Abstract

Lead has detrimental health effects to humans especially children, in which it causes problems from stunted growth to reduced IQ. In response to this problem, the purpose of this project is to use the fluorescence of the dye acid red 94 (AR94) to develop a rapid and inexpensive method of detecting and quantifying lead present in water. To fulfill this purpose, aqueous solutions were made with constant AR94 concentration ([AR94]) but increasing $Pb^{2+}_{(aq)}$ concentration ($[Pb^{2+}_{(aq)}]$). The fluorescence spectra of those solutions were used to construct a Stern-Volmer plot that relates $[Pb^{2+}_{(aq)}]$ to fluorescence for each solution. The measured detection limit of Pb^{2+} ions using AR94, 0.754 mg/L, exceeds the Environmental Protection Agency's action level, 0.0150 mg/L. AR94 binds with $Pb^{2+}_{(aq)}$ in a 1 to 2 molar ratio as determined by a Job plot. Filter paper strips dyed with AR94 were used to detect $Pb^{2+}_{(aq)}$ in the same way pH strips are used to measure acidity. When dipped in solutions of equal concentration of different metal salts, the paper strips exhibit a color change of pink to purple in the presence of $Pb^{2+}_{(aq)}$ but not other metal ions it was tested on. When dipped in lead ion solutions of varying concentration, the color change was more pronounced for higher $[Pb^{2+}_{(aq)}]$ than lower $[Pb^{2+}_{(aq)}]$. This shows AR94 can be a sensitive and selective sensor for lead. Future work can include developing a quantitative color scale for $[Pb^{2+}_{(aq)}]$ using the paper strips.