WATER TREATMENT USING SLOW SAND FILTER

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ABSTRACT

Studies about the slow sand filtration treats any type of water to see the efficiency of the treatment performance (consist of 3 layers of fine sand <600μm, 600μm, 1m, activated carbon, varies size of river gravel). The purpose of purifying water is to increase the quality of water that is safe and no harm for human consumptions. The capability of slow sand filter is known as the most efficient water treatment method base on previous nineteenth century practical used by using the slow sand filtration method. It is cheapest method comparing to other kind of water treatment, not to say that other treatment is not functional but instead it is the cheapest and less maintenance required so it is most common used method in developing countries and small community on producing a good quality of treated water that are safe and cheap. The removal of total suspended solids (TSS), color, turbidity, toxic heavy metals iron, biological oxygen demand (BOD) and chemical oxygen demand (COD), E-coli, were evaluated for water treatment. For 4 weeks slow sand filter filtered untreated water from sungai Belat, successfully reduces the concentration of physical parameters up to 85% of losses, for chemical parameters and Iron reduces is 11% until 35% of losses.SSF need further filtration to increase the potential of filtration.

ABSTRAK

Kajian ini mengenai Slow Sand Filter (SSF) merawat air kotor untuk melihat potensi rawatan ini yang terdiri dari 3 lapis pasir halus <600μm, 600μm, 1m, activated carbon, pelbagai saiz batu sungai. Tujuan merawat air ialah untuk menginginkan kuality air yang selamat dan tiada bahaya di dalam dan jua luar secara kontak. Kebolehan SSF ini dikenali sebagai teknik yang paling berkesan dari abad yang ke 19. SSF jua teknik yang murah berbanding teknik-teknik rawatan air yang lain, bukan secara langsung teknik lain tidak berfungsi tetapi SSF ialah satu teknik rawatan air yang paling murah di mana penyelenggaran yang kurang jadi SSF dipilih di kawasan yang membangun dan komuniti yang kecil dalam menginginkan air yang berkualiti tinggi, selamat dan murah. Pembuangan total suspended solid (TSS), warna, kekeruhan,bahan logam,E-coli, BOD dan COD dikenal pasti di dalam kajian keberkesanan system penapisan SSF. Selama 4 minggu SSF menapis air kotor dari Sungai Belat, berjaya mengurangkan konsentrasi fizikal parameter setinggi 80% pembuangan, untuk parameter kimia dan juga logam Iron pembuangan sebanyak 11% sehingga 38%. SSF memerlukan penapisan selanjutnya untuk meningkatkan potensi system penapisan SSF.

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Mg/L – milligram per litre

TCU-unit for color

NTU-unit for turbidity

SSF-Slow Sand Filter

TSS-Total Suspended Solid

BOD-Biological Oxygen Demand

COD-Chemical Oxygen Demand

E-coli- Escherichia Coli

pH- measure of the amount of free hydrogen ions concentration in water.

mm-milimeter

cm- Centremetres

µm- Micrometer

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Chapter 1

Introduction

1.1 Background of Study

Untreated water is drinking water that has not been chemically treated, filtered, or boiled to eliminate infectious bacteria, viruses, and parasites. These organisms can cause diarrhea and serious illness. To solve the problem of drinking untreated water, the water treatment is a method to purify the water from dangerous organisms. The most efficient with low cost of water treatment is slow sand filter. However, whilst widely used throughout the world, knowledge about filtration mechanism still remains limited (Ellis 1. K., 1987). For over 150 years, slow sand filters have been an effective means of treating water for control of microbiological contaminants (Gary S. Logsdon).

Slow sand filters do not need constant operator attention, making them an appropriate attention, making them an appropriate technology for water systems that are small or that employ part-time operators (Gary S. Logsdon). Slow sand filter were the first of the modern treatment techniques devised for the purification of portable water (Ellis, 1987). In the portable water industry slow sand filtration is still extensively employed and slow sand

filters are known for their ability to produce consistently a high class filtrate with the minimum of control (Ellis, 1987). In a slow sand filter, the filter bed is constructed of a medium with high surface area which can be colonized by suppressive micro-organisms (water and its impurities article).

Slow sand filtration is a simple technology that has been successfully used for over 200 years in drinking water purification. It is credited as a particle and pathogen filter that combines biological, physical and chemical processes (Obst, 1990). Slow sand filters may be adapted for wastewater disinfection but only a few studies have been conducted on tertiary treatment of wastewater using slow sand filters (Adin, 2003)They showed total coliform bacteria removal of 0.3–3.5 log-units [(Keraita et al.) , fecal coliform removal of 2 log-units (Ellis, 1987) and, *E. coli* reduction of 2.3–3.7 log-units and Enterococci removal of 2.6 log-units (Mälzer, 2005)depending on raw water quality, filter design and hydraulic loading rate.

Main advantages of the slow sand filter are its simplicity and economical construction, operation and maintenance using local materials and skills as well as no requirements for chemicals or energy (Visscher et al., (1987)).The efficiency of slow sand filter depends on the particle size distribution of the sand, ratio of surface area of the filter to depth and the flow rate of water through the filter (water and its impurities article).

1.2 Problem Statement.

Malaysia receives an average annual rainfall of 3 000 mm. Water resources development has been a catalyst for the socio-economic development of the country during the past decades. Dams and kilometers of pipelines and canals divert water from rivers to sustain domestic, industrial and agricultural needs. Lately, the water situation for the country has changed from one of relative abundance to one of scarcity (repository).

Population on growth, urbanization, industrialization and the expansion of irrigated agriculture are imposing rapidly growing demands and pressures on the water resources, besides contributing to the rising water pollution. Water management is becoming increasingly comprehensive and complicated due to large concentrations of population, commercial activities and industries around the cities and towns, increasing water consumption, increasing water pollution, increasing land use conflicts and climate changes. At the same time, any new development of water resources to meet the ever-increasing demand faces rigorous scrutiny from environmentalists and conservationists (repository).

On 23rd October 2008, the star, news to us about water shortage crisis looms over Malaysia. It is said that the country's per capita renewable water was about 5,000 cubic metres. This problem was attributed to unsustainable management of water resources rather than to the quality of water available for domestic, industrial and agricultural uses. Datuk Douglas Unggah Embas said a recent study indicated that only 40 percent of the country's lakes and reservoirs were in good condition.

Water pollution is a serious problem in Malaysia and impacts negatively on the sustainability of water resources. It reduces total water availability considerably as the cost of treating polluted waters is too high and in some instances, polluted waters are not

treatable for consumption. I proposed that river water treatment seems to be beneficial method for minimizing water scarcity in Malaysia.

1.3 Objectives of study

The aim of this study is to made river water as a safe drinking water resources with water treatment of slow sand filter. These aims can be achieved with the following objectives:

i. To review the effectiveness of slow sand filter

ii. To identify the quality of river water as a drinking water as an alternative source that refers to drinking water quality standard 2009.

1.4 Scope of Study

The scope of study that in this study is:

i. The area of case study at River Belat, where the samples located.

ii. The effectiveness of slow sand filter to filter river water and turn the water safeness to a drinking source.

1.5 Significant of Study

The treatment of river water can use to determine efficiency by using slow sand filter from this study. This investigation is essential as it gives the efficiency of using slow sand filter as a method of water treatment. It is also crucial for the future to promote proper water treatment process with low cost of investment.

1.6 Expected Result.

i. Effectiveness of slow sand filtration can be determined

ii. Analysis of result before and after filtration shows decreases of amount dangerous parameters in water.

iii. The water that had been filtered expected to be safe for drinking purpose.

Chapter 2

Literature Review

2.1 Introduction

Man cannot survive without water. Water is the universal solvent. In nature, it is never totally pure. No matter how isolated it is from sources of contamination, it will always have some chemicals. Gases or minerals in the air, soil or rock are dissolved by the water. Human can cause contamination through the improper use of pesticides or fertilizers and through the disposal of waste. These impurities can dissolve in the water, causing it to be contaminated. Construction areas also have substantial exposed surfaces that erode in the right conditions. Runoff from these sites carries sediment into drainage networks and then to ecosystem downstream (river, lakes etc). There are many examples of poor pollution control that leading to increased water pollution, reduced quality in downstream waters. There are many ways in which pollution can be managed to reduce unqualified water.

In early days, these types of surface water and groundwater were consumed by human beings for bathing, drinking, washing, etc. Those days, man did not have technical knowledge for purifying contaminated water. As a result, man had to suffer water-borne diseases like dysentery, cholera, etc. With the growth of civilization and development of towns and cities, man began to think over the issues of pure water for drinking, safely of life and healthy environment. Though absolute pure water

cannot be available, but it should contain the least amount of impurities which may not be harmful to human health.

2.2 River water

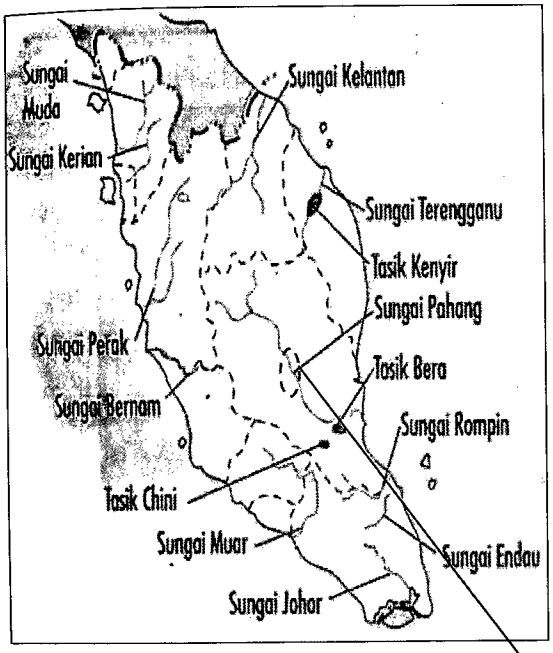

Figure 2.1 rivers in Malaysia

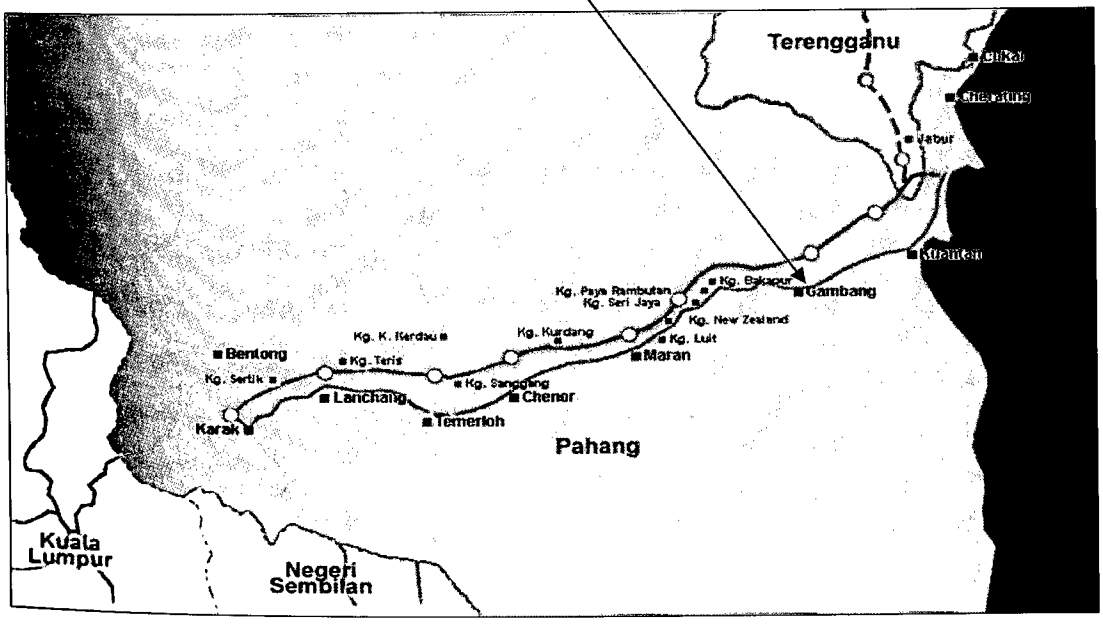

Figure 2.2 scope area of research is Sungai Gambang

River is a large natural stream of water emptying into an ocean, lake, or other body of water and usually fed along its course by converging tributaries. Rivers are of immense importance geologically, biologically, historically and culturally. Although they contain only about 0.0001% of the total amount of water in the world at any given time, rivers are vital carriers of water and nutrients to areas all around the earth. They are critical components of the hydrological cycle, acting as drainage channels for surface water – the world's rivers drain nearly 75% of the earth's land surface (Paul D. N. Hebert, 2009).

They provide habitat, nourishment and means of transport to countless organisms; their powerful forces create majestic scenery; they provide travel routes for exploration, commerce and recreation; they leave valuable deposits of sediments, such as sand and gravel; they form vast floodplains where many of our cities are built; and their power provides much of the electrical energy we use in our everyday lives. Rivers are central to many of the environmental issues that concern society, and they are studied by a wide range of specialists including hydrologists, engineers, ecologists and geomorphologists (Paul D. N. Hebert, 2009).

2.3 Pollution of river water

Pollution is when water, air or land becomes very dirty. Pollution can come in 4 different types effecting different types of areas in the world that are air pollution, water pollution, land pollution and also noise pollution. We all contribute to pollution in some way or another. Whether it is with a large amount or small amount, it can still cause major damage to our health and the environment. However, only a minority of people who realize how much pollution can cause damage on us. Pollution is gradually destroying our planet and also killing us too. Water pollution

affects the water and marine life. However, it doesn't end just like that. It will be like a chain virus when people use the polluted water, eat the polluted water animals, and then starting to give birth to unhealthy children due to polluted water used. This is only a small scope of how danger and how much harm can water pollution cause us. In this topic, we will discuss only about water pollution, or more specifically; river pollution due to domestic effluent.

River pollution can be caused by several effluents and their effects are of great concern to health. Disposal of waste water generated from municipal and industrial sources with little or no treatment prior to discharge is a common practice in many developing countries including Malaysia. This practice has been continuing over the history of civilization and as a result of population growth and increasing industrialization, serious problem of the water quality are common place. Rivers play a major role in assimilating or carrying off industrial and municipal wastewater, manure discharges and runoff from agricultural fields, roadways and streets, which are responsible for river pollution (Ward and Elliot, 1995).

Peninsular Malaysia has been categorized as very polluted. Until 1999, there were about 13 polluted tributaries all over Malaysia with 36 polluted rivers due to human activities such as industry, construction and agriculture at the tributaries (DOE, 1999). In 1990, there were 48 clean rivers compared to only 32 rivers in 1999 that could still be classified as clean (Rosnani Ibrahim, 2001). Basically, the river effluents created from domestic activities such as cooking, washing, and bathing are a major cause of pollution of public waters. It happens everywhere including here in Malaysia. Domestic activities come from 2 types of area. Those are rural and urban. It is a common sense to know that some part of rural area doesn't have the technologies that we call sewerage system, or septic tank, or whatever. So, this is where the pollutions exist that is whatever they do, the wastes will go into the river.