An Example of Standard Additions
Chapter 8 Problem 21

Copper was determined in a river water sample by atomic absorption spectrometry and the method of standard additions. For the addition, 100.0 μL of a 1000.0 μg/mL Cu standard was added to 100.0 mL of solution. The following data were obtained:

Absorbance of reagent blank = 0.020
Absorbance of sample = 0.520
Absorbance of sample plus addition – blank = 1.020

(a) Calculate the copper concentration in the sample

Start by defining the problem spectroscopically:

(1) $A_1 = kC_1$ where C_1 is the concentration of the unspiked sample

(2) $A_2 = kC_2$ where C_2 is the concentration of the spiked sample

Calculate the concentration, C_2, in terms of C_1 and C_{spike} :

(3) $C_2 = \dfrac{C_1 V_1 + C_{\text{spike}} V_{\text{spike}}}{V_{\text{total}}}$

Substitute eq 3 into eq 2

(4) $A_2 = k \dfrac{C_1 V_1 + C_{\text{spike}} V_{\text{spike}}}{V_{\text{total}}}$

Now, ratio eq 4 to eq 1 to eliminate k :

$$\frac{A_2}{A_1} = \frac{\left(k \dfrac{C_1 V_1 + C_{\text{spike}} V_{\text{spike}}}{V_{\text{total}}} \right)}{kC_1} = \frac{\dfrac{C_1 V_1 + C_{\text{spike}} V_{\text{spike}}}{V_{\text{total}}}}{C_1} = \frac{C_1 V_1 + C_{\text{spike}} V_{\text{spike}}}{C_1 V_{\text{total}}}$$

All of the variables except C_1 are known. Correct the sample absorbance for blank and calculate:

$$\frac{1.020}{0.500} = \frac{C_1 (100.0\text{mL}) + \left(1000.0\,{}^{\mu g}\!/_{\text{mL}}\right)(0.1000\ \text{mL})}{C_1 (100.1\ \text{mL})}$$

$$\boxed{C_1 = C_{\text{river}} = 0.9597\,{}^{\mu g}\!/_{\text{mL}}}$$