The Effect of Raw Materials on the Pore Structure of Ceramic Water Filters and its Relationship with End User Performance Metrics

Ireoluwatoni Asojo[1,2], Zachary Shepard[3], Sami Doner[3], Sumanta Das[3] & Vinka Craver[3]

[1]Science, Technology, & Society, Brown University, Providence, RI
[2]Illustration, Rhode Island School of Design, Providence, RI
[3]Civil Engineering, University of Rhode Island, Kingston, RI

Contaminated drinking water leads to a variety of diseases that cause sickness and death; however, an estimated 884 million people live without access to clean drinking water. One technology focused on providing clean drinking water to under-served communities is ceramic water filters (CWFs). CWFs are a point-of-use technology that are low cost and use locally available clay and burnout materials during construction. The goal of this project is to relate manufacturing processes (selecting and processing clay and sawdust) to the pore structure and determine the effect of the pore structure ceramic strength and bacterial removal. Clays sourced from filter factories at 9 locations around the world and hardwood sawdust were used in the construction of the filters. The porosity of the filters was measured by soaking in water and weighing to determine void volume. Compositional analysis for the clays was performed using X-ray diffraction (XRD). Clay minerals were extracted from the bulk material, and both were analyzed using XRD. Compressive and flexural strength were used as metrics for ceramic strength and bacterial removal was quantified using E. coli as the model organism. Compressive strength was shown to decrease with an increase in porosity and initial testing shows that the ceramics have a high flexural strength. Bacterial removal testing was performed but due to limitations with the tests, conclusive results are yet to be determined. This study will demonstrate how the quality of raw materials used for CWF construction influence performance metrics that are important to the users. This information will assist CWF factories in choosing materials and processes that can be used to manufacture high quality filters.

This work was supported by RI NSF EPSCoR C-AIM