

Design and Analysis of Biosand Filtration with Added Copper as a Disinfectant

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EXTENDED ABSTRACT

Biosand filtration is a prominent means of providing clean drinking water to residents in developing countries where access is limited or nonexistent. Aqua Clara International (ACI) is a nonprofit organization whose sole purpose is to provide cheap, clean water to families in such countries through the use of biosand filters. These filters are designed for a 20 L/day holding capacity and include a brass alloy placed in a single layer between the fine and coarse sands for disinfection. A small-scale study was conducted in order to determine if the filters would perform in the same manner with a 0.5 L/day holding capacity and copper shavings, rather than the brass alloy. Five filtration columns were constructed to compare two different amounts and arrangements of the copper shavings as well as a control. Column 1 had no copper while Columns 2 and 3 contained 4.7 g of copper and Columns 4 and 5 contained 2.35 g. The copper was placed in a single layer, like that of the ACI filters, in Columns 2 and 4, and was mixed uniformly throughout the fine sand in Columns 3 and 5. In order to determine the best placement for the copper, each of the five columns had to remove at least 95% of fecal coliform present in the influent water. One-half liter of water collected from the Ocmulgee River in Macon, GA was diffused into each column every day for approximately 30 days. The columns were then allowed to sit for 24 hours, after which the filters were drained and their effluents collected. In addition to HACH plate counts for fecal coliforms, the pH, turbidity, TSS, COD, and BOD were monitored for each effluent and compared with that of the influent. After 30 days of testing, the results indicated an average removal efficiency of 97.5% for fecal coliforms in Column 5, the highest of all five filters. Columns 1 – 4 attained removal efficiencies of 96.5, 93.9, 97.4, and 95.4%, respectively. This suggests that copper works extremely well as a disinfectant. Since the goal was to determine the best arrangement of the copper in the filters by the removal efficiency of fecal coliforms, Column 5, which contained 2.35 g mixed throughout the fine sand layer, was chosen for further testing. A single, full-scale filter was then constructed, with 94 g of copper being mixed into the fine sand layer. The testing process was repeated, but for a longer time period and without monitoring BOD. Compared to the previous results, the full-scale filter attained an average removal efficiency of 96.5% for fecal coliforms. Therefore, it can be concluded that copper may be considered as an alternative to the brass alloy for disinfection in a biosand filter. However, the results of the fecal coliform testing suggest that mixing the copper within the fine sand layer provides a better removal efficiency than placing it in a single layer between the fine and coarse sands.