

# A comparative assessment of chemical contaminant removal by three household water treatment filters

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## Abstract

This study was aimed at modifying the design of, constructing, evaluating and comparing chemical contaminant removal efficiency by, 3 household water treatment filters. The filters were: 1) biosand filter (BSF); 2) the ceramic candle filter (CCF); 3) bucket filter (BF). The filters were evaluated for their efficiency in removal of calcium, magnesium, iron and arsenic, nitrates, phosphates, fluorides, total organic carbon and turbidity, by determining levels of these contaminants in water before and after filtration through the filters. The effects of chlorophyll *a* concentration ( $\text{mg}/\text{m}^3$ ) of intake water, as well as the effects of turbidity of intake water, on the flow rates of the filters was quantified and recommendations on the quality of water that could be filtered through these filters were made. Chlorophyll *a* concentrations in intake water had a positive correlation with the turbidity of the unfiltered water ( $r = 0.607$ ). The flow rates of the filters were 0.8  $\ell/\text{h}$  - 6.48  $\ell/\text{h}$  (BSF), 0.05  $\ell/\text{h}$  - 2.495  $\ell/\text{h}$  (CCF) and 106.5  $\ell/\text{h}$  - 160.5  $\ell/\text{h}$  (BF). Because of the large particle size materials used in constructing the BF and the design, which caused it to be a rapid sand filter, the biosand filter (BF) was found to have flow rates significantly higher than those of BSF and CCF ( $p \geq 0.05$ ). There was no difference in the efficiency of removal of metals (average 40% - 50%) by the filters ( $p \geq 0.05$ ), as the same removal mechanisms (straining, ammonification, fixation and adsorption) were believed to be taking place in all of the filters. The CCF removed total organic carbon (TOC) (up to 39%) better than the BSF and BF ( $p \leq 0.05$ ). The filters removed turbidity effectively with the BSF having the highest reduction (70%). The average turbidity reduction efficiency was in the order BSF (70%) > BF (51%) > CCF (44%). The BSF, CCF and BF reduced turbidity and other contaminants even after filtering a total cumulative volume greater than 1 000  $\ell$ .

**Keywords:** Biosand filter, bucket filter, ceramic candle filter, flow rate, chlorophyll *a*.