieve Drinking Water Quality Standard. Subsequently, the effectiveness of adopting Horizontal Collector Well as a future use in Pahang was investigated and the main focuses were in terms of cost construction, operation (chemical and electrical) and maintenance cost. From the total cost, it was found Horizontal Collector Well is cheaper (RM4,685,857.42) compared to Conventional Raw Water Intake (RM8,720,050.52). As a conclusion, it can be said that the Horizontal Collector Well is a successful alternative as a replacement of conventional raw water intake.

ABSTRAK

Air memainkan peranan yang penting dalam menyokong dan mengekalkan kesihatan manusia dan pembangunan ekosistem mampan. Walau bagaimanapun, perubahan iklim seperti musim panas, musim banjir dan seumpamanya menyebabkan tekanan kepada agensi bekalan air untuk mencari alternatif lain sebagai sumber bekalan air. Oleh itu, kajian ini adalah untuk menilai sampel air pengumpul perigi mendatar (air bawah tanah) sebagai sumber air berbanding dengan mukasauk konvensional (air permukaan) di Sungai Sekor, Pekan Pahang. Beberapa ujian telah di lakukan berdasarkan parameter kekeruhan, besi, mangan, aluminium dan pH bermula dari Januari 2016 sehingga Disember 2016 dan keputusan dari ujian tersebut dibandingkan dengan piawaian kritirea kualiti air mentah. Dari ujian sampel yang telah di uji, di dapati tahap kekeruhan air bawah tanah adalah lebih baik berbanding air permukaan, purata nilai pH ialah 6.8 lebih berasid berbanding air permukaan nilai purata adalah 7.18 dan air bawah tanah juga mengandungi tinggi nilai besi dan mangan berbanding dengan air permukaan. Lanjutan dari keputusan ujian tersebut, seterusnya adalah perlu untuk mengkaji keberkesanan air bawah tanah di rawat menggunakan loji rawatan air. Sedikit pengubahsuaian dilakukan pada pengudaraan dan menukar jenis kimia bagi mencapai piawaian kualiti air minuman. Seterusnya, mengkaji keberkesanan pembangunan Pengumpul Perigi Mendatar untuk digunakan pada masa hadapan, dan focus utama ialah dari segi kos pembinaan, operasi (kimia dan elektrik) dan kos penyelenggaraan. Dari jumlah kos keseluruhan, di dapati Perigi Pengumpul Mendatar adalah lebih murah (RM4,685,857.42) berbanding dengan kos mukasauk konvensional (RM8,720,050.52). Kesimpulannya, ia boleh dikatakan Pengumpul Perigi Mendatar adalah alternatif yang berjaya bagi mengantikan mukasauk konvensional.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Water is a vital part of the ecosystem and clean water is required for life on Earth in order to support and maintain human health and sustainable ecosystem development. Although the total volume of water in the world remains constant, but the quality and availability of water resources are not constant. The planet has mostly been covered with water in liquid, gaseous or frozen form and out of that, more than 95% of the total water supply is salt water. Only a small portion of the planet presents as groundwater, and as little as 0.01% of the world's total water are present as freshwater in rivers or lakes (Odlare, 2014).

Currently, economic expansion and population explosion have caused water demand to continually increasing for freshwater resources worldwide by municipal, industrial, and agricultural users (Cai, *et al*., 2014; Bagatin, *et al*., 2014). However, the availability of water resource is limited due to the polluted surface water which is resulted from erosion, municipal and industrial wastewater and also by weathering (water runoff) as well as climatic condition (Arain., *et al*., 2014).

Moreover, Marston, *et al*. (2015) has stated that due to climate change, surface water source has been affected in many countries and has the potential to buffer fluctuations in surface water availability. Smith and Chandler (2010) estimated that climate change could lead to drastic changes in the region over the next sixty years and furthermore and it may impact on the whole cycle of water supply with the changes in the availability, quantity and quality of water resources. Recent modelling has revealed evidence for a doubling in El Nino event occurrences in the future as a result of greenhouse warming (Cai, *et al*., 2014).

Therefore, in order to full fill demand of water resource and reducing environmental problems caused by excessive exploitation of surface water, effective approach by using underground water was introduced, where river water percolates through riverbeds into aquifers. With underground water, it can be guaranteed clean and dependable water supply without neglecting the resource potential of the surface water used as a supplementary source of water supply (Shamsuddin, *et al*., 2014).

1.2 Problem Statement

More than 80% of future world water stresses are due to ever increasing population, urbanization and development. One of the most significant disruptive forces (pressures) to get water resources is climate change. Climate change has been predicted to cause high variability in rainfall patterns, with more frequent extreme weather events including droughts and high-intensity rainfall (Van der Pol, *et al*., 2015; Chen, *et al*., 2014; Teng, *et al*., 2012).

Kirschner, *et al*., (2009) stated that during flood season, the quality of surface water (river) might be deteriorated due to combined sewer overflow events or direct runoff from areas with intensive agriculture. Furthermore, very high turbidity is obtained during and after the monsoon seasons. Pollution has made the surface water unsuitable for treatment, and in specific cases has caused the treatment costs to rise unexpectedly (Shamsuddin, *et al*., 2014).

Water Treatment Plant at Sekor, Pekan, Pahang is one of the water treatment plant affected with these problems. The existing conventional raw water intake is not fully sunken in the river during the dry season and this has caused raw water pump to stop operating. In addition, due to low water level of river, this water treatment plant has to stop its operation due to seawater intrusion was detected during high tide at water intake and halted operation for a while. Frequently, this has caused raw water intakes to operate under capacity condition.

Furthermore, during flooding and monsoon seasons raw water intake and the water treatment plant sometimes need to be shut down due to high levels of turbidity. Sometimes high water level of the river will cause swamp water (black water) intrusion into the conventional raw water intake and worsen the water quality. Several newly developed water treatment methods are being used to obtain higher quality water, but the raw water with high levels of turbidity will cause increases in amount of chemical to use for treatment and consequently increases the water treatment cost unexpectedly.

Besides that, because of Water Treatment Plant at Sekor, Pekan, Pahang is located in the downstream area, therefore the water quality often significantly worse after heavy due to pollution runoff from farming, illegal logging and etc from upstream. Poor quality of surface water will requires more dosing of chemicals thus increases the water treatment cost. In additional, there is also a possibility of raw water pump to break down in the event of flooding. Even though conventional raw water intake has a coarse screen and a fine screen, but solid waste like branch, plastic and etc may enter the pit of the raw water pump during flood season. Therefore, it may increase the cost of maintenance and operation.

Water Treatment Plant at Sekor, Pekan is cater to supply treated water to 16 areas such as Pekan town, Kampung Pelangkah, Kampung Time, Kampung Ganchong and etc, where it consumes around 6593 numbers of accounts. Therefore, frequent closure of water intakes and water treatment plant will directly affect demand for treating water and revenue of the Pengurusan Air Pahang Berhad. company.

This issue is seen very stressful, especially for water supply agencies because of the failure to fulfil the demand and imposed pressure to Pengurusan Air Pahang Berhad to look for other alternative supplementary sources. Therefore, to meet the rising demand of water in that particular area, underground water could be used for water resources using Horizontal Collector Well (HCW). This method is the first in Pahang and it has started to operate in January 2016.

1.3 Objectives of the Study

The objectives of this study are as follows:

i. To investigate the raw water quality of underground water compared to surface water.

ii. To study the effectiveness of using the conventional water treatment plant existing water treatment plant to treat water from HCW

iii. To investigate the effectiveness of HCW as a future use in Pahang.

1.4 Scope of the Study

Water Treatment Plant Sekor, Pekan, Pahang has two phases namely phase one where the water resource is surface water by using conventional raw water intake and phase two where the water resource is underground water by using HCW. The scope of this case study is to investigate the raw water quality of underground water comparable to surface water based on Recommended Raw Water Quality Criteria. Samples taken at the site will be tested in the laboratory and the parameters are focused only to pH value, turbidity, Magnesium, Aluminium, and Iron.

Both phases have their own water treatment plant to treat raw water from underground water and surface water. Therefore, there is a need to study the effectiveness of underground water treated by using conventional water treatment plant. At the end of this research, suggestions were given for the modifications that have been done to ensure underground water can achieve Drinking Water Quality

Standards. The effectiveness of HCW as a future use in Pahang was investigated and the benefits of using HCW, compared to conventional raw water intake in term of construction, operation and maintenance cost were investigated and the significant contributions of HCW to the Pengurusan Air Pahang Berhad were outlined.

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