Field Method for Estimation of Fuoride in Drinking Groundwater by Photometric Measurement of Spot on Impregnated Reagent Paper

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Abstract

Few years ago WHO decided to make mandatory the determination of fluorine and arsenic in drinking water. The reason is that in large parts of the world the population is exposed to these elements at toxic levels, more than 100 million are exposed to arsenic and about 62 million to fluorine, and in some parts like Inner Magnolia, people are exposed to high levels of both elements. Because most of the countries with such health problems belong to third world, the number of existing laboratories is not sufficient to control the amount of these elements. Therefore, simple field method are favored to allow a reliable determination right at the source. To determine arsenic a small handheld instrument based on a photometric measurements of reagent paper was developed and now is available. There is an urgent need to expand the functionality of this small instrument to analyze fluorine too.

Through the search for the best fluoride reagent, 94 possible ligands containing groups capable of holding metals in stable combination were examined. These ligands belong to the main types of dyes: triphenylmethane, azo, and anthraqunion dyes. For an optimal result it turned out new prepared a polymeric aluminum complex of 5-(2-carboxyphenylazo)-8-hydroxyquinoline (LH_2), and aluminumquinalizarine 2:1 complex. The reagent reacts on an impregnated paper in the following way:

$AlLH_{2(yellow)} + 6F^- \rightarrow AlF_6^{-3}{}_{(colorless)} + LH_{2\,(red)}$

$Al_2\,[quinalizarin]_{(pink)} + + 6F^- \rightarrow AlF_6^{-3}{}_{(colorless)} + [quinalizarin]_{(orange)}$

The molar absorptivity of the complex formation of the above two reagents is 8.48×10^3 L mol^{-1} cm^{-1} at 410 nm and 4.41 L mol^{-1} cm^{-1} at 553 nm respectively. For the field instrument the analytical range from 0.0 to 2.0 µg ml^{-1} is linear. The limit of determination is 0.3 µg ml^{-1}. The recovery of 1.0 µg ml^{-1} is 96.2% and 104.7% respectively. There is no interference by nitrate or chloride. Sulfate interfered with the measurement, but at high concentrations which are not expected in drinking water.

An interesting results were obtained with aluminum complexes of Triphenylmethane dyes, Flavonoid Chrysin, and Resocrin Blue. However, these complexes can be recommended as spectrophotometric reagent for fluoride determination in water.

KEYWORDS: fluoride analysis; drinking water; field method; impregnated paper; aluminum -azo dye complex; Arsenator