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STUDY ON COM TER AND BIOSAND FILTER FOR I N RURAL AREA

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ABSTRACT

Biosand Filter usually is used for household capacities since it is small, easy to build and maintenance but highly effective in purify water that have contaminant. Biosand filter is adapted from conventional slow sand filter for intermittent usage and it is suitable for the rural area, which their resident cannot afford to have a clean water supply. By using two Biosand Filter and one of them is integrated with raw coconut coir pith to increase the performance, the effectiveness to purify the untreated water can be determined by comparing the result testing for both filters. Recently, many researchers interested to conduct a study regarding coconut coir pith as one of the medium to purify the contaminant in water. Thus, in this study groundwater from Kg. Fajar 2, Gambang is treated using both filters since it contaminated by impurities and contain high level of heavy metal. Several testing is conducted on this groundwater such as pH, turbidity, *E.Coli*, total coliform, total dissolved solid, total suspended solid, dissolved oxygen and some of heavy metal which is iron, zinc, lead, manganese, copper, and chromium. Groundwater, which has been treated using both filters show impressive rate of reduction especially in bacteria and heavy metals removal as the result after the test is carried out. Based on Malaysia: National Guidelines for Raw Drinking Water Quality (Revised December 2000), the underground water from Kg. Fajar 2 is safe to be consumed after filtration using both of the filters.

ABSTRAK

Lazimnya, penapis Biosand digunakan untuk kapasiti sebuah rumah memandangkan ianya kecil, senang untuk dibina dan diselenggara namun sangat effektif untuk menjernihkan air yang mempunyai kekotoran. Penapis Biosand diadaptasikan daripada penapis perlahan berpasir lazim yang digunakan secara berselang dan ianya sesuai untuk kawasan luar bandar, yang mana penduduknya tidak mampu untuk memperolehi bekalan air yang bersih. Dengan menggunakan dua penapis Biosand dan salah satunya akan disepadukan dengan sabut kelapa mentah untuk meningkatkan lagi prestasinya, keberkesanan untuk menjernihkan air yang tidak terawat boleh ditentukan dengan membandingkan hasil ujian daripada kedua-dua penapis. Semenjak kebelakangan ini, ramai penyelidik tertarik untuk menjalankan kajian berkenaan sabut kelapa sebagai medium untuk menjernihkan kekotoran di dalam air. Oleh itu, dalam kajian ini, air bawah tanah daripada Kg. Fajar 2, Gambang dirawat menggunakan kedua-dua penapis memandangkan ianya dicemari dengan bendasing dan mempunyai kandungan logam berat yang tinggi. Beberapa ujian dijalankan ke atas air bawah tanah tersebut seperti pH, kekeruhan, bakteria *E.Coli*, jumlah bakteria merbahaya, jumlah bahan terlarut, jumlah bahan terampai, oksigen terlarut and beberapa ujian ke atas logam berat seperti besi, zink, timah hitam, mangan, kuprum dan kromium. Air bawah tanah yang telah dirawat menggunakan kedua-dua penapis menunjukkan hasil penurunan yang mengagumkan terutamanya dalam penyingkiran bakteria dan logam berat selepas ujian dijalankan. Berdasarkan Malaysia: Garis Panduan Kebangsaan untuk Kualiti Air Minum Mentah (Disemak pada Disember 2000), air bawah tanah dari Kg. Fajar 2 selamat diminum selepas dituras menggunakan kedua-dua penapis.

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Fe	-	Iron
Mn	-	Manganese
Pb	-	Plumbum/Lead
Zn	-	Zinc
Cu	-	Copper
Cr	-	Chromium
DO	-	Dissolved Oxygen
TDS	-	Total Dissolved Solid
TSS	-	Total Suspended Solid
NTU	-	Nephelolometric Turbidity Units
%	-	Percentage
mg/L	-	milligram per liter
Kg	-	*Kampung*

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CHAPTER I

INTRODUCTION

1.1 Background of Study

The shortage of clean water supply often being read and heard form media such as newspapers, radios, television and others. Usually, the rural area is the most places to facing this problem not to mention when the drought is come, the clean water become not available anymore.

There is no exception in this situation and Malaysia also facing the same problems regarding the scarcity of cleaned water at rural area. The biggest reason that clean water supply is not reached to the rural area is its geographical location. The house of resident at rural area is isolated, then it is hard for pipeline to reach, and it will take more cost built a complete water supply pipeline. The house that located in the hills and far to each other also will cost more money to build a pipeline system.

Thus, the resident switched to the raw water from the source such as river and groundwater as a daily used. The raw water that is not treated usually contained

microorganisms, high level of heavy metal dissolved and others. This water will caused a disease to the resident if it is not treated properly to produce a good quality of water.

This study is been conducted to ease the burden of the resident at rural area to get a treated water with their own effort. By using a water filtration, all source of water can be increased its quality to meet the standard that government state for raw drinking water.

Biosand Filter has the ability to remove biological micro and macro organisms, solid matter, and water that contain chemical (Chapetta, 2008). As stated, Biosand Filter is been proven as one of the effective methods to filter untreated water to produce a better quality. There are layers in Biosand Filter such as fine sand, coarse aggregates, and others that doing its work respectively but working together to removes any impurities in water.

Biosand Filter is the simplest filter, which contained three basic layers, fine sand, fine aggregates and coarse aggregates. Because it is simple, it is easy to install with low cost and easy maintenance. However, through time, the modification of these layers is been study to increase its effectiveness to treat water.

Coconut is well known as an agricultural waste that have a high possibility as biosorbent for removal various pollutant in water (Bhatnagar et al., 2010). Various studied is conducted widely to determine its effectiveness as biosorbent such as using the coir or shell of coconut tree in removal impurities in water.

By the statement above, coconut coir pith is been selected as the integrated subject to Biosand Filter to from Bio-cocosand Filter for this study. This study will evaluate how far the effectiveness of coconut coir pith in water filtration compares to the Biosand Filter in treating raw water in rural area.

1.2 Problem Statement

Rural area has always been associated with the scarcity of cleaned water because of lack of piping system which provided by government to distribute the treated water. Some of the area does not have an adequate cleaned water supply from pump house because of geographical area. Due to lack of treated water, the resident in rural area takes another initiative by use a river or groundwater as a daily water supply.

However, there is uncertainty of quality of water from this source if compared to the standard that is specified by the government for raw drinking water. The content of raw water were used by resident in rural area either contaminated or not, will bring other problems such as disease. Because of that, there were various research and study is been conducted to increased the quality of raw water for rural area so it is safe to be use daily.

Biosand Filter is one of the methods used to increase the quality of drinking water for society. The raw water will flow through several layers in Biosand Filter to removes any impurities and microorganisms to produce a better quality of water. The development of Biosand Filter is easy and cheap compare to the other filters on the market.

In this study, two Biosand Filter is been constructed and one of filter is been added with coconut coir pith and called Bio-Cocosand Filter. Raw coconut coir pith is been washed and dried before is added to the Bio-cocosand Filter to form a layer.

Roughly, coir pith is a waste from the coconut that can be used in water filtration after undergo some process. Coconut coir pith is widely available in Malaysia since the weather is suitable for coconut tree to grow naturally. Thus, coconut coir pith can easily obtain with low cost as well as this research can increase its value added.

Hence, this filter can helps the resident in rural area to get cleaned water and the quality is same as or better compare to the water supplied by government. Besides that, this filter is low cost, the material can be found anywhere, easy maintenance, and the resident can be protected from disease and other problems caused by untreated raw water.

1.3 Objective of Study

The goal of this study is to determine the excellence of Biosand Filter integrated with coconut coir pith to treat groundwater compare to the regular Biosand Filter. This study is carried out in order to achieve these following objectives.

i. To analyze the groundwater quality in rural area
ii. To determine the effectiveness of coconut coir pith for water filtration in Biosand Filter
iii. Comparison between the quality of water using Biosand Filter and with the integrated coconut coir pith in Bio-cocosand Filter

1.4 Significance of Study

Resident in rural area always facing a problem involving water supply from government and they is forced to take water from river or groundwater as a daily used. Biosand filter is one of the solutions to increase the quality of raw drinking water without create an effect to the resident. Biosand filter also is easy to install with low cost and easy to maintain.

The usage of coconut coir pith is been evaluated to determined its effectiveness in water filtration for raw drinking treatment. Bio-Cocosand Filter is been compared to the Biosand Filter determined the effectiveness of both filter to increase the raw drinking water quality which has been set by government standard.

Bio-Cocosand Filter and Biosand Filter can gives a benefit to the rural area since the resident does not get a cleaned water supply. This caused by its geographical location of area, which is hard to supply clean water to the resident. Moreover, some of the houses is isolated and does not suitable to build a piping system to supply the water.

Coconut coir pith is a waste from coconut tree. This coconut tree can be found widely in Malaysia especially in rural area. Thus, it is easy to the resident to produce coconut coir pith for water filtration. In addition, this study will increase the value added of coconut coir pith and improve the water quality especially rural area.

Bhatnagar and Sillanpää (2010) stated that coir pith, a waste from coconut is used as absorbent and success to remove various pollutants such as removal Pb (II), Co (II), Cr (III) and others in previous research. For this reason, it is important to study on comparison of Bio-Cocosand Filter and Biosand Filter for drinking water treatment in rural area with more clearly and detail.

1.5 Scope of Study

Some of limitation is stated to study on comparison of Bio-Cocosand Filter and Biosand Filter for drinking water treatment in rural area. It is to make sure the objectives of this study can be achieved successfully.

The scope of this study is:

i. Raw coconut coir pith as an integrated media in the Biosand Filter
ii. Laboratory testing for the effectiveness of both Bio-Cocosand Filter and Biosand Filter
iii. The source of water is groundwater at No. 7, Lorong 1, Kg. `Fajar 2, Gambang
iv. The groundwater analysis such as:
    a. pH
    b. Turbidity
    c. Total Suspended Solid (TSS)
    d. Total Dissolved Solid (TDS)
    e. Dissolved Oxygen (DO)
    f. *E.Coli* and total coliform
    g. Heavy Metal (Cr, Cu, Fe, Mn, Zn, and Pb only)

CHAPTER II

LITERATURE REVIEW

2.1 Water Supply and Quality in Rural Area

Water supply system from government ensures the citizen to receive treated water from the water source. Without any treatment, raw water from water source contains microorganisms such as bacteria, heavy metal, dirt and other impurities. Consuming untreated water will cause a major problem such as disease that can lead to death. In Malaysia, there are two sources of water used by urban and rural area.

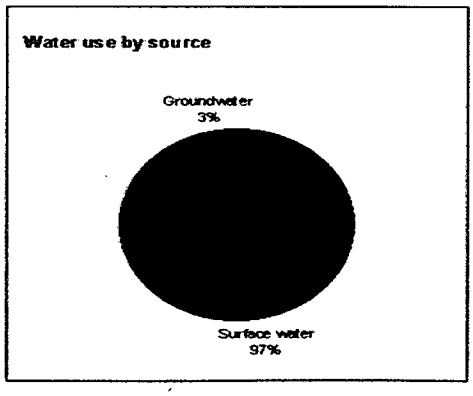

Figure 2.1: Water Use by Source (McGinley, 2009)

Based on Figure 2.1, the main source of the water used is surface water with 97 percent and 3 percent is from groundwater. The government usually treated surface water and supply throughout the urban and rural area using piping system. The availability of groundwater is limited and usually is found in rural area, which is used by the resident near groundwater to replace piped water supply (McGinley, 2009). However, not all the area receive a piped water supply and some of rural area using groundwater as a daily water intake to replace the scarcity of clean water treated by treatment plant.

State	Population Served	% Population Served			Consumption Per Capita (litre/cap/day)
		Urban	Rural	Total	
Kedah	1,621,827	100	98	98.7	309
Sarawak	2,136,274	100	92	95.8	232
Labuan	80,000	100	-	100	338
Perlis	200,091	100	98	99.2	262
Pahang	1,306,342	98	89	92.7	250
N.Sembilan	852,379	100	99	99.5	336
Sabah	2,001,123	88	59	72.9	90*
Perak	2,093,833	100	99	99.5	277
Melaka	662,949	100	99	99.6	363
Pulau Pinang	1,292,981	100	99	99.8	476
Terengganu	832,037	97	79	87.7	299
Selangor	5,688,556	100	98	99.7	325
Johor	2,931,650	100	99	99.6	289
Kelantan	827,405	71	57	61.7	144*
Total/ Average	22,527,447	97	86	93.2	283

Source: MWA (2004)
* Low consumption per capita due to insufficient supply

Figure 2.2: Access to Water and Water Consumption, 2002 (Lee, 2005)

Rural area in Malaysia usually encounter serious problem regarding water supply system compare to the urban area. Lee (2005) stated that 93 percent of population in Malaysia could access to water supply. It makes, 7 percent of Malaysia population is severe in accessing water supply for treated water. From the Malaysia population that has access to water supply; urban area is 97 percent in average served meanwhile rural area is 86 percent served.

Sabah and Kelantan is less developed state, which is recorded have low consumption of water per capita (Lee, 2005). It can be shown at Figure 2.2, Sabah population has access to water supply is about 72.9 percent and the rural area is only

about 59 percent served which is halved of the people has access to piped water supply. Kelantan population is more severe in accessing water supply, which is only about 61.7 percent. The access of water supply at urban and rural area in Kelantan is relatively low which is 71 percent and 57 percent respectively. Thus, rural area such as in Sabah and Kelantan usually using other alternatives to substitute piped water supply with groundwater to be used as daily water supply.

Groundwater is a well-known source as a replacement to the piped water supply in rural area. The water is pumped out from the ground either is bore or drilled, dug or others. Harter (2003) stated that naturally groundwater contained mineral ion. The content of mineral ion in groundwater is different from each area, several are high and the other is lower depending to the soil content around of the groundwater.

The most concern in groundwater is its chemical and biological aspect and qualities since groundwater is usually odorless, do not have a specific taste and colorless (Harter, 2003). Harter (2003) also stated that the quality of groundwater is tested by three component which the physical, chemical, and biological qualities. Usually, color, taste, odor, temperature, and turbidity are physical parameter that is tested to the groundwater to determine its quality. Chemical quality includes the heavy metal or mineral ion contain in groundwater. Biological quality is bacteria and other microorganism that can be found in groundwater.

Since the raw content of groundwater is unknown, the people who used it as a water supply are prone to disease cause by the content of the water. Thus, it makes Malaysia release a standard that is used as a guideline for raw drinking water. On Table 2.1, the raw water quality status is determined based on the Malaysia: National Guidelines for Raw Drinking Water Quality (Revised December 2000) from the Malaysia Ministry of Health. The content of groundwater must not exceed this standard guideline to make sure the raw water from groundwater do not brings any harm to the consumer.

Table 2.1: Malaysia: National Guidelines for Raw Drinking Water Quality (Revised December 2000)

Parameter	Symbol	Benchmark
Sulphate	SO4	250 mg/l
Hardness	CaCO3SO	500 mg/l
Nitrate	NO3SO	10 mg/l
Coliform	-	Must not be detected in any 100 ml sample
Manganese	Mn	0.1 mg/l
Chromium	Cr	0.05 mg/l
Zinc	Zn	3 mg/l
Arsenic	As	0.01 mg/l
Selenium	Se	0.01 mg/l
Chloride	Cl	250 mg/l
Phenolics	-	0.002 mg/l
TDS	-	1000 mg/l
Iron	Fe	0.3 mg/l
Copper	Cu	1.0 mg/l
Lead	Pb	0.01 mg/l
Cadmium	Cd	0.003 mg/l
Mercury	Hg	0.001 mg

Source from Ministry of Health, Malaysia

However, the people in rural area does not concern about the content of the groundwater. Usually, they intend to use the groundwater directly after is pumped out making them vulnerable to the disease cause by water. Some of the people do not have any knowledge the effect that will cause after consuming untreated raw water. Even though some people might have the knowledge, they do not have any equipment to removes any contaminant and impurities in the water.