Investigating the Water Filtration Capabilities of Carbon-Coated Oyster Shells

Howard, Alexander (School: Timberline High School)

This project's goals were to determine the failure point of carbon-coated oyster shells when filtering lead (Pb) from water, and to investigate which components of carbon-coated shells lend to the material's filtration ability. Water containing Pb above 100 ppb was filtered through 5 g of carbon-coated shells. The filter outflow was periodically sampled and analyzed by an Inductively Coupled Plasma-Mass Spectrometer to determine its Pb concentration. Failure was defined as the outflow measuring above 5 ppb. Secondly, carbon-coated oyster shells, fired oyster shells, carbon, and non-fired oyster shells were used to filter water containing lead (Pb), cadmium (Cd), zinc (Zn), and copper (Cu). The outflow from each filter was sampled and analyzed by an ICP-MS. Firstly, the filter failed after ~4,860 mL of Pb-contaminated water. The filter's output deviated by 0.19 ppb Pb and consistently filtered below 1 ppb Pb until the 4,000 mL mark, after which the output climbed to 5 ppb. In the second half, each filter was compared to the others using a one-way ANOVA, with a Tukey post hoc test to determine which filters were comparable to the others. These comparisons showed both carbon and fired shells provide carbon-coated shells their filtration ability. These results indicate that if 75 g of carbon-coated shells were used in a filter, its performance would be comparable to many activated charcoal filters. Oyster shells currently cost 0.44 USD per kg, and white sugar currently costs 1.17 USD per kg. 75 g of filtration material could be made for only 0.05 USD. Thus, carbon-coated shells are a promising option for developing areas where available filtration methods inadequately remove heavy metals like Pb or Cd from the water supply, while doing so in an inexpensive manner.

Awards Won:

Fourth Award of $500