Sink Equipped With Wastewater Filter System

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Abstract
The Sink Wastewater Filter System is designed as an alternative to reduce pollution in drains and domestic sewage lines caused by oil and suspended solids which can harm the environment. As a result of this situation, the channel is often clogged, thus increasing the maintenance cost as well as contributing to mosquito breeding grounds. The product is made of 64cm x 30.5cm x 30.5cm x 30.5cm fiber and comes with filters from natural materials as the main medium i.e. coconut coir, coal, river rock (5mm – 10mm), coarse sand (0.45mm) and *fibre* sponge. Researchers develop a disposable and recyclable filter system. The sample of restaurant sink wastewater is tested for pH, BOD, COD, TSS and Oil & Grease before and after being filtered and compared with *the Standard Environmental Quality Act 1974 (EQA).* The data obtained show that there is a decrease in the rate of water pollution before and after filtering. The pH value shows a reading of 5.0 (before) and 4.7 (after). The BOD test showed readings of 95mg/L (before) and 68mg/L (after). Both parameters do not comply the EQA standard of 5.5 – 9.0 for pH values and 20mg/L – 50mg/L for BOD. The COD test recorded readings of 184mg/L (before) and 96mg/L (after). The Total Suspended Solid Test (TSS) showed values of 33mg/L (before) and 23mg/L (after). The O&G test showed readings of 15.8mg/L (before) and 9.8mg/L (after). The results showed that the Sink Wastewater Filter System affected several parameters such as COD, TSS, and O&G. However, it was found that the pH and BOD values were decreased but did not meet the requirements of the *Standard Environmental Quality Act 1974 (EQA).* As conclusion, the Sink Wastewater Filter System is significant in reducing the emissions of pollutants before being disposed of into the natural ecosystem of water resources, as well as having a positive impact on individuals and organizations.

Keywords: Toxicity, parameters, environment

1.0 Introduction
Water is a natural resource required for a variety of daily activities as well as economic development. Water resources, including agriculture, industrialization, fisheries, and electricity generation, are critical to human existence and the environment. The primary role of water is to ensure human well-being and the balance of the natural ecosystem. Household activities, improper waste disposal, and insufficient sewage systems significantly contribute to water pollution (Babuji et al., 2023). The discharge of solid waste, including food waste, oil, and grease, into household and restaurant sinks is one of the sources of pollution. According to Marlia et al., (2018), the

breakdown of organic materials produces concentrations of ammonia, nitrogen, and phosphorus as well as an increase in the amount of suspended and dissolved solids in wastewater, which is also referred as wastewater.

The biggest source of pollution in the environment is when wastewater from the sink is drained into the drain and the residues become caught in the channel. The situation becomes more serious if the drain is clogged, which can create an unpleasant odor. This situation causes discomfort to residents due to the bad smell and pollution of drains, which can cause various symptoms of the disease due to the presence of pests such as mosquitoes and flies. Paranagama et al. (2022) wrote that domestic kitchen wastewater has a lot of substances such as organic food scraps from food processing, oil and grease, soap and detergents and other suspended compounds. If wastewater is not properly treated before being drained into the environment, it can pollute the water and generate unpleasant odors, particularly in the absence of an efficient conduction system. As a result, it is critical to cleanse wastewater before it is released into the environment or drainage system to prevent offenses.

Figure 1: Contaminated Drain. (Sources: https:\\www.jkt.kpkt.gov.my)

1.1 Problem Statement

Water pollution from domestic sinks or restaurants is an environmental problem that occurs when water is used to wash dishes or bowls, kitchen utensils, or hand washes containing various chemicals and dense particles (suspended solids), which are then channeled into an open drainage system without undergoing treatment procedures. This study is supported by field observations where most drains are clogged due to waste such as food waste, oil, fats and other materials. All the pollutants coming from this sink wastewater can further increase existing environmental pollution. The amount of discharge of sink wastewater into open sewers or natural drainage (drains and rivers) will further increase the pollution of the community, rural or city disposal system. The impact of water pollution on human health is significant, although there may be regional, age, gender, and other differences in degree. The most common disease caused by water pollution is diarrhea, which is mainly transmitted by enteroviruses in the aquatic environment. (Lin et al., 2022)

Uncontrolled waste disposal is the main source of infectious disease transmission if it is not well managed before being released into the main drainage. These residues clogged drains, which result in stagnant water and become a breeding ground for oyster mosquitoes and Aedes mosquitoes. Furthermore, flies are drawn to unpleasant odour. These mosquitoes and flies cause malaria and dengue disease which are contagious to humans. According to Nur Faeza Abu Kassim (2018), vectors are a mobile intermediary agent, that diverts virus-like pathogens from one host (human or animal) to another. Vectors are a category of insects that includes flies, mosquitoes, bugs, ticks and other pests (Nur Es Naini, 2021). The transfer process is carried out by vectors (mosquitoes and viruses) which may cause various diseases such as African yellow fever and dengue fever as well as mechanically (home flies and bacteria as occurs in the case of diarrhea). Therefore, to minimize the contamination of home sink wastewater, a proactive effort needs to be taken. One of the initial steps that the researchers worked on was the installation of a water filtration system starting from the source of the sink wastewater disposal. This wastewater will be filtered using the "Sink Water Filter System" which is produced from natural materials at an affordable cost.

1.2 Study Background

Researchers have been working hard to develop an innovative tool aimed at cleaning sink wastewater to meet the requirements of the Environmental Quality Act, 1974 *(Environmental Quality Act)* by separating suspended *solids,* oil or grease and certain chemicals before they are drained into a nearby drain or river. This innovative product is named the "Sink Wastewater Filter System" made of *fiber* installed under the sink on the outlet drain. With this filter, it can prevent solid waste and oil or filterable materials from the sink from entering the channel system and forming sludge that can clog it. This filter uses natural ingredients as the main medium such as coconut coir, gravel, fine sand, and fiber sponge which acts as a pollutant waste-absorbing agent.

1.3 Objectives of the Study

The following are some of the objectives that have been set to achieve the goals of the study:

i. Design the Sink Wastewater Filter System using coconut fibre, charcoal, gravel, coarse sand and sponge fibre as medium.
ii. Testing wastewater samples before and after filtration to obtain differences in parameters namely pH, Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS) and Oil & Grease (O&G) and comparing them with values Standard Environmental Quality Act, 1974 (Environmental Quality Act).

2.0 Literature Review

Water pollution affects water's physical, chemical, and biological properties, often resulting from suspended particles, organic waste, and other materials causing turbidity and abnormal color. This should slow down the pace at which sunlight enters the water, which might have an impact on the

photocentrisis of many aquatic plants. The second form of pollution alters the chemical composition of water in the presence of dangerous compounds such as heavy metals, pesticides, organic waste, and nutrients. This can change the pH of water, reduce the quantity of dissolved oxygen, which is critical for diverse aquatic organisms, and raise the concentration of nutrients such as nitrogen and phosphorus. These alterations have a deleterious impact on aquatic life and environmental equilibrium. It also contributes to the rising of water temperature caused by some environmental contamination, such as sewage waste from industries and some chemicals (detergents, etc.).

Temperature increases can disrupt the aquatic life environment, and each living creature has a certain (optimal) temperature range for growth and productivity. While biological changes occur as a result of increased pollution of harmful microorganisms, domestic or industrial waste can also increase the concentration or dispersion of pathogenic bacteria such as E. coli (E. coli), nematode worms, and other microbes in water (Consumerism Competition Blog in conjunction with Malaysia Consumer Day, 2016). This can increase the danger of disease transmission through water to humans and animals who rely on water supplies for survival and reproduction. Water pollution is a serious hazard to both the aquatic ecology and human health. Thus, the planned and scheduled processing or procedure of sewage treatment is critical to assure water quality safety and promote sustainable living.

2.1 Previous Studies

Among the previous studies that inspired this project was a study from Junaidi Osmaz (2013). The Environmental *Friendly Compact Sink Filter System (EFCSFS) innovation product* has won the *Gold Medal* award at the *Asean Invention, Innovation and Design* Competition. The purpose of the production of the EFCSFS project is to address the problem of pollution, especially those that occur in the drains as well as to prevent the flow of pollution from entering the river. The EFCSFS project is said to be a solution to the problem of water pollution as well as to restore cleanliness, clarity, and reduction of water resources. This project is environmentally friendly where hazardous materials and oil waste in the sewage fluid will be screened first before the treated water is drained out, thus avoiding blockages and oil contamination in the designed drain.

2.2 Wastewater Quality Parameters

There are various measurable parameters to determine the quality of wastewater according to the requirements of the Environmental Quality Act, 1974 as shown in table 1. This standard is designed to address issues related to the quality of wastewater released into natural irrigation systems.

Table 1: Environmental Quality Act, 1974

Parameter	Units	Standard	
		A	B
Temperature	C	40	40
PH value	-	6.0	5.5 - 9.0

BOD5 at 20C	mg/L	20	50
COD	mg/L	50	100
Suspended Solids	mg/L	50	100
Mercuri	mg/L	0.005	0.05
Cadmium	mg/L	0.01	0.02
Chromium, Hexavalent	mg/L	0.05	0.10
Arsenic	mg/L	0.05	0.10
Cyanide	mg/L	0.05	0.10
Leads	mg/L	0.10	0.5
Chromium, Trivalent	mg/L	0.20	1.0
Copper	mg/L	0.20	1.0
Manganese	mg/L	0.20	1.0
Nickel	mg/L	0.20	1.0
Tin	mg/L	0.20	1.0
Zinc	mg/L	1.0	4.0
Boron	mg/L	1.0	4.0
Iron (Fe)	mg/L	1.0	4.0
Phenol	mg/L	0.001	1.0
Free Chlorine	mg/L	1.0	2.0
Sulfide	mg/L	0.50	0.5
Oil and Grease	mg/L	Undetectable	10.0

Source: Environmental Quality Act 1974_Indah Water Effluent Standard

Wastewater samples flowing into the river must meet the standards set by the Environmental Quality Act 1974. Waste discharged upstream must meet standard A, while waste discharged downstream must meet the requirements of standard B.

2.3 Determination of Wastewater Parameters

Wastewater from the sink must be tested for its hygienic quality before draining into drain or river drain. This should be emphasized in to ensure health and reduce environmental pollution. The following is a description of each of the wastewater quality parameters tested:

i. PH value

The pH test aims to measure the concentration of hydrogen ions (H^+) in water. In addition, pH is used to assess the increase in acidity in water content. A pH value of 7.0 is considered a neutral or alkaline value. If the pH value is lower, then the concentration of hydrogen ions (H^+) is getting higher and the acidity in the water is increasing (Caenn R. at al., 2011).

ii. Biochemical Oxygen Demand (BOD)

BOD refers to the amount of oxygen aerobic biological organisms require to

decipher organic cells in water samples at a given temperature. The greater the concentration of organic contaminants in the water, the greater the demand for bacterial oxygen (Metcalf & Eddy 2003).

iii. Chemical Oxygen Demand (COD)

COD refers to the demand for chemical oxygen to measure the amount of dissolved oxygen needed to decompose organic cells and oxidize inorganic chemicals such as ammonia and nitrites. COD measurements are generally carried out on wastewater or water samples contaminated by domestic or industrial waste (Sawyer et al.1995; Metcalf & Eddy 2003; Nayan et al. 2009).

iv. Total suspended solids (TSS)

TSS refers to the abundance of suspended solids content that is not soluble in water samples tested and analyzed using filtration devices. Measurements of this parameter are used to determine the quality of samples from different types of water such as seawater or wastewater. The more suspended solids content, the water quality deteriorates (Department of Irrigation and Drainage Malaysia, 2009).

v. Oil & Grease (O&G)

Oils and greases including fats, oils, waxes and other related constituents are found in water, generally wastewater. If these compounds are not eliminated before the discharge of wastewater, oil and grease can interfere with biological life on the surface of the water (Caltest Analytical Laboratory, n.d).

3.0 Method Research

All planning and procedures will be described in detail to clarify the planning and implementation of the study. This methodology includes sample selection, design, production techniques and analysis to be used to achieve the objectives of the study. In addition, planning must be on track *(plan your work, work your plan) to* reduce risks during innovation production. Figure 2 below shows the flowchart of the study process conducted according to the following steps:

Figure 2: Flowchart of the Study Process conducted

3.1: Design of Sink Waste Water Filter System

Objective 1: Design the Sink Wastewater Filter System coconut fibre,

charcoal,gravel, coarse sand and sponge fibre as medium.

For this study, a rectangular filter was designed using fiber material with dimension as shown in Figure 3. The arrangement of the filter as follows:

First layer = Coconut fiber
Second layer = Charcoal
Third layer = Gravel
Fourth layer = Coarse Sand
Fifth layer = Sponge fiber

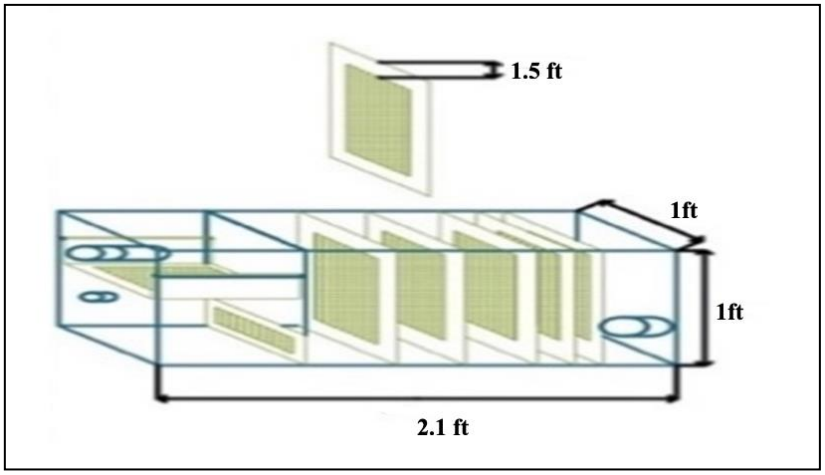

Figure 3: Dimension of the Sink Wastewater Filter System

3.2 Material Selection

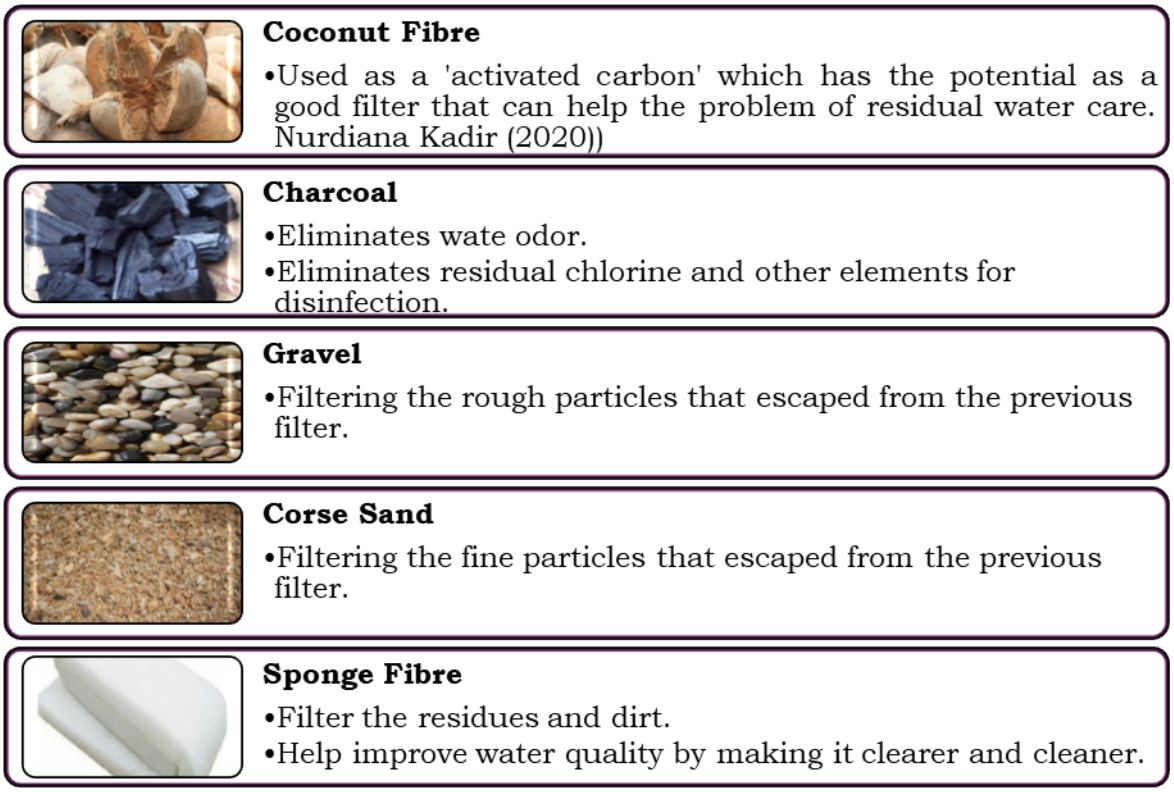

Figure 4: Arrangement of filter materials

Figure 4 above shows the arrangement of natural materials used for wastewater treatment filters. The choice of certain materials or media is an important factor in the production of quality products. Preliminary studies and field tests have been carried out to select and determine the specifications of the material suitable for the manufacture of the filter to assess the effectiveness of the material. Several natural ingredients have been identified as capable of treating wastewater such as sponges from cotton, banana sticks, coconut coir and charcoal.

Objective 2: Test wastewater samples (restaurant sink samples) before and after filtration to obtain differences in parameters namely pH, Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS) and Oil & Grease (O&G) and compare with the values of the Environmental Quality Act Standards, 1974 *(Environmental Quality Act).*

The analysis data obtained from Table 2 below shows the differences in sink wastewater samples in the restaurant for each parameter before and after the filtration process using the "Sink Wastewater Filter System" and compared with the Environmental Quality Act, 1974 *(Environmental Quality Act)* to assess the quality standards of wastewater after filtering. The results showed a significant decrease in each parameter before and after using the Sink Wastewater Filter System.

4.0 Results and Discussion

Table 2: Test Results on Wastewater Samples Based on Environmental

Quality Act (1974)

No	Parameter	Samples Before Treatment	Samples After Treatment	Decrease Differences	Standard
1.	Ph	5.0	4.7	0.3	-
2.	Biochemical Oxygen Demand (mg/L)	95	68	27	-
3.	Chemical Oxygen Demand (mg/L)	184	96	88	100 (B)
4.	Total Suspended Solid (mg/L)	33	23	10	50 (A)
5.	Oil & Grease (mg/L)	15.8	9.8	1.8	(B)

i. PH value

Table 2 above, shows that the result of the pH parameter test for the sink wastewater before the filtration process was 5.0 and there was a decrease of 4.7 after the filtration process. This suggests that the filter material used can influence the reduction of the pH value reading due to a decrease of 0.3. The pH parameter readings obtained in this trial did not meet the requirements of the permitted Environmental Quality Act Standard 6.0 (Standard A) and the range between 5.5 – 9.0 (Standard B). This wastewater needs to be given follow-up treatment before it can be released into natural habitats (rivers, ditches and so on).

ii. Biochemical Oxygen Demand (BOD)

The reading of the BOD parameter experiment recorded a decrease from 95mg/L to 68mg/L after going through the filtering process. From this data, the filter material used can lower the BOD parameter reading in the water sample by 27mg/L. Despite the reduction in BOD readings, it still does not meet the requirements of the permitted Environmental Quality Act Standard of 20mg/L (Standard A) and 50mg/L (Standard B). These wastewater samples need to undergo treatment process before being drained into a drain or river.

iii. Chemical Oxygen Demand (COD)

The reading value of the COD experiment from table 2 showed a significant decrease in water sample parameters of 88mg/L. The reading value before filtration was 184mg/L and there was a decrease to 96mg/L after undergoing the filtration process. Referring to the data obtained, it was found that the selection of filter material can reduce the reading value of the COD on the wastewater sample. The COD reading value meets the requirements of the permissible Environmental Quality Act Standard of 100 mg/L (Standard B).

iv. Total Suspended Solid (TSS)

The initial reading of the TSS parameter before filtration is 33mg/L and after the filtration process is 23mg/L. Despite the slight decrease of 10mg/L, the value obtained meets the requirements of the permissible Environmental Quality Act Standard of 50mg/L for Standard B.

v. Oil & Grease (O&G)

The Oil and Grease (O&G) result showed that a filtering process effectively reduced oil and grease levels in effluent. The initial concentration was 15.8 mg/L, but it dropped to 9.8 mg/L after refining. The filter medium alone reduced oil and grease levels by 1.8 mg/L, meeting Environmental Quality Act Standard B. This compliance ensures the quality of treated wastewater and supports sustainable water management practices.

5.0 Conclusion

As a responsible society, it is important to preserve the cleanliness of the environment to create a harmonious and healthy atmosphere. In this effort, researchers have produced the Sink Wastewater Filter System as a solution to the frequent water pollution problem in our country due to the lack of human awareness. This product also helps to reduce water pollution that often occurs unnoticed. Sink Wastewater Filter System products are manufactured using natural materials as the main medium can devalue water quality parameters. However, there should be a review of the selection of filter materials and their quantity as they can have a positive impact on three parameters, namely COD, TSS, and O&G that meet the requirements of the Environmental Quality Act Standards. However, two trial results for pH and BOD assessments did not meet the standards set by the Environmental Quality Act Standards. By optimize the layering of the filter medium could be the solution to solve the problem of the pH and BOD that do not meet the requirement. In conclusion, the use of the Sink Wastewater Filter System is significant in use as it can lower the presence of certain parameters and help lower the emission level of pollutants before the water is released back into the natural ecosystem as a water source.

5.1 Impact

The innovative products produced have an impact on people, organizations and the environment. Among them are:

i. Environmental

The filtered wastewater will flow down the drain and into the nearby river. With the existence of a wastewater filter system, it can help reduce pollution and treat water before it is released into the river as well as save the environmental ecosystem from the negative effects of pollution.

ii. Industry or residential homes

The use of the Sink Wastewater Filter System in eateries or restaurants can prevent drain pollution and clogged domestic sewage lines due to suspended solid waste and oil. This can prevent the breeding of pests such as rats, cockroaches and mosquitoes which can damage the reputation of the restaurant as well as prevent the restaurant from the risk of being seized and subject to legal action by the Ministry of Health (MOH).

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Author Contributions
Hamidah Z.: Design and drawing, fieldwork & data collection, Testing, Data Analysis, Writing and Editing; **Mohd Yuzha U.:** Fieldwork & Data Collection, Testing, Methodology; **Che Din I.:** Fieldwork & Data Collection. **Rahayu M. A.:** Writing Reviewer.

Conflict of Interest
The manuscript has never been published in any place and it is not under the consideration of other journals. All authors confirm the review and agree to its submission and declare no conflict of interest involved in this manuscript.

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