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Topic: Ceramic Filter Design and Appraisal for the Treatment of Greywater Generated from Handwashing for Reuse.

ABSTRACT

Porous ceramic filters are used for water treatment because they are known to be a low-cost and effective technology and have the tendency to remove impurities from water. The purpose of this study was to assess the efficiency of the ceramic filter in treating greywater generated from handwashing in three market centers-Boadi, Ayeduase and Kotei in the Ashanti region for reuse. Data on handwashing practices of people in the market centers as well as the public's perception of greywater reuse was collected from one hundred and fifty (150) respondents: 50 people from each of the participating markets. Greywater collected from the three markets were then quantified and characterized, and greywater with the highest microbial loading was then used to run the ceramic filters. Three ceramic filters with ratio of clay to rice husk 90:10, 80:10 and 70:30 by weight were produced, fired at a temperature of 850°C and were coded as filter 1, filter 2 and filter 3 respectively. Their removal efficiencies, filtration rate and clogging time were then assessed. Results indicated that the public's willingness to reuse greywater before and after educating them was 9% and 77% respectively. The study further revealed that the average greywater generation rate was 1.06 l/c/day. The range of characteristics of greywater collected from the market centers were pH 6.25-7.2, Electrical Conductivity 528.1-913.4 $\mu\text{S}/\text{cm}$, TDS 165.9-416.2 mg/l, TSS 9-215 mg/l, Colour 177-735 Pt.Co, Turbidity 1.75-95.9 NTU, Nitrates 0.8-3.4 mg/l, Phosphates 0.02-1.3 mg/l, BOD 52-560.4 mg/l, COD 300-1115 mg/l and Total Coliforms 11×10^4 CFU/100ml– 103×10^4 CFU/100ml. The results indicated that the filter with ratio of clay to rice husk to be 70:30 had the highest flow rate (2.9 L/hr) due to the high amount of combustible material in the mixture but had the least removal efficiency of coliforms with average removal of 86.9%. The ceramic filter design with 90:10 clay to rice husk (Filter 1) was the most efficient due to its microbial removal efficiency of 96%. After treating the greywater with ceramic filter with ratio of clay to burn-out material of 90:10, the following percentage reductions were achieved: 89.7% for turbidity, 93% for BOD₅, and 81.4% for COD. The average removal of physicochemical parameters by Filter 1 were; Total Dissolved solids 14.5%, suspended solids 98%, turbidity 89.7% and colour 96.3%. The filter was inefficient in removing nitrate and phosphate since their effluent concentrations were higher than their influent concentrations. The average filtration rates for all filters dropped during the filtration period due to clogging of the filter pores. It was observed that the efficiency of the filters were highly sensitive to cleaning due to the clogging of the pores. The hydraulic loading rates of Filters 1, 2 and 3 were 0.4 l/m²/hr, 0.63 l/m²/hr and 0.72 l/m²/hr. The study recommends pre-treatment to prevent the fast clogging of the filter. The ceramic filter system developed generally worked well to reduce some contaminant levels in the greywater samples and will need further studies and improvements to produce high-quality filtrates to be used to treat greywater for handwashing purposes.