

UVA UV254 Measurement of Waters by Spectrophotometer

Key words

Drinking water, source water, UV-absorbing organic constituents, EPA methods, UVA, UV254, 254 nm wavelength, UV-Vis spectrophotometer, Drinking water, source water, UV-absorbing organic constituents, EPA methods, UVA, UV254, 254 nm wavelength, UV-Vis spectrophotometer, EPA Method 415.3, Standard Methods 5910B, Orion AquaMate, SAC 254, SUVA, Log 137

Goal

This application note describes how to measure the absorbance of waters, such as drinking water and source water, at 254nm wavelength using a Thermo Scientific™ Orion™ AquaMate™ UV-Vis Spectrophotometer.

Introduction

This method utilizes a spectrophotometer to measure the absorbance of waters, such as drinking water and source water, at 254nm wavelength. These results may be correlated to organic carbon, color, and/or disinfection byproduct precursors. Results can also indicate the efficacy of treatment processes that remove organic carbon or results may be used with a corresponding total organic carbon (TOC) result to calculate the Specific UV Absorbance (SUVA) value for a water sample.¹

Equipment

- Thermo Scientific Orion AquaMate UV-Vis Spectrophotometer³
- Filtration apparatus
- 0.45 µm filters, 47 mm
- Vacuum source – aspirator, air flow or water flow, handoperated or low pressure electric vacuum pump



- UV disposable cuvettes, 1 cm, or quartz sample cell, 1 cm, 5 cm, or 10 cm
- Thermo Scientific™ Orion™ pH Meter and Electrode

Solutions

- Reagent-grade water (RGW)
- Reagents for pH adjustment - Sodium hydroxide, 0.1N, Hydrochloric acid, 0.1N, Thermo Scientific™ Orion™ pH 4.01 and 7.00 Buffers (Cat. No. 910104, Cat. No. 910107),
- Spectrophotometer Check Solution (SCS)
Optional: Organic Carbon, KHP in pH 7 phosphate buffer, prepared² or purchased

Sample cell storage and cleaning

In order to obtain reproducible results, clean and store sample cells per instructions in the Orion AquaMate user guide.

Meter setup

Turn on the spectrophotometer. Choose a suitable cell size and method for the organic carbon content expected in your samples. See chart (below). Select the desired cell holder. Locate and select the desired preprogrammed method from the Orion AquaMate methods menu. See Figure 1 for choosing the method.

Figure 1.

Sample concentration	Organic Carbon > 0.5 mg/L	Organic Carbon > 0.1 mg/L	Organic Carbon > 0.05 mg/L
Quartz cell size*	1 cm (10 mm)	5 cm (50 mm)	10 cm (100 mm)
Method name	UV254_1	UV254_5	UV254_10

*Alternately, use disposable cuvettes formulated for UV measurements, available in the 1 cm (10 mm) cell path.

Zero the meter; spectrophotometer check

1. Touching only the frosted sides of the cell, rinse a clean cell three times with RGW. Then fill with RGW water. Use a lint-free wiper to remove water on the outside.
2. Open the sample compartment and insert the sample cell containing RGW water (the blank) into the sample holder, with the clear sides aligned with the light beam (facing left and right). Close the lid, then select Blank.
3. If required, test an SCS: Using the same cell, empty and fill with the prepared SCS, wipe dry, and insert into the sample holder. Close the lid, and select Measure. The result will be logged automatically.
4. The reading for the SCS should be within the desired criteria, per your QA plan. See Results section for examples.

Sample storage

Samples are not preserved. Analyze as soon as possible after collection. Samples may be stored for up to 48 hours at <6°C prior to analysis. See EPA Method 415.3 for SUVA storage.

Sample preparation: pH adjust and /or sample filtration

For non-SUVA: If the pH is not between 4 and 10, adjust pH per steps in "pH Adjustment of Sample" (see below).

Note: Do not adjust pH for a SUVA determination.

For UVA, UV254: Set up the filtration apparatus with a 0.45µm filter. Wash the filter with 50 mL RGW and discard the rinse water. Filter 50 mL of the sample. Test the filtrate.

Sample measurement

Ensure the meter has been zeroed properly. Touching only the frosted sides of the cell, rinse the clean cell with a portion of the filtered sample, then fill with the filtered sample. Wipe dry. Insert the sample cell into the holder, close the lid, and select Measure. Results will be logged automatically.

The results can be exported to a local network or saved to a USB stick if desired. If the reading is >0.900 absorbance, dilute and retest. Multiply the reading by the dilution factor. If the results are <0.010 absorbance, consider using a larger cell. Load the appropriate method, and rezero the meter.

Quality control (QC)

Run an SCS and duplicate samples with each batch, or run QC samples per your QA plan. For SUVA testing, follow requirements of EPA Method 415.3.¹

pH adjustment of sample

Note: Do not adjust the pH of a sample which will be used for a SUVA calculation. Proceed to the filtration step, noted

1. Calibrate the pH probe in pH 4.01 and 7.00 buffers.
2. Warm the sample up to room temperature.
3. Shake the sample to insure homogeneity.
4. Measure 50 mL of the sample to a 100-mL beaker using a graduated cylinder.
5. Immerse the pH probe in the sample and record the initial pH.
6. Adjust the sample into the range of pH 4 to 10, by adding dropwise 0.1N sodium hydroxide to raise the pH or by adding dropwise 0.1N hydrochloric acid to lower the pH. Different strength acid or base can be used, if needed.
7. Note that the overall volume change should not be greater than 1% (0.5 mL). Discard and re-prepare with stronger acid or base if the volume changes more than 1%.
8. Record the adjusted pH. Proceed to the filtration step.

Results of SCS Testing on the Orion UV-Vis Spectrophotometer – 25.0 mg/L Organic Carbon (KHP)

Figure 2.

Bias method UV254_1	Expected (per SM 5910B)	Result	Difference	Evaluation
Absorbance	0.358 cm ⁻¹	0.360 cm ⁻¹	0.002 cm ⁻¹ (0.6%)	Good
Organic Carbon Concentration	25.0 mg/L	24.9 mg/L	0.1 mg/L (0.4%)	Good

Bias: readings of a KHP organic carbon standard at 25.0 mg/L in phosphate buffer (prepared per SM 5910B) tested in a 1 cm cell demonstrate good accuracy:

- The average AquaMate UV-Vis Spectrophotometer absorbance result is within 0.002 absorbance units of the average reading expected per SM 5910B, 0.6% difference from the expected absorbance.
- The average AquaMate UV-Vis Spectrophotometer organic carbon concentration result (calculated per SM 5910B) is within 0.1 mg/L of the expected value; 0.4% difference (99.6% recovery) from the expected value of 25.0 mg/L organic carbon.

Figure 3.

Precision method UV254_1	# of samples tested	Maximum % RSD (per SM 5910B)	Result	Evaluation
Absorbance	14	< 10.7% RSD	0.3% RSD	Good

Precision: readings of a KHP organic carbon standard at 25.0 mg/L in phosphate buffer (prepared per SM 5910B) tested in a 1 cm cell demonstrate good precision:

- The relative standard deviation (RSD) of 14 test results on the AquaMate UV-Vis Spectrophotometer is 0.3% RSD, well within the maximum 10.7% limit expected

To purchase Orion meter, electrodes and solutions, please contact your local equipment distributor and reference the Cat. Nos. listed below:

Product	Cat. No.
Instruments	
Orion AquaMate UV-Vis Spectrophotometer	AQ8000 / AQ8100
Orion pH Meter	Multiple
Orion pH Electrode	Multiple
Solutions	
Orion pH Buffers 4.01	910104
Orion pH Buffers 7.00	910107
RGW Barnstead Smart2Pure 12 UV Water Purification System	50129890*
Accessories	
Spectrophotometer Performance Verification Kit	840-312600
Long path rectangular cell holder	AQX1LWLVH

*Please contact your local Thermo Scientific representative for support to order the best water purification system for your application, and visit our website at thermofisher.com/labwater.

References and footnotes

1. EPA Method 415.3 Rev 1.1. UV254 for SUVA. <http://www.epa.gov/microbes/ordmeth.htm>.
2. Standard Methods 5910B, UV-Absorbing Organic Constituents. www.standardmethods.org.
3. This application note is compatible with Thermo Scientific Orion AquaMate 8000 and 8100 series spectrophotometers.

Find out more at thermofisher.com/aquamate

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