One Cent Is Enough: Novel Cost-Effective and Eco-Friendly Heavy Metal Detection Method

Cho, Seungbeom (School: Korean Minjok Leadership Academy)
Lee, Grace (School: Chadwick International School)

Heavy metal contamination in water poses a significant threat to human health and the environment. Effective detection of heavy metals is crucial for the prompt removal of contamination sources. However, conventional detection methods are often expensive, complex, and difficult to identify. This project proposes a new cost-effective and eco-friendly method for detecting heavy metals in water using a dried form of alginate. Alginate, a natural biopolymer derived from brown seaweed, is known to interact with metal ions forming a gel. Utilizing this property, this project hypothesizes that the dried alginate would expand to different sizes when immersed in water, depending on the concentration of heavy metals. Experimental results showed that dried alginate films expanded in water, with visually distinguishable size differences observed at Cu, Cd, and Pb concentrations of 100 ppm, 50 ppm, 25 ppm, and 10 ppm, respectively. As the concentration of heavy metals decreased, the area of the alginate films increased. Dried alginate beads similarly exhibited larger size changes at lower heavy metal concentrations. These results demonstrate that dried alginate is effective for the detection of heavy metal concentrations. Further tests showed that temperature and film thickness affected expansion behavior, suggesting that these factors should be considered under different environmental conditions. In addition, incorporation of meso-tetra(N-methyl-4-pyridyl)porphyrin toluene sulfonate (TMPP) enabled visual differentiation of heavy metal types through color changes. Based on these findings, this project offers a low-cost and simple method for heavy metal detection using dried alginate, enabling clear visual identification through changes in size and color.

Awards Won: