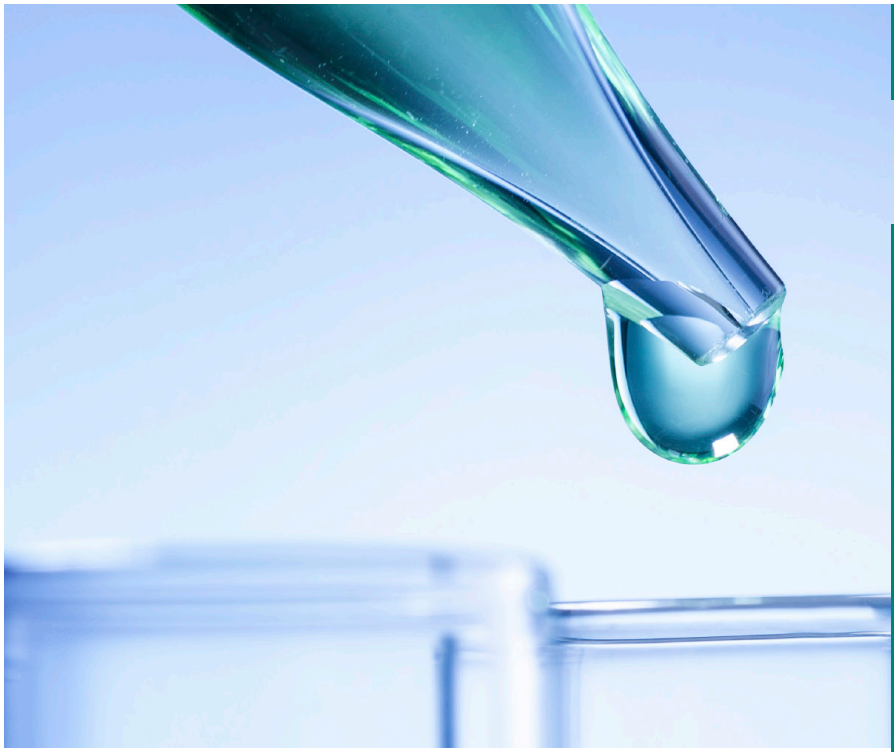

APPLICATION NOTE

UV/Visible Spectroscopy

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Water Analysis Using LAMBDA UV/Visible Spectrophotometers: Formaldehyde Determination

Introduction

In this application, the quantitative analysis of formaldehyde was successfully executed using the LAMBDA™ 265 UV/Vis spectrophotometer and Merck Spectroquant® formaldehyde cell test kit.

Principle

Formaldehyde reacts with chromotropic acid in sulphuric solution to form a violet dye which can be detected photometrically at 565 nm. The formaldehyde cell test kit is appropriate for the concentration range of 0.10 to 8.00 mg/L formaldehyde allowing the concentration of formaldehyde in a water sample to be determined without the use of a calibration curve by multiplying the measured absorbance at 565 nm by a known factor.

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Reagents and Apparatus

1. Merck Spectroquant® formaldehyde cell test kit – (1.1450.0001) containing reaction cells and reagent HCHO 1K
2. PerkinElmer LAMBDA 265 PDA UV/Visible Spectrophotometer
3. UV Lab™ software
4. Cuvettes (10 mm pathlength)
5. Formaldehyde solution (37%)
6. Deionised (DI) water
7. Volumetric flasks (1 L and 100 ml)
8. Micropipettes

Experimental

A stock solution of formaldehyde (1000 mg/L) was prepared in a one litre volumetric flask using 37% formaldehyde solution (2.50 ml) and diluting with DI water. From this stock solution a 1.0 mg/L formaldehyde solution was prepared in a 100 ml volumetric flask by dilution with DI water.

Following preparation of solutions, one level green microspoon of 'HCHO-1K' was placed in a reaction cell. The cell was then closed and shaken until the solid had dissolved. Using a pipette, 2.0 ml of the 1.0 mg/L formaldehyde solution was added to the reaction cell, shaken and the cell left to stand for five minutes. This technique was also carried out for the blank which instead used DI water.

Using the UV Lab software, the LAMBDA 265 instrument parameters were set as shown in Figure 1 to measure the absorbance at 565 nm, and an equation set up to calculate the formaldehyde concentration as shown in Equation 1. A blank was measured and after reaction completion, the known formaldehyde sample in the reaction cell was transferred to a 10 mm cuvette. The absorbance of this sample was then measured, thus enabling the calculated formaldehyde concentration to be determined.

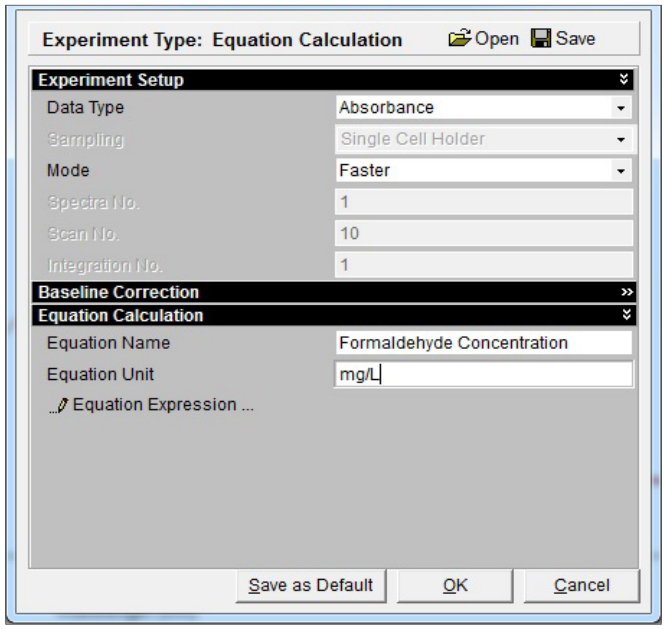

Figure 1. Instrument parameters and method setup .

Equation 1.

$$\textit{Formaldehyde concentration (mg/L)} = A_{565} * 4.36$$

Results

Figure 2 shows spectra from five repeat runs of the 1.0 mg/L formaldehyde sample, with the results shown in Table 1. The mean absorbance at 565 nm was determined to be 0.229, correlating to a mean calculated concentration of 1.00 mg/L formaldehyde. The results obtained had a high level of accuracy and repeatability with a relative standard deviation of 0.28%.

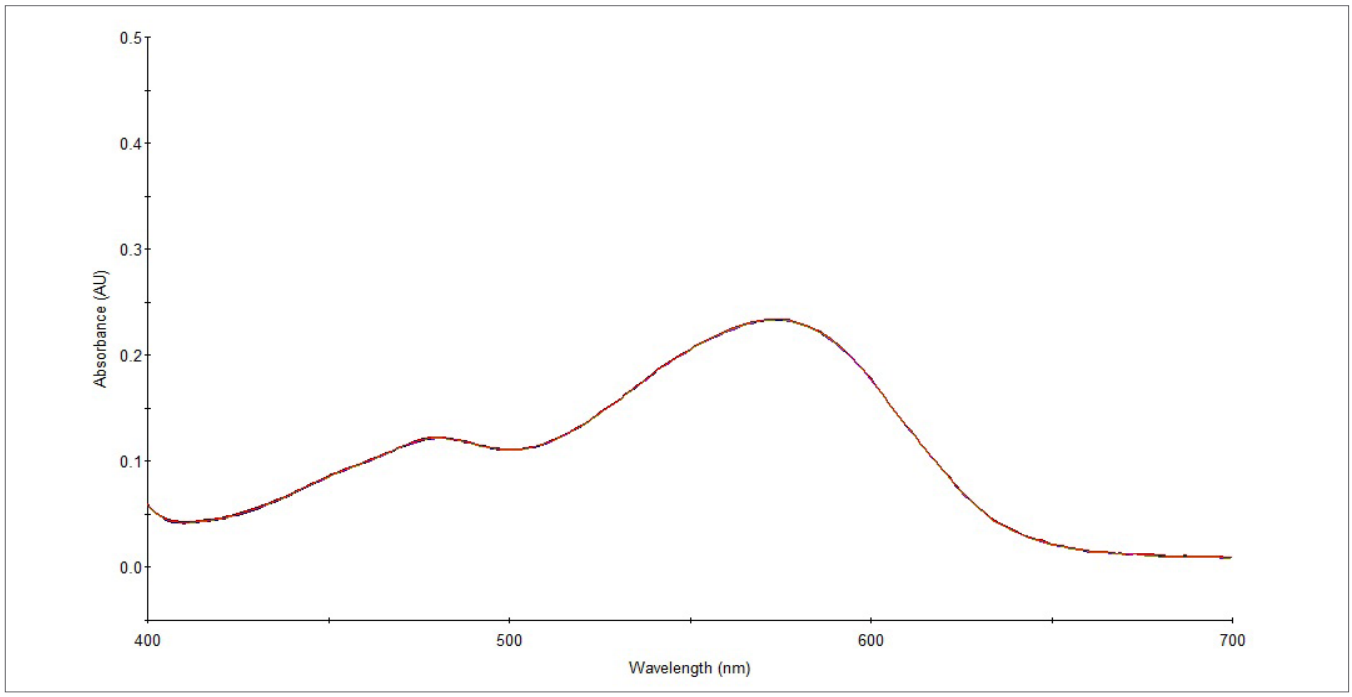

Figure 2. Overlaid UV/Vis spectra of repeat measurements of formaldehyde solution.

Table 1. Results for repeat measurements.

Formaldehyde Solution	Absorbance at 565 nm	Formaldehyde Concentration (mg/L)
Repeat 1	0.228	0.99
Repeat 2	0.230	1.00
Repeat 3	0.229	1.00
Repeat 4	0.229	1.00
Repeat 5	0.230	1.00

Conclusion

Using the LAMBDA 265 UV/Vis spectrophotometer and UV Lab software, quantitative analysis of formaldehyde in water was achieved with a high level of repeatability, accuracy and with rapid acquisition of spectra. The use of test kits allows for a fast and simple analysis, avoiding mixing and weighing of hazardous chemicals, and enables the concentration of formaldehyde to be determined without a calibration curve and simply using a known factor. Quantitative analysis using UV Lab software provides immediate results.

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