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Original Research Article

Study Using Natural Ingredients in Polluted Water Filtration in the prototype SPL Up flow

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Abstract: The research objective was to determine the effectiveness of the use of natural materials as filter and effectiveness of the thickness of the filter in the filtration of water contaminated with upflow SPL prototype equipment based on the parameters of physics, chemistry and microbiology. This study is an experiment that is descriptive. Analysis of the data referring to the parameters of physics, chemistry and microbiology as many as eight parameters, physical parameters: TDS, TSS and turbidity, chemical parameters: BOD, COD, DO and pH, microbiological parameters: total coliforms. Sugiarto data analysis using the formula to calculate the effectiveness of filtration based on the type of filter (Ef) and the thickness of the filter (EKF) and the average formula. Results of the study the effectiveness of this type of filter for physical parameters: TDS and TSS turbidity more effectively with sand filters that average percentage is respectively 40.50%, 36.34% and 48.82%; for chemical parameters (BOD, COD and DO) turned out to use sand filters are also more effective with a percentage of 42.11%, 41.52% and 8.89%, except for the parameters pH where the use of charcoal filters slightly more effective with only 6.48 percentage %; for microbiological parameters (Total Coliform) turned out to be the use of filter fiber / fibers more effectively with the percentage of 40.16%. While based on the effectiveness of the thickness of the filter for physical parameters (TDS and TSS) more effective use of filter sand with a percentage of 17.11% and 25.00%, except for turbidity where the use of a charcoal filter is more effective with a percentage of 32.38%; for chemical parameters (BOD and COD) appeared more effective use charcoal filters with a percentage respectively 12.35% and 11.52%, whereas the DO and pH parameters that slightly more effective use of sand with a percentage of 8.61% respectively and 1.00%; for microbiological parameters (Total Coliform) proved more effective use of filter sand with a percentage of 39.06%. Results of this study suggest the use upflow SPL prototype equipment which utilizes natural ingredients for household scale in both urban and rural.
Keywords: Study Natural Ingredients, Polluted Water Filtration, prototype SPL Upflow.

INTRODUCTION

Clean water is one of the important components for the needs of human life. Clean water is used for drinking, cooking, bathing and washing. Water demand in humans is important because the human body consists of 65% water, if someone loses water as much as 12% of his body, then the question will die from dehydration. If no human food was still able to survive for 81 days without water, while if the man is only able to survive for 10 days [1].

In Indonesia, for the needs of the population in rural households need water as much as 60-100 liters / day / soul, while the urban population use water even more, i.e. 100 s / d 150 liters / day / person. (Kimpraswil, 2003, in Ardiansyah) [2]. Along with population growth, the gods into account the needs of water were only increasing.

Meeting the needs of today's clean water has begun to decrease, due to a decrease in the quality and quantity of water in the environment. Water quality degradation can be caused by water pollution. Consequences caused by water pollution become a big problem. The direct impact of water pollution is the degradation of water, whether groundwater, river water, and seawater [3].

According to Johnstone and Wood in Mungkasa [4] that people who cannot access clean water must bear the consequences of the high costs and water consumption decreased. As a result, for the people who do not have access to clean water will spend about 10-40% of their income or perhaps 10-100 times the price of an average air fare. Thus the need for clean water will be expensive.

Impact rather than high costs, long distances and a long time to get clean water makes people cannot meet the needs of clean water standards, which continues in a loss of revenue due to reduced productivity and increased health care costs. With no access to clean water direct or indirect effect on income and health because many people are affected by the disease (Johnstone and Wood in Mungkasa) [4].

While the technology for water treatment that is now very diverse, from the simple to the use of advanced technology, from cheap to expensive costs. To take advantage of the technology of processing raw water into clean water, obviously require a fee. However, there is several alternative water treatments traditionally simple and usable.

To get clean water, raw water that comes from the earth's surface (ground water, river water, lake water, and the like) are considered to have been contaminated, generally undergo processing through physical, chemical and biological. The third processing method can be applied individually or in combination.

One water treatment techniques are already quite long known and still widely used today is the slow sand filter (SPL). Since the 1800s slow sand filter has long been known in Europe. Slow sand filter was first created by John Gibb in Paisley Scotland in 1804 in a small scale. Then in 1829 James Simpson made a slow sand filter on a large scale for Chelsea in the English water company [5].

At SPL water flows from the fine sand layer at the top towards the layer of coarse sand on the bottom and then into the gravel at the bottom. Problems often occur in the SPL is due to frequent occurrence of deadlock due to the high turbidity of raw water in the upper layer, resulting in the top layer must be dredged or cleared. This can be overcome with a modified design of the SPL Up flow filtration with flow from bottom to top [6].

In everyday life quite a lot of material that can be used as filters infiltration of polluted water, including sand, coconut fiber, palm fiber, gravel, charcoal, red brick rubble, rice husks and seeds of Moringa.

RESEARCH METHODS

a. Research methods

This study is an experimental research that is descriptive.

b. Place and Time Research

This research was conducted at the Laboratory of Environmental Physics Department of Physics, State UNIMA, and the installation of SPL Up flow prototype equipment for the filtration of polluted water that uses natural ingredients filter. The research was conducted in January through March 2014, starting from the manufacture of prototype tools SPL Up flow, providing materials that will be used as a filter, testing equipment and sampling studies.

c. Materials and tools

This study uses a prototype tool with meman-SPL Up flow filter advantage of natural materials. What is meant by natural materials are materials obtained directly from nature in which the activities of citizens occur. Natural materials are used as a filter for this study is limited to the material fibers, coconut fiber, sand, gravel and charcoal.

While the equipment used include: Up flow SPL prototype equipment for the filtration of polluted water as shown below, gallons of water reservoirs, bottles for testing samples of water (aqua 1.5 liter bottles and special bottles of 150 ml), pH meter, thermometer, secchi disk, Kemmerer water sampler and water quality checker.

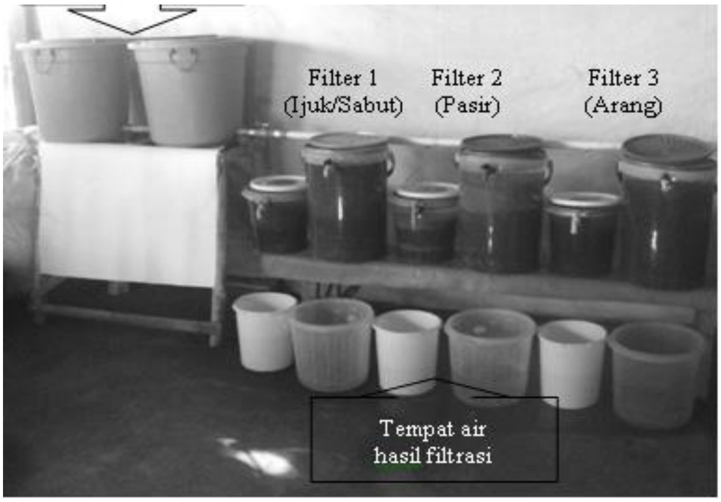

Fig- 1: Prototype equipment SPL Up flow

Equipment used to test samples of polluted water and water sample results and the filtration materials used in this study can be seen in the following table1.

Tabel-1: Parameters, Methods and Tools in Water Quality Analysis

Parameter	Unit	Analytical methods	Equipment
I. Physics			
1. TSS	mg/L	Gravimetric	analytical balance
2. TDS	mg/l	Gravimetric	analytical balance
3. Turbidity	NTU	Turbidimetric	Turbid meter
II. Kimia			
4. Ph	-	Potentiometer	Ph Meter
5. DO	Mg/L	Titimetrik winkler	DO Meter
6. BOD	Mg/L	Titimetric	titration equipment
7. COD	Mg/L	Spectrophotometric	Spectrophotometer
III. Microbiology 8. Total coliform	MPN/100 Ml	Metode MPN	Table MPN, Filter

In this study is limited to eight parameters of physics, chemistry and microbiology, namely: three physical parameters: 1) TDS (Total Dissolved Solid) or TSS, 2) TSS (Total Suspended Solid) or total suspended solids, and 3) Turbidity; four chemical parameters: 4) BOD (Biological Oxygent Demand) or biological oxygen demand, 5) COD (Chemical Oxygent Demand) or Needs Chemical Oxygen, 6) DO (Dissolved Oxygent) or Dissolved Oxygen and 7) pH) and the microbiological parameters: 8) Total Coliform.

Procedure

1. Prior to this research, the materials to be used as fibers, coir, sand, gravel and charcoal that is cleaned and dried in the sun to dry. This meant that the materials are sterile. Then the materials included on prototype equipment SPL up flow according Figure 4. The procedures for making prototype equipment SPL up flow in detail in the appendix.
2. Equipment is set up for all the inlet water flow to each filter as large (in this case is set at 2 liters / hour or 33 ml / min).
3. After that, the source of water that had been collected from a location that is considered to be contaminated coded L1 (source water from the river mouth Remboken), put in a gallon-gallon reservoir and taken to the location where the installation of prototype up flow SPL.
4. In the area of gallon-gallon water is put in shelter on prototype equipment SPL up flow. Then stop tap is opened to drain water into the equipment consisting of filter 1 (fiber / fibers), filter 2 (sand) and the filter 3 (Charcoal) for the equipment K1 = 20 cm thickness or K2 = 40 cm.
5. After a certain period (while noting the flow of water that comes out of each outlet filter), then take a sample of water has passed through the filter to be tested in the laboratory and which does not pass through the filter. Further water samples for filter 1, 2 and 3, the water samples were coded: L1K1F1, L1K1F2 and L1K1F3 for the first filter with a thickness of 20 cm, and the code: L1K2F1, L1K2F2 and L1K2F3 to filter the second thickness of 40 cm. For water samples taken does not pass through the filter coded: L1K1F0 = L1K2F0.
6. Water samples were taken to the Lab Accredited (Lab BTKL) for the examination of water quality in accordance with the parameters set.
7. Further to the next data collection, sources of polluted water coming from the second location coded L2 (taken from the drains at the edge Roong village near the rice fields). Perform step three until the sixth by using water sources contaminated from L2, in order to obtain a water sample code: L2K1F1, L2K1F2 and L2K1F3 to the thickness of K1 = 20 cm and a water sample code: L2K2F1, L2K2F2 and L2K2F3 to the thickness K2 = 40 cm, and water samples taken not pass through the filter coded: L2K1F0 = L2K2F0.
8. After the results of lab testing are complete, the data analysis will be done in accordance with the parameters set.

Data analysis

To calculate the filtration effectiveness of every ingredient in every parameter used formula:

$$E_f = \frac{K_0 - K_x}{K_0} \times 100\ \%$$

(Sugiarto in Devi et al) [7].

Ef = Effectiveness filtration of each filter type (%)
Ko = water quality data samples initially were without filtration
Kx = water quality data samples after filtration

To calculate the effectiveness of the filtration filter thickness of each material at each parameter used formula:

$$E_{kf} = \frac{K_2 - K_1}{K_2} \times 100\ \%$$

(Sugiarto in Devi et al) [7}

Ekf = Effectiveness Filter Thickness (%)
K1 = Data water quality samples after filtration on filter thickness of 20 cm
K2 = Data water quality samples after filtration on filter thickness of 40 cm

To determine the effectiveness of the filtration better than the third filter installed on prototype equipment SPL up flow in every parameter, used the formula the average effectiveness of filtration in each filter, namely:

$$\overline{E}_f = \sum_{1}^{n} \frac{E_{f\,i}}{n}$$

$\overline{E}_f$ = Average effectiveness of filtration for each filter (%)
Ef_i = Effectiveness of filtration ef i = i-th (%)
N = number of samples

RESULTS AND DISCUSSION

Table 2: Average Effectiveness Type Filter (Parameter Physics)

Parameter	Average Effectiveness Type Filter ($\overline{E}_f$)		
	F1 (Fiber/Ijuk)	F2 (Sand)	F3 (Charcoal)
TDS	12,35%	40,50%	10,67%
TSS	14,67%	36,34%	13,61%
Turbidity	45,29%	48,82%	42,85%

For physical parameters obtained percentage of the average effectiveness of the type of filter to filter F2 (Sand) is greater than the percentage of the average effectiveness of this type of filter than the filter F1 (Belt / Ijuk) and the filter F3 (Charcoal), namely: parameter TDS (f = 40, 50%), TSS (f = 36.34%) and turbidity (f = 48.82%).

Table 3: Average Effectiveness Type Filter (Parameter Chemistry)

Parameter	Average Effectiveness Type Filter ($\overline{E}_f$)		
	F1 (Fiber/Ijuk)	F2 (Sand)	F3 (Charcoal)
BOD	26,28%	42,11%	14,12%
COD	27,63%	41,52%	15,12%
DO	5,89%	8,89%	4,23%
pH	1,55%	3,75%	6,48%

For chemical parameters obtained percentage of the average effectiveness of the type of filter to filter F2 (Sand) was greater than the percentage of the average effectiveness of this type of filter in the filter F1 (Belt / Ijuk) and the filter F3 (Charcoal), namely: the parameter BOD (f = 42.11%), COD (f = 41.52%) and DO (F = 8.89%). Unless the parameters of pH, where the average percentage of the effectiveness of filtration types of filter F3 (Charcoal) larger namely: pH (f = 6.48%), while the filter F2 (sand) only f = 3.75%.

Table 4: Average Effectiveness Type Filter (Parameter Microbiology)

Parameter	Average Effectiveness Type filter ($\overline{E}_f$)		
	F1 (Fiber/Ijuk)	F2 (Sand)	F3 (Charcoal)
Tot. Coliform	40,16%	0,00%	0,00%

For microbiological parameters obtained an average percentage of effectiveness of the type of filter for F1 (Belt / Ijuk) is greater than the average percentage of the effectiveness of this type of filter in filter F2 (sand) and the filter F3 (Charcoal), namely: Tot parameter. Coli (f = 40.16%).

CONCLUSIONS

From these results it can be concluded that the use of natural materials in the filtration of polluted water in the SPL prototype up flow filter that compares the effectiveness of the fiber / fibers, sand and charcoal, then:

1. Based on the effectiveness of the filter types for physical and chemical parameters, use sand filters are more effective than the use of filter

fiber / fibers and sand, for more effective microbiological parameters using the filter fiber / fibers.

2. Based on the thickness of the effectiveness of the filter, for physical and chemical parameters, filter more effectively distributed on the sand and charcoal filters, for more effective microbiological parameters using filter sand.

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