The Effect of Composition Sequence on a Filter toward the Acidity Level in Greywater

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***Abstract*—The aim of this research is to identify the effect of greywater filter composition sequence toward the water acidity level (PH). This research includes the production of greywater filter tools and water laboratory testing. Waste water from households were used as water samples. The samples were tested twice using PH meter tool which used water before and after filtration. The materials of filter are of sand, gravel, palm fiber and charcoal with the thickness of each layer which is 5 cm. The result indicate that: (1)the different sequences of greywater filter composition result different water's acidity level (PH), (2) The optimum composition which produce the lowest PH level has the arrangement of gravel, sand, palm fiber, and charcoal, sequentially. As an addition the composition sequence which produces the highest PH level has the sequential arrangement of sand, charcoal, palm fiber, and gravel.**

Keywords*—Greywater, Greywater filter, Acidity level (PH)

I. Introduction

The demand of clean water is increasing day by day due to the growth of industrialization, population explosion, climate change and indiscriminate exploitation of water resources. This demand poses a great challenge invoking the search of strategies for sustainable use of water, which calls for the use of rainwater, greywater and various other type wastewater [1]. A pragmatic alternative to meet the water needs for agriculture, specifically for irrigation is needed due to the shortage of clean water supplies, therefore it is crucial to improve water productivity and develop good water management policies producing improvement in water productivity and develop good water management policies. The greywater reuse is in many sectors, including industrial and households may reduce the usage of potable water by up to 50%. Reusing water from households usually involves the treatment and disinfection of water source before reusing it for applications such as toilet flushing and irrigation. The need for water consumption for irrigation usually increases 40-60% in the dry season. Reusing greywater also reduces sewage generation. It also saves money and increases the effective water supply in regions where irrigation is needed and scarce of water. The reuse of greywater involving sufficient treatment namely filtration, sedimentation, adsorption and disinfection process to prevent bacteria proliferation, minimize health risk and avoid unpleasant odor [2].

II. Literature Review

Wastewater from bathroom sinks, showers, tubs, washing machines, and other household wastewater are called greywater. It also does not have contact with fecal materials and toilet waste, washing diapers, and septic tanks [3]. Normally, it is usually safer to handle and easier to treat and recycle onsite for toilet flushing, landscape or crop irrigation, and other non-potable uses. Greywater is different with from black water in the amount and composition of its chemical and natural contamination. However, the use of non-toxic and low-sodium soap and personal care products is recommended to keep vegetation not get affected when reusing greywater for irrigation purposes [4]. Greywater constitutes about 70% of household water consumption and has lower concentration of organic compounds and fewer pathogens compared to domestic wastewater. As a result, greywater may be treated and reused much easily than composite domestic wastewater for the point of treatment technologies applied and relevant costs [5].

Greywater quality, just as the quantity, is variable from location to location depending upon the sources, personal hygiene habits, and season [6]. According to the regulation of Indonesian Environment Minister No. P68/Menlhk/Sekjen/Kum.1/8/2016 [7], on the requirements of domestic wastewater quality, the good domestic wastewater is water having 6-9 PH level.

The reuse of treated effluents has long been practiced in different countries [8]. In this research, the material used was easy to find. The materials were composed by sand, gravel, palm fiber and charcoal. Sand filters are a natural media that can be used as massive filter for wastewater treatment [9]. Sand has two roles; on the one hand the solid retention and biomass fixation can be developed in granular material and on the other hand biodegradation of organic, phosphorus and nitrogen pollutants [10]. Charcoal contains carbon. Over the recent years, carbons have been widely used as an active support for the treatment of wastewater. This importance comes from the possibility of preparing structural modifications particularly leading to the enhancement of both porosity and specific surface [11].

III. METHODOLOGY

The research materials included of: charcoal, gravel, sand and palm fiber. Sixteen different sequences of filter compositions were prepared from the aforementioned four materials. Each material had 5cm of thickness. PVC pipe in 2 inch diameter with the pipe cap was used as the filter device. The sample in this research was waste water from households. The samples were tested twice using PH meter tool which used water before and after filtration process. The construction of the greywater filter was illustrated in Fig. 1.

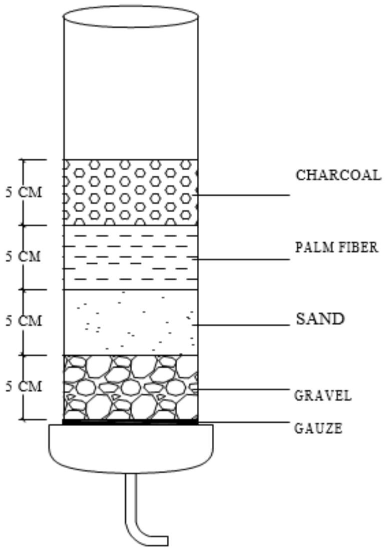

Fig 1. The construction of greywater filter

IV. RESULTS AND ANALYSIS

a. *First trial*

In the first trial of greywater filter production, all materials used were not washed before that were used. Therefore, the water produced from the filtration process was darker than the raw water. The PH level of filtered water did not decrease compared to the previous PH level. Fig. 2 shows one of the result from the first trial.

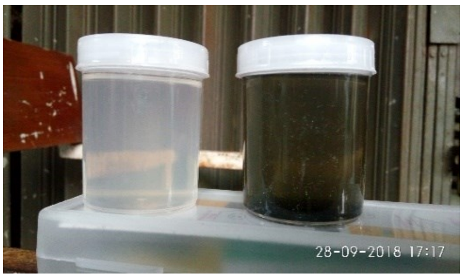

Fig 2. First trial's results

b. *Second trial*

In the second trial, all the materials were washed before used composing the filter. The result of the second trial appears in Fig. 3.

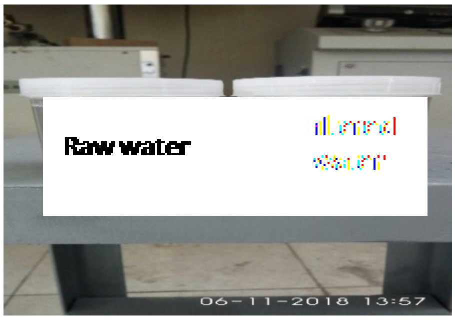

Fig 3. The second trial's results

The summary of the first and second trial is presented in Table I.

TABLE I. ACIDITY TEST RESULT

No	Composition Sequence	Acidity Level (PH)	
		First Test	Second Test
1	Sand Gravel Charcoal Palm fiber	9.50	9.20
2	Sand Gravel Palm fiber Charcoal	9.48	9.10
3	Sand Charcoal Palm fiber Gravel	9.51	9.30
4	Sand Charcoal Gravel Palm fiber	9.28	9.00
5	Charcoal Gravel Palm fiber Sand	9.39	9.20
6	Charcoal Gravel Sand Palm fiber	8.99	9.00
7	Charcoal Sand Palm fiber Gravel	9.34	9.10
8	Charcoal Sand Gravel Palm fiber	9.10	8.90
9	Palm fiber Sand Gravel Charcoal	9.21	9.00
10	Palm fiber Sand Charcoal Gravel	9.35	9.10
11	Palm fiber Gravel Charcoal Sand	9.28	9.00
12	Palm fiber Gravel Sand Charcoal	8.78	8.70
13	Gravel Sand Charcoal Palm fiber	8.73	8.70
14	Gravel Sand Palm fiber Charcoal	8.67	8.60
15	Gravel Charcoal Sand Palm fiber	8.98	8.90
16	Gravel Palm fiber Charcoal Sand	8.71	8.70

After two trials, it was found that the filter materials can reduce the acidity level of waste water and can purify filtered water. In addition, a filter consisting of four materials is proven to be able to reduce acidity in waste water. The treatment system successfully reduced the load of pollution in large extend due to the efficacy of materials. This is reinforced by Sahar [12] who researched on the "Efficiency of Bark, Charcoal, Foam and Sand Filters in Reducing Pollutants from Greywater". It is concluded that charcoal and sand can reduce the acidity of wastewater. Palm fiber is used because it has flexibility and density so it is easy to filter large impurities in the water [13]. In other studies, Bhutiani and Ahamad [14] examined on the "Efficiency Assesment of Sand Intermittent Filtration Technology for Waste Water Treatment". It is reported that filter consisting of sand and gravel can reduce acidity of wastewater by 6,15 %. This treatment study demonstrated that it is potential to employ the low technology of greywater treatment application in small-scale level or household. Hence, in the future, it is expected that water pollution from household waste will decrease and water that has been used can be reused.

V. RESULTS AND CONCLUSION

The different sequences of material composition generate different acidity level (PH).The materials need to be washed before used as filter material in order to avoid the decay of the dirt attached to the filter material into filtered water. The optimum composition sequence which producing the lowest

PH value has the following arrangement of Gravel, Sand, Palm fiber, and Charcoal, while composition sequence which producing the highest PH value has the following arrangement of Sand, Charcoal, Palm fiber, and Gravel.

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