PRODUCTION OF CERAMIC CANDLE WATER FILTERS USING SAW DUST, RICE HUSK AS BURNT OUT MATERIALS

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ABSTRACT: *Water is a commodity that every family needs on a daily basis, but unfortunately most of the sources of water available to people in the developing nations is nothing to write home about as treated water is not easy to come by. There is no doubt therefore that there is an urgent need for small, affordable water treatment facilities that the people can easily access. This study was designed to investigate the effectiveness of rate of flow through ceramic candle filters when locally available raw materials such as hardwood sawdust and rice husk are used as burn out materials components in the production of water ceramic candle filters. Three different water candle filters were produced using Ekulu coal deposit clay as the major raw material. With sawdust in ratio of 2:8 with the clay and rice husk in the ration 2: 8 also as the combustible (burnout) materials. Water flow rate were measured for the ceramic candle filters produced by measuring the volume of filtrate. It was observed that the filter that had sawdust as burntout materials yielded a filtrate of 100ml in 2 hours, 900ml in 6 hours and 1,500ml in 12 hours and the candle filter with rice husk yielded a filtrate volume of 90ml in 2 hours, 120ml in 6 hours and 220ml in 12 hours. The low yield of the candle filter with rice husk was due to the inability of the husk to be burnt off at temperature 900^{0}C and below.*

KEYWORDS: Ceramic Filter, Rice Husk, Saw Dust, Clay, Burnout Material.

INTRODUCTION

The availability of safe, bacteria free water is a global problem, particularly in developing nations. It is estimated that roughly half of the world’s population has limited access to acceptably safe potable water. As an alternative to chlorine treatment and U.V. distillation, a ceramic candle filter system was developed some years ago that, when treated with silver, provided an efficient and inexpensive solution for the supply of safe drinking water. The ceramic filter system has been through several iterations over the years and currently consists of 12 cm in diameter and 12 cm tall filter, filter element that is typically about 27.5 mm thick. This filter element can provide approximately two to three liters per hour of filtered water that is virtually free of E coli and other pathogens.

Ceramic filters are manufactured in a variety of pore sizes. However, it is not a popular method for treating contaminated water at household levels in Uganda. The filters are in different shapes and sizes which include hollow candle like filters, disk filters and pot filters (Matteiletea C, 2006). Good quality filters have micron and submicron ratings (Thomas FC, Brown J, Collin S, Suutura O and Sandary C.C, 2004). The main raw materials for the manufacturing of ceramic filters are clay and burnout materials. According to Mcalister and Hwanga the specifications of such filters include pore size, percolation rate, physical size, manufacturing conditions and

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concentration of colloidal silver percolation rate, physical size, manufacturing conditions and concentration of colloidal silver applied.

Colloidal silver cannot be found by rural people in Uganda; however, its role can be replaced with solar disinfection. Materials for solar disinfection such as black fabrics, corrugated iron and clear plastics are available locally. (Katherine et al, 2008) showed that children in Kenya who put plastic water bottles on their roofs reduced incidences of diarrhea by 26%. The results would have been better if the water was first filtered since solar disinfection may not remove pathogens hidden in the particles.

The (WHO/UNICEF, 2004) has put guidelines for creating sustainable water filters which include the following: limit non-renewable energy consumption, lessen environmental impact, select appropriate materials which are readily available and easy to process, the manufacturing process should not cause harm to individuals and be as simple as possible and should not disregard cultural practices or customs.

Water is used for various purposes which include drinking, recreation, fisheries, personal hygiene, and industrial production and at the same time water is used as a medium for water disposal, a large volume of which is domestic. Domestic waste water contains major contaminants like oxidizable organic matter, suspended materials, solids, combined nitrogen compounds, phosphates and pathogenic organisms (Mujunga, 1999). This calls for deliberate efforts from the side of government, non-governmental organizations, private sector to invest in research and implementation of simple and effective technologies. Ceramic filters is one of such technology since pottery is common practice in many developing countries so little efforts will be required to train the potters. The ceramic filter has been successfully used in removing 99.9% E-coli bacteria under laboratory testing condition (Mcallister S, 2005). This represents high efficiency for possible application.

METHODOLOGY

Methods of Samples Collection

The clay samples used were collected from Ekulu Coal deposit in Enugu, Enugu State of Nigeria. Hard wood sawdust used as one of the burnout material was obtained from timber market, Maryland in Enugu, Enugu State of Nigeria. Rice husk used as one of the burnout material was obtained from a rice mill at Industrial area in Abakaliki, Ebonyi State of Nigeria. The water used was drawn from a underground well dug in a premise located at No 5 Ugwuomu street, off Namchi street, off Rehabilitation road, Emene, Enugu.

Experimental Analysis

Water drawn from the well was filtered through the filtration unit. Four separate test runs were completed as summarized in Table 3.1

The first test consists of candle filter produced from clay and sawdust as burn out material. The second test consists of candle filter produced from clay and rice husk as burn out material. The third test consists of candle filter produced from clay and a combination of sawdust and rice husk as burn out material.

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Table 3.1: Candle filter produced from clay and sawdust

S/NO	TIME INTERVAL	VOLUME OF FILTRATE
1	2 hours	100ml
2	6 hours	900ml
3	12 hours	1,500ml

Table 3. 2 Candle filter produce from clay and rice husk

S/NO	TIME INTERVAL	VOLUME OF FILTRATE
1	2 hours	15ml
2	6 hours	120ml
3	12 hours	220ml

Table 3.3 Candle filter produce from clay and combination of sawdust and rice husk

S/NO	TIME INTERVAL	VOLUME OF FILTRATE
1	2 hours	90ml
2	6 hours	325ml
3	12 hours	800ml

RESULT AND DISCUSSION

RESULT

For each of the candle filters, the flow rate was calculated by dividing the volume of filtrate by the time at which the volumetric measurement was taken (Equation 3.1).

$$Flow\ rate = \frac{Volume\ of\ water\ measured\ at\ time\ T\ (mL)}{Elapsed\ time, T, from\ start\ of\ test\ (hours)} \qquad \ldots\ldots\ldots\ldots\ldots 3.1$$

Shown below on table 4.1 is the result of the flow rates for the candles, where time = the duration of filtration, V1 = volume of water filtered from candle filter 1 (which is the candle filter produced from clay and sawdust), V2 = volume of water filtered from candle filter 2

(Which is the candle filter produced from clay and rice husk) and V3 = volume of water filtered from candle filter 3 (which is the candle filter produced from a mixture of clay, sawdust and rice husk).

Table 4.1

Time(hr)	V1(ml)	V2(ml)	V3(ml)	Q1(ml/hr)	Q2(ml/hr)	Q3(ml/hr)
0.5	0	0	0	0	0	0
2	100	15	90	50	7.5	45
6	900	120	325	150	20	54.17
12	1500	220	800	125	18.3	66.67

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Q1 = flow rate of candle filter 1

Q2 = flow rate of candle filter 2

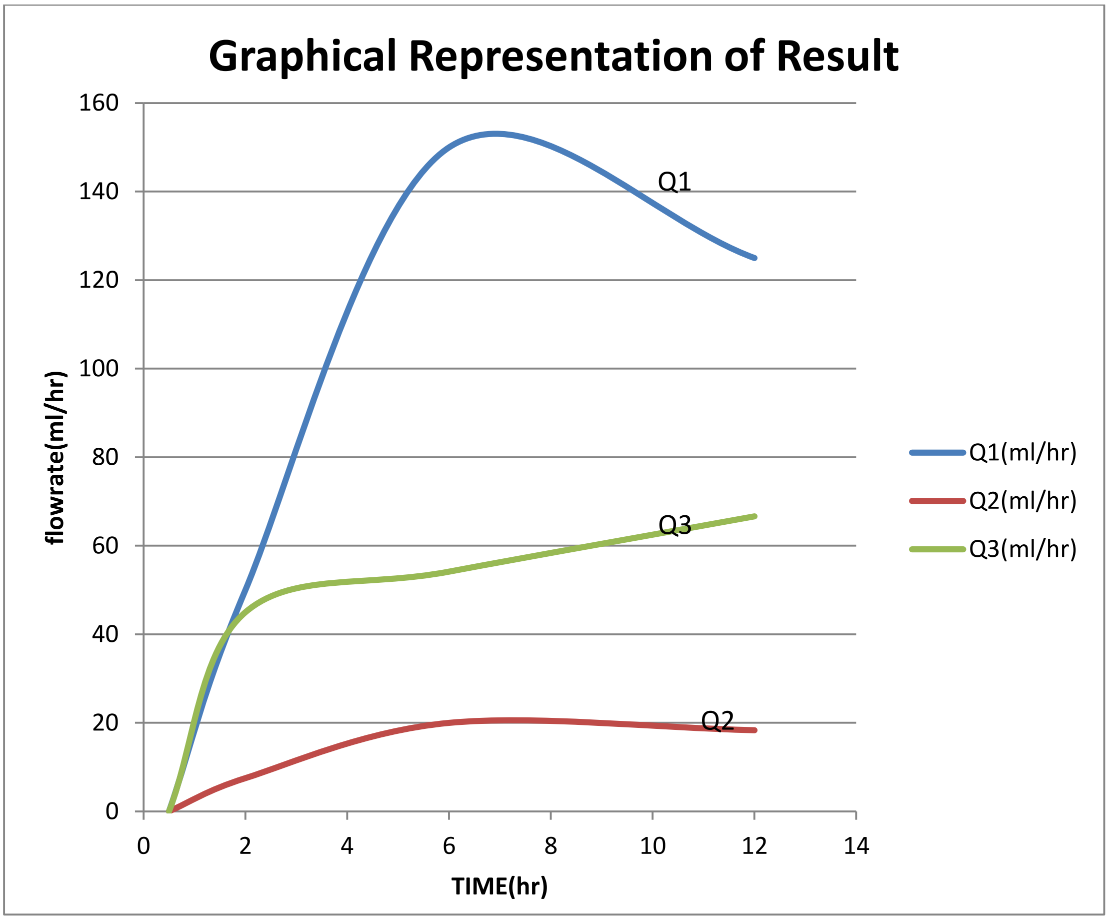

Fig 4.1

DISCUSSION

As can be seen from table 4.1 and figure 4.1 (the graph) the flow rates for filters 1 and 2 were increasing with time until after six (6) hours when it started to decline. The flow rate for the third filter was on the increase continuously but still a small amount of water was filtered out. But the most significant discovery was the great difference in the filtration rate of the candle filter produced with sawdust as against that produced with rice husk.

From the graph, one can deduce that the candle filter produced with sawdust seems to do better with respect to filtration. This can be said to be indicative of the fact that the sawdust was burnt out properly and completely at 900^{o}C more than that of the rice husk. The above then is in agreement with the work by Kaminska and Valuikevicius, in which they stated that other materials burn out at higher temperature than that required for sawdust (wooden dust).

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CONCLUSION AND RECOMMENDATION

Conclusion

The temperature of firing is also a factor which is dependent on the burnt out material being used for the candle filter production. This also can be seen in the higher flow rate displayed by the filter produced with a combination of sawdust and rice husk, which is indicative of the fact that the sawdust burnt out completely at 900^{o}C whereas the rice husk was not completely burnt out, hence, hampering the flow rate of the filter.

Recommendations

It has been recommended that:

1. Government is called upon to sponsor the production of these filters as the raw materials are locally available and with little or no cost.

2. In the event of production of candle filters using other burnt out materials other than sawdust, the reader is advised to use temperatures ranging from 1000^{o}C to 1200^{o}C in other to improve on the filtration rate of the filters. And also taking cognizance of the melting properties of the clay at temperatures above 900^{0}C.

REFERENCES

Hwang R. E. (2003). "Six Month Field Monitoring of Point of Use Ceramic Filter by Using H_2S Paper Strip. Most Probable Number Method in San Francisco Libre, Nicaragua", MSc Thesis, Massachusetts Institute of Technology, Nicaragua.

Kaminska A and Valuikevicius C. (2005). Influence of Petroleum Refining Waste Product Contaminated Soil on Properties of Porous Ceramic Articles. ISSN 1392-1320 Material Science (Medziagotryra) Vol. 11, 159-161.

Katherine L.C, Lauren E. F, Krause C. F, Manto P. J, Dara J. P and Brooke L. Y Implementation of an Appropriate House-Hold Water Purification System in Tourou, Cameroon. www.sys.virgina,edu. Accessed 14th/July/2008.

Matteiletea C. (2006). "Household Ceramic Filter Evolution using three Simple Low Cast Methods: Membrane Filtration, 3m Petri Film and Hydrogen Sulphide Bacteria in Northern Region Ghana". Msc Thesis, Massachusetts Institute of Technology

Mcallister S. (2005). Analysis and Comparison of Sustainable Water Filters. EPD397 Technical Report. http://pottersforpeace.org.accessed 8th/July/2008.

Mujunga F. N. (1999). "Design and Performance of a Single Household Constructed Wetland". Msc Thesis, International Institute for Infrastructural Hydraulic and Environmental Engineering.

Thomas F. C, Brown J, Collin S, Suutura O and Sandary C. C. (2004). Reducing Diarrhea Through the Use of Household Ceramic Water Filters: A Randomised Controlled Trail in Rural Bolivia. Tropical Medicine and Hygiene 70 (6), 651-657.

World Health Organization and United Nations Fund WHO/UNICEF (2004). Meeting the MDG Drinking Water Sanitation Target a Mid-Term Assessment Progress, UNICEF AND WHO, Geneva.

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