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Development of A Dye Sensitized Strip to Assess Fluoride Levels in Drinking Water

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Abstract

Free fluoride ions and the metal complexes of fluoride ions significantly affect the quality of drinking water. It shows both beneficial and detrimental effects to the human health. Several techniques based on Ion Selective Electrode (ISE), ion chromatography and colorimetry has been developed to assess the fluoride levels in drinking water. However, all those above methods require sophisticated instruments, which must be operated inside laboratories. The objective of this project is to develop a fluoride sensitive strip that is cost effective and can be used in the field. The SPADNS method is a well-accepted method for fluoride analysis. Reference to this method, the fluoride sensitive strip is designed. Whatman 41 ashless filter paper was modified with titanium butoxide via a sol-gel process. The red color SPADNS-Zr dye was grafted on to the titania layer of the modified strip. The resultant dye sensitized strip is dark blue. The modified strip shows rapid and obvious color change from dark blue to pale pink in the presence of fluoride ions and the original color (red) of the dye appear in the solution. The strips were tested with fluoride concentrations ranging from 1-10 ppm. The tests were triplicated. Approximately one (01) hour is required for the color change in 1 ppm. This suggests that the concentration of fluoride ions is the rate limiting factor for the reaction. The next step of the project is to optimize the strip to detect concentrations 1 ppm or below. There are no interferences to the method by acids (pH 3-7), sulphates (20 ppm) and other halogen ions such as chlorides (20 ppm) and bromides (20 ppm). In addition, the interferences from hydroxide, phosphate and bicarbonate ions have to be analyzed. This is an ongoing research. The results of the initial stages are very promising thus this can be developed further to use in household water filters by enhancing the sensitivity.

***Keywords*:** Fluoride, SPADNS-Zr dye, Titania