



APPLICATION NOTE

UV/Vis Spectroscopy

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Water Analysis Using LAMBDA UV/Visible Spectrophotometers: Ammonia-Nitrogen Determination

Introduction

Ammonia-nitrogen ($\text{NH}_3\text{-N}$) occurs naturally in

groundwaters at concentrations below 0.2 mg/L and up to 12 mg/L in surface waters, as a result of decomposition of organic matter. High concentrations of ammonia in surface waters are toxic to aquatic life and are indicative of contamination from industrial effluent, raw sewage and agricultural runoff. Ultimately the pH value of the water determines whether ammonia-nitrogen is found as NH_4^+ , NH_4OH or NH_3 .¹

In this application, the quantitative analysis of ammonia-nitrogen was performed using the LAMBDA 265™ UV/Vis spectrophotometer and CHEMetrics ammonia nitrogen cell test.

Principle

Ammonia reacts with the Nessler reagent (K_2HgI_4) to form a yellow colored complex which can be detected spectrophotometrically at 430 nm and is directly proportional to the ammonia concentration. Stabilizer solution (potassium sodium tartrate) is added to prevent cloudiness of the Nessler reagent which may occur in some waters due to calcium and magnesium concentrations.

This method is suitable for the concentration range of 0 – 7.00 mg/L ammonia in surface, drinking and nitrified waste waters allowing its concentration to be determined without the use of a calibration curve by incorporating the measured absorbance at 430 nm into a known equation.

Reagents and Apparatus

1. CHEMetrics ammonia Vacu-vials® kit (K-1503) - containing 30 vials, reference sample, A-1500 stabilizer solution (Potassium sodium tartrate) and sample cup
2. PerkinElmer LAMBDA 265 PDA UV/Visible Spectrophotometer
3. UV Lab™ software
4. Ammonia standard solution (100 mg/L)
5. Deionised (DI) water
6. Volumetric flasks (100 ml)
7. Micropipettes

Method

A stock solution of ammonia (100 mg/L) in water was used to prepare a 4.00 mg/L ammonia solution in a 100 ml volumetric flask by dilution with DI water.

Following preparation of solutions, the sample cup was filled with the 4.00 mg/L ammonia solution up to the 25 mL mark and two drops of A-1500 stabilizer solution mixed in. The tip of the Vacu-vial ampule was placed in the sample cup and snapped. The ampule was inverted several times to promote mixing, then dried and left to stand for two minutes, followed by the absorbance being measured in the spectrophotometer. This technique was also carried out for the reference sample supplied in the test kit.

Using the UV Lab software, the LAMBDA 265 instrument parameters were set, as shown in Figure 1, to measure the absorbance at 430 nm. An equation was set up to calculate the ammonia concentration, as shown in Equation 1. Following measurement of the blank, the absorbance of the known ammonia solution in the Vacu-vial was recorded.

Equation 1.

$$\text{Ammonia-nitrogen concentration (mg/L)} = 7.16 (A_{430}) - 0.16$$

Results

Figure 2 shows spectra from five repeat runs of the 4.00 mg/L ammonia sample, with the results shown in Table 1. The mean absorbance at 430 nm was determined to be 0.590, which corresponded to a calculated concentration of 4.06 mg/L ammonia-nitrogen. The results obtained had a high level of accuracy and repeatability with a relative standard deviation of 0.37%.

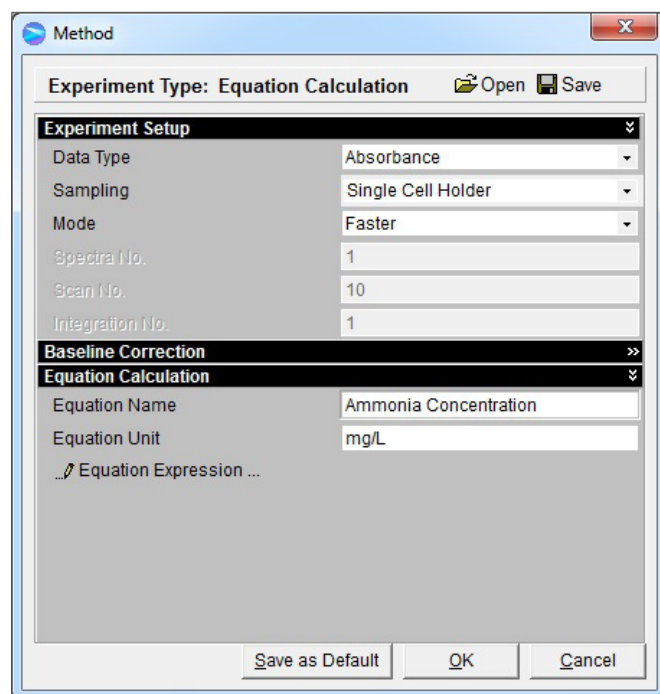


Figure 1. Instrument parameters and method setup.

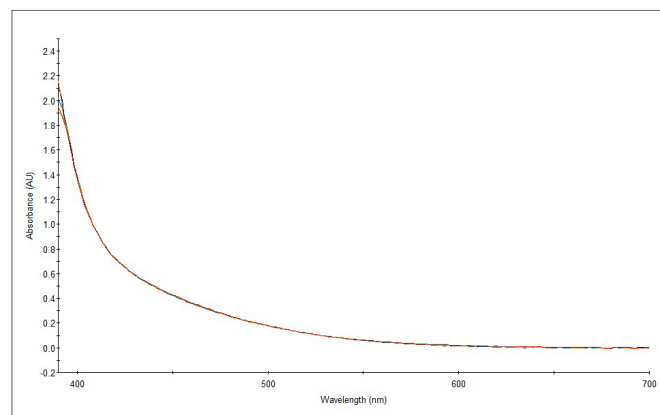


Figure 2. Overlaid UV/Vis spectra of repeat measurements of ammonia solution.

Table 1. Results for repeat measurements.

Ammonia Solution	Absorbance at 430 nm	Ammonia-Nitrogen Concentration (mg/L)
Repeat 1	0.587	4.04
Repeat 2	0.588	4.05
Repeat 3	0.591	4.07
Repeat 4	0.591	4.07
Repeat 5	0.592	4.08

Conclusion

Quantitative analysis of ammonia-nitrogen in water was achieved with no complex sample preparation, exposure to hazardous chemicals, or measurement of calibration standards, by using the CHEMetrics test kit. Results were obtained rapidly using the LAMBDA 265 UV/Vis spectrophotometer and UV Lab software with a high level of accuracy and repeatability.

References

1. http://www.who.int/water_sanitation_health/dwq/ammonia.pdf
Date accessed: 09/11/2015.