

# Color of water and wastewater by platinum-cobalt method at 455 nm

## Key words

Water, wastewater, true color, apparent color, platinum-cobalt, spectrophotometric-single wavelength, UV-Vis spectrophotometer, visible-only spectrophotometer, log 133

## Goal

This application note describes the use of the Thermo Scientific™ Orion™ AquaMate™ Spectrophotometer to measure the absorbance of light based on the platinum-cobalt method.

## Introduction

Color in water may result from the presence of natural metallic ions (iron and manganese), humus and peat materials, plankton, weeds, and industrial wastes. Color is removed to make a water suitable for general and industrial applications. Colored industrial wastewaters may require color removal before discharge into watercourses.

The following application note describes a method that utilizes a spectrophotometer to measure the absorbance of light as it passes through a sample at 455 nm wavelength. The method can be used for water, wastewater, and other light-colored liquids, with light absorption characteristics nearly identical with those of the platinum-cobalt color standards used<sup>1-3</sup>.



## Equipment and accessories

- Thermo Scientific Orion AquaMate Spectrophotometer\*
- Water filters, pore size 0.45  $\mu\text{m}$
- Sample cell: 50 mm glass cell, 25 mm vial, or 24 mm vial (Cat. No. AC2V24)

## Required solutions

- Platinum-Cobalt (Pt-Co) color standard solution, 500 PCU<sup>4</sup>
- Pt-Co color verification standard(s), per SOP, or near the expected sample color
- Reagent-grade water (RGW)

## Solutions preparation

Prepare verification standard(s) by diluting an appropriate volume of the 500 PCU Pt-Co standard with RGW in 100 mL volumetric flask. For example, to prepare a 50 PCU color standard, dilute 10 mL of 500 PCU Pt-Co color standard with RGW in a 100 mL volumetric flask.

## Meter setup

1. Turn on the spectrophotometer. Allow the Orion AquaMate Visible Spectrophotometer to warm up per the user guide. The Thermo Scientific™ Orion™ AquaMate™ UV-Vis Spectrophotometer does not require warm up.
2. Choose a sample cell size (50, 25, or 24 mm). For example, 24 or 25 mm cells are convenient and inexpensive, while a 50 mm cell may achieve a lower detection limit.
3. Depending on the sample cell size, locate and select the desired preprogrammed method\*\* from the Orion AquaMate methods menu.

## Calibration verification

1. Open the sample compartment and insert the sample cell containing RGW (the blank) into the sample holder with the orientation mark forward (for round vials). Close the lid and press Blank.
2. Empty and fill the same cell† with the prepared color standard (e.g., 50 PCU), and insert it into the sample holder with the orientation mark facing forward. Close the lid, and press Measure. Results will be logged automatically.
3. The reading for the calibration verification standard should be within the desired criteria, per your QA plan.

## Sample storage and preparation

Samples must be analyzed within 48 hours of collection and should be stored at <6°C. Refer to EPA 40 CFR Part 136.3 for details. Warm samples to room temperature before measurement. Do not adjust the sample pH as long as it is between 4 and 10. If not, adjust to pH 7, and note. Turbid samples should be filtered through a 0.45 µm filter. If samples are filtered, prepare a method blank by filtering RGW. Analysis of filtered samples gives “true” color. If the sample is not filtered, the result is considered “apparent” color. Dilute samples with color above 500 PCU.

## Sample cell storage and cleaning

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

## Sample measurement

Clean the cell by rinsing three times with RGW. Fill the clean sample cell with about 10 mL of a sample or a method blank. Open the lid and insert the sample cell into the sample holder, orientation mark facing forward. Close the lid and press Measure. If reading is >500 PCU, dilute and retest. Multiply the reading by the dilution factor.

## Quality control (QC)

Run a calibration verification, duplicate samples, and method blank (if filter samples) with each batch or per your QA plan.

## Results of color testing by platinum-cobalt method on Orion AquaMate spectrophotometers\*

**Bias:** readings of color standards in various light path length cells on Orion AquaMate spectrophotometers demonstrate good accuracy.

- Lower-level standards (0 to 50 PCU) gave readings within 3 PCU of expected values (Figure 1).
- Higher-level standards (250 PCU and 500 PCU) gave readings within 5% of expected values (data not shown).

**Precision:** surface water sample readings at various concentrations on Orion AquaMate spectrophotometers demonstrate good precision.

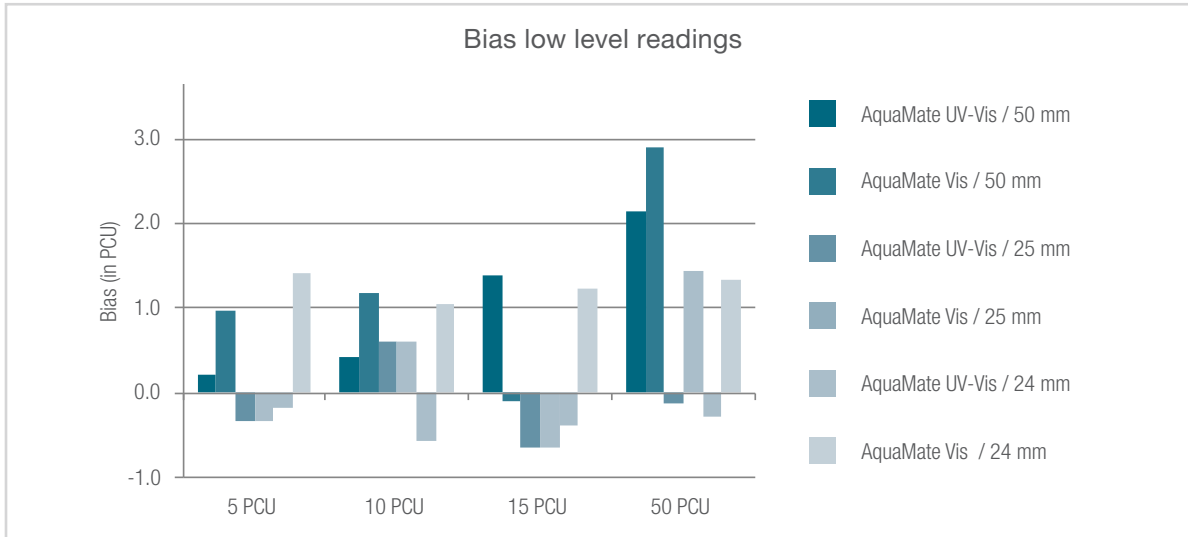
- Filtered (true color) and unfiltered (apparent color) readings for a turbid sample, a stream sample, and a low color stream samples showed precision near or less than 2% relative standard deviation (RSD) or precision less than 2 PCU standard deviation (for low color sample). See Figure 2.

**Sample cell path length and precision:** readings of true color in different surface water samples (Figure 3) indicate

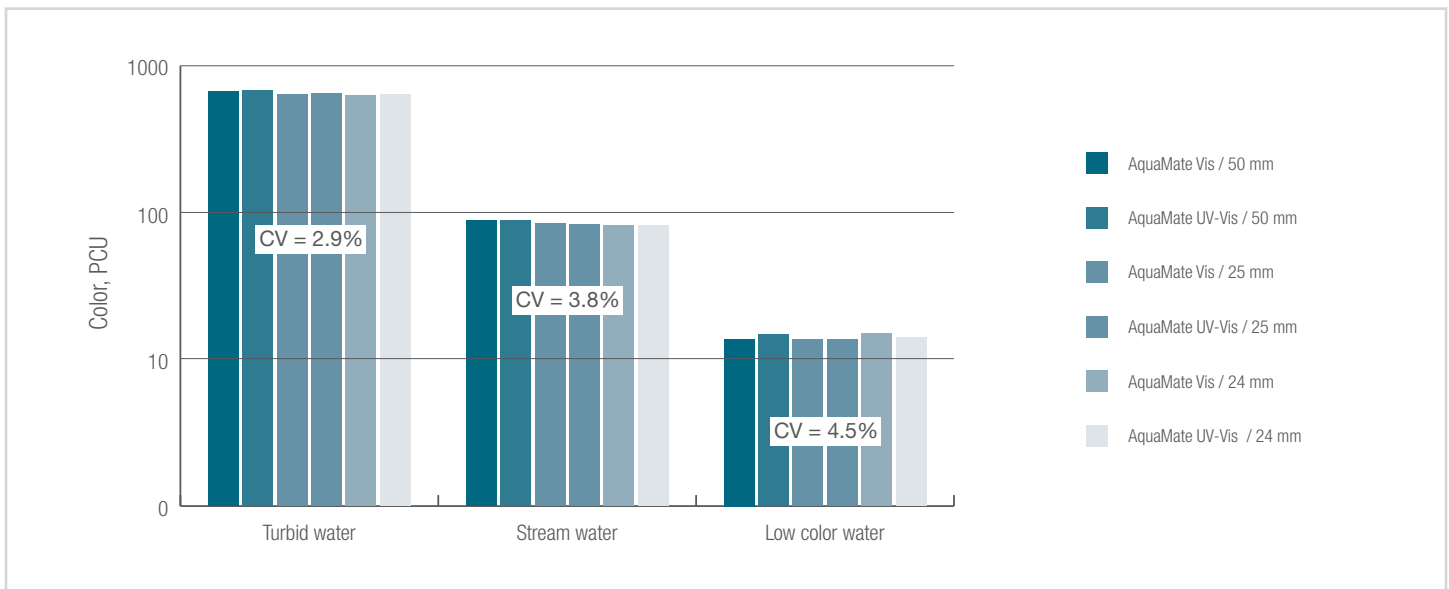
good agreement between various cells (50 mm, 25 mm, and 24 mm) and both meters. Good readings are achieved in all cases.

- True color readings on two different meters and three different cell sizes all agree to within 2.9% RSD (CV) for

**Figure 1. Orion AquaMate Spectrophotometer bias.**



**Figure 2. Sample cell path length and precision for three water samples**



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

Product	Cat. No.
<b>Instruments</b>	
Orion AquaMate UV-Vis Spectrophotometer	AQ8000 / AQ8100
Orion AquaMate Visible Only Spectrophotometer	AQ7000 / AQ7100
<b>Accessories</b>	
Orion AQUAfast 24 mm Round Vials (12 pack)	AC2V24
Nalgene 100 mL Polypropylene Copolymer (PPCO) Volumetric Flask	4000-0100
Barnstead Smart2Pure 12 UV Water Purification System	50129890

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](http://thermofisher.com/labwater).

\* The method described in this application note is compatible with Orion AquaMate Visible and UV-Vis Spectrophotometers.

\*\* For 50 mm cell, use CLRPT50; for 25 mm cell, use CLRPT25; for 24 mm cell, use CLRPT24.

†For best accuracy, use the same sample cell for measuring the standard, the blank, and the samples.

#### References

1. Standard Methods for the Examination of Water and Wastewater, Method 2120C. [www.standardmethods.org](http://www.standardmethods.org).
2. Bennet L, Drikas M (1993) The evaluation of color in natural waters. *Water Res* 27:1209.
3. Hongve D, Akesson G (1996) Spectrophotometric determination of water colour in Hazen units. *Water Res* 30:2771.
4. To prepare Platinum-Cobalt (Pt-Co) color standard solution, see the Standard Methods for the Examination of Water and Wastewater, Method 2120B.

Find out more at [thermofisher.com/aquamate](http://thermofisher.com/aquamate)