Use of a portable soil color meter for in situ colorimetric determination of Fe2+ NH4+ in natural water.

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Introduction

The Fe2+ and NH4+ concentrations in natural water may be affected by redox changes after sampling. These redox-sensitive species must be analyzed in situ. In December-2004, we planed to analyze Fe2+ and NH4+ concentrations of Bangladesh groundwater with a spectrophotometer using the 1,10 phenanthroline method for Fe2+ and indophenol blue method for NH4+. Unfortunately, the spectrophotometer was broken during transportation. However, we were able to determine these species using a portable soil color meter as an alternative spectrophotometer. Here we report the details of the methods.

Experimental method

The soil color meter (SPAD-503) measures digitally the color of contacting flat surface of any material in terms the L*A*B* color system. L*(1~100) expresses brightness, and a*(-60~60) and b*(-60~60) express the depth of red-green and yellow-blue colors, respectively.

2mL of the Fe2+ standard solutions (0.0, 0.05, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.8, 1.0 ppm) was put into a plastic cell followed by the addition of the coloring reagent (a mixture of 1,10 phenanthroline and buffer solutions) using a pipette. After the color stabilized, L*, A*, and B* values were measured with the soil color meter in triplicate.

The procedures were similar to the Fe2+ analysis. 2mL of the standard solutions containing 0.0, 0.05, 0.1, 0.2, 0.4, 0.6, 0.8, and 1.0 ppm NH4+-N was put into a plastic cell. 0.8mL of phenol-nitroprusside solution and 1.2mL of sodium-hypocloride solution were used as the coloring reagents.

Result and discussion

Fe2+ analysis: Fe2+ solution was colored orange in the 1,10 phenanthroline method. The error of L*, A* and B* measurements was less than 0.1% of the observed values. The b* values and Fe2+ concentrations showed good linearity with the correlation coefficient (R2) better than 0.99 (see Fig.1).

NH4+ analysis: NH4+ solution was blue. The error of L*, A* and B* measurements was less than 0.1% of the observed values. The relationship between L* and NH4+-N concentration (C) was approximated by an exponential curve. The of L* - logC relationship had the correlation coefficients (R2) better than 0.99 (see Fig.2).

The soil color meter was found to be used for a spectrophotometer. The advantages are that it is (1) portable, (2) stable, (3) easy to operate, and (4) it requires no electric power line because it runs on battery. The method described here can be used for determination of the other redox-sensitive species such as NO2-.

Fig.1

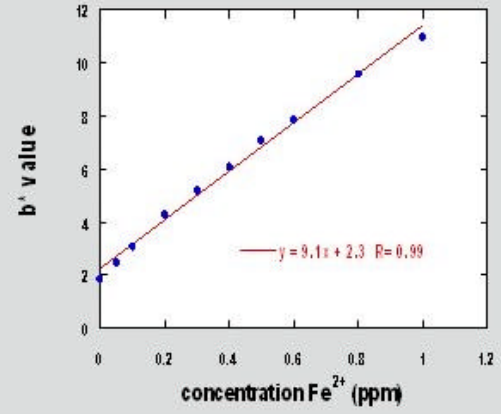
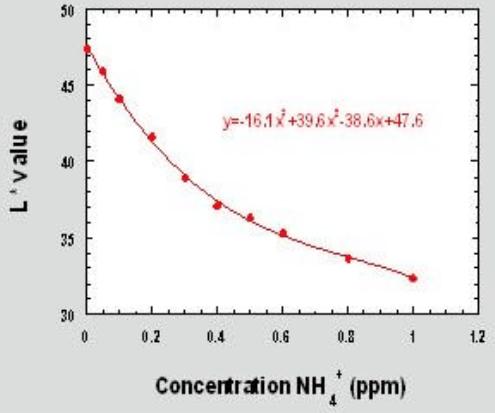

b* value
concentration Fe2+ (ppm)
y = 9.1x + 2.3 R= 0.99
0
2
4
6
8
10
12
0
0.2
0.4
0.6
0.8
1
1.2

Fig.2


L* value
Concentration NH4+ (ppm)
y=-16.1x3+39.6x2-38.6x+47.6
30
35
40
45
50
0
0.2
0.4
0.6
0.8
1
1.2