EXPERIMENT E3

Spectrophotometric Analysis: Phosphates in Water

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Section 5

Group 4

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**Objectives**

* Calculate and perfume dilution of solutions
* Determine the concentration of phosphate by spectrophotometric
* Construct and utilize a calibration curve
* Explore the dynamics of working

**Background**

Phosphates is a salt of phosphoric acid which will hydrolyze to form PO43-. Because of too much use of fertilizers and detergents, the phosphates enter the water environment with high concentration.

* **Spectrophotometric Analysis and the Determination of Phosphate**

Spectrophotometric analysis relies on the fact that the amount of light absorbed by a sample shows a linear dependence upon the concentration of the compound present in the solution. The more concentrated solution absorbs more light and is darker. Scientists use an instrument called a spectrometer to quantitatively determine the amount of light absorbed by a solution.

* **The Calibration Curve**

A calibration curve help scientists determine the unknown concentration of a known species. The absorbance of the sample increases linearly as the concentration increases. Sometimes the points may not fall directly on line but a good agreement is expected and needed for accurate determination of the unknown concentration.

**Theory**

* **The principle of spectrometer**

The spectrometer emits light focused with a small slit. The wavelength of interest is selected using the monochromator and an additional slit. The selected light reaches the sample and depending on how the photons interact with the compound, the light is absorbed or passes straight through. By comparing the amount of light entering the sample (I0) with the amount of light reaching the detector (I), we can know how much light is absorbed. Percent transmittance is calculated as the fraction of original light intensity. **%T= (I/ I0)\*100**

The absorbance A can be converted from %T. **A=-Log10(%T/100) =bc**

、b、c respectively represents the molar absorptivity, solution path length and molar concentration of absorbing species in the sample.

**Introduction**

Excessive nutrient input, mainly caused by extensive use of various resources, stimulates the growth of algae and bacteria, robbing the water of oxygen. Excessive nutrient input is the source of eutrophication and it has caused lots of negative effects on the water environment.

**Data Processing**

**Data table for λopt**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| λ(nm) | 400 | 410 | 430 | 450 |
| Absorb. (A) | 0.266 | 0.205 | 0.119 | 0.074 |

λopt is 0.266 when λ is 400nm.

**Data table for the concentration for each solution**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sample | 1# | 2# | 3# | 4# | 5# | 6# | 7#B |
| V(ml) | 0.00 | 1.00 | 2.00 | 3.00 | 4.00 | 5.00 | 5.00 |
| %T | 100% | 92.47% | 81.47% | 73.96% | 68.71% | 54.20% | 88.10% |
| Conc.(M) | 0 | 2\*10-5 | 4\*10-5 | 6\*10-5 | 8\*10-5 | 1\*10-4 | 2.5\*10-5 |
| Absorb. (A) | 0 | 0.034 | 0.089 | 0.131 | 0.163 | 0.266 | 0.055 |

**A=-log10(%T/100)**

**Calibration curve**

Equation: C=(38.643\*A+0.5688)\*10-5

C = (38.643\*0.055+0.5688)\*10-5=2.5\*10-5

**Discussion**

**Part A. Preparation of Standard Solution**

When I used the pipets to pipet HNO3 solution, I put my thumb at the top of the pipet. Professor Hamade had already emphasized that the action is wrong before the experiment because it is safer to put my index finger on the pipet. My action might make the pipet slide from my hand so I should pay much more attention to it.

**Part B. Adjusting the Spectrophotometer**

On Hamade’s PPT, it says that we should calibrate the spectrophotometer every time when I use it to measure the Absorbance but after our first measurament ,I found the meter read 0 when the black block was inserted and the meter read 100 when the 1# cuvette is inserted. Therefore, I wonder if the calibration is necessary every time. I think once calibration is enough.

When I inserted the cuvette containing the solution, my finger touched the transparent surface of the cuvette accidently, which might caused error in our measurement.

**Part C. Making the Absorbance Spectrum & Finding λOPT using a Standard Solution**

Through my observation, I found the absorbance is smaller when the λ**OPT** is bigger, I wonder what’s the reason behind the phenomenon.

**Part D. Making the Calibration Curve Using the standard Solutions**

The calibration curve should be linear function passing through the original point but the function matched by our data isn’t a proportional function, I think there must be some wrong with our measurement.

**Conclusion & Recommendations**

The experiment report include knowledge about phosphate, spectrophotometer, and calibration curve. It also records our data measured by the spectrophotometer and the matched calibration curve line.

Through the experiment, I observe that the bigger concentration a non-transparent solution has, the more obvious color it has. By this principle, I learned how to use a spectrophotometer to measure a solution’s concentration. Additionally I got a rough idea about what phosphate is and what role it plays in our daily life.

**References**

Prof. T. Hamade,” Spectrophotometric Analysis”, UM-SJTU JI & SJTU Chemistry Department