The Impact of Metallic Biocide and User Compliance on the Effectiveness of Biological Sand Filtration

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EXTENDED ABSTRACT

Clean drinking water is often not readily available in many third world countries. As a result, there is a need to develop novel ways to provide water purification systems in people's homes. One form of water treatment is slow sand filtration, which includes biological sand filtration. Biological Sand Filters (BSFs) are a form of slow sand filtration designed to serve as point-of – use treatment units in a home. BSFs are simple to make, as they are composed of a gravel layer, coarse to fine sand layers and a biolayer. BSFs are becoming a more common form of water treatment around the world, and when operated under the right conditions, studies in laboratories have shown BSFs to be highly effective.

The purpose of this experiment was to determine the impact of milled copper and user compliance on the effectiveness of biological sand filtration in order to provide enhanced water filtration systems to marginalized communities around the world. Testing entailed the creation of 4 BSFs, two built according to traditional BSF guidelines, and the other two were modified to contain copper. Each filter was watered with 20 liters at a time with water samples taken from the Ocmulgee River in Macon, Georgia. To test the effectiveness of user compliance, one set of filters were fed daily while the other set were fed once every three days. One filter from each set had copper mixed into the filter bed of fine sand.

In order to measure the effectiveness of the copper and the watering compliance, solids, coliforms, turbidity, pH, temperature and chemical oxygen demand (COD) were measured. Copper concentrations were also tested, and it was found that all copper levels in the effluent were below toxicity levels, including the EPA's maximum contaminant level goal of 1.3 parts per million. All filters were effective, often removing over 99.5% of coliforms from the source water. In order to determine if any of the filters performed significantly better than the others, a set of paired t-tests with $\alpha=0.5$ were employed. Tests results determined that when a filter was watered daily, the addition of copper had a significant positive impact on its coliform removal efficiency, but the difference was not significant if the filter was watered irregularly. Unequal flowrates are a possible reason for why copper did not have an impact when the filter was watered irregularly. A longer residence time and slower flowrate is preferred for the removal of contaminants in the water.