CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Nadia Ansari

Project Number
J1103

Project Title
Passive Xylem Filter for Bacterial Elimination from Wastewater

Abstract

Objectives/Goals
The purpose of my study is to examine passive flow, without applying vacuum or suction, through xylem (microscopic tubes inside the branch) filters using both Pine (gymnosperm) and Eucalyptus (angiosperm) tree branches to build a low-cost filter to make contaminated water safe to drink

Methods/Materials
Materials: Pine and Eucalyptus Tree branches, PVC Tubing, Metal Pipes, Epoxy, Plumbers Tape, Probiotic Capsules (Lactobacillus, Bifido, Streptococcus) to make contaminated water, Shelving unit, Clamps, Bacteria Enrichment Tubes, Bacteria Detection Tubes, Luminometer, Incubator, Digital Scale
Methods: Different filters were constructed using a wood chip at the end of a PVC tube or a metal pipe to measure water flow and bacterial elimination from contaminated water. Contaminated water was created using probiotic capsules with lactobacillus and bifido bacteria species. Pre-filtration bacteria sample from the top of each filter was taken as well as sample post-filtration. The samples were placed in the enrichment device into the incubator set at 30 degrees C for 7 hours. The samples were then placed in a detection tube inside luminometer and relative light unit (RLU) reading were recorded correlating to bacteria colony counts.

Results
To understand the difference between pine and eucalyptus filters, I calculated permeability (variable k) of my filters using Darcy#s equation for flow through a porous membrane. I had measured flow rate, could calculate area of the wood piece, had the filter length, and calculated the pressure gradient based on the height of the water in the pipe (equivalent to the length of the pipe above the wood). My permeability (k) for pine was .02 kg/m s MPa and was.33 kg/m s MPa for Eucalyptus. Most of my second and third generation filters eliminated about 40%-99.7% of the bacteria. I observed that with sufficient resistivity (determined by area and length of the wood chip, Eucalyptus (Angiosperm) can be as effective as Pine (Gymnosperm). This property of the wood chip is linked to its ability to clear bacteria.

Conclusions/Discussion
Eucalyptus had much higher flow, without application of any vacuum or suction, and once we found the right length and permeability of Eucalyptus inserted into a filter design with no leakage, we found it to be as good as pine wood in eliminating 97%-100% of bacteria and making water contaminated with bacteria safe to drink.

Summary Statement
A low cost filter using locally available tree branches can be used in a simple design to make water contaminated with bacteria safe to drink and could be used to decrease waterborne illnesses in the world.

Help Received
Dad helped in cutting of wood chips and pipes