Improvement of Colorimetric Arsenic (V) Detection by an Image Processing Technique: Application of Factorial Design Analysis

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Abstract : Colorimetric method of commercial test kits for arsenic detection interpreted by visual comparison with standard color chart are normally inaccurate and lack of sensitivity. This paper describes the results of our attempt to improve the reliability of a colorimetric technique to detect arsenic (V) on-site by incorporating an image processing technique into it where various factors that may influence the detection and the optimum conditions for detection were determined. Detection of arsenic (V) was conducted by adding zinc powder into arsenic (V) working solutions under acidic conditions where arsenic (V) is converted to arsine gas and eventually reacts with silver nitrate on the silver nitrate-impregnated filter paper, which forms colored compound. The images of the colored compounds were digitised into Red, Blue, and Green (RBG) color values. The most significant factor was found to be mass ratio of sulfamic acid to zinc powder followed by reaction period and mass ratio of sulfamic acid to zinc powder-reaction period-drying period of silver nitrate-impregnated filter paper interaction, which significantly influence RGB color values and hence influence detection of arsenic (V). The optimum mass ratio of sulfamic acid to zinc powder and reaction period to detect arsenic (V) were found to be 3.0 g: 1.5 g and 5 minutes, respectively, using 100 g of weight load for drying silver nitrate-impregnated filter paper in 20 seconds. Incorporation of image processing into colorimetric method was found to be a more effective technique for detection of arsenic (V).

Keywords : Arsenic (V); Colorimetric; Factorial design of analysis; Image processing; Optimisation.

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