Application Note: Colored DissolvedOrganic Matter (CDOM) Calibration Procedures and Performance Data

Background

Colored or Chromophoric Dissolved Organic Matter (CDOM) is present in fresh or saltwater primarily due to the release of tannins (polyphenols that bind to proteins and other large molecules) or lignins (polymers of phenolic acids) by decaying plant material. CDOM may also be characterized as byproducts from the decomposition of animals. Watercolor may range from pale yellow to brown as a result of varying concentrations and sources of CDOM. One of the most interesting and important characteristics of CDOM is fluorescence. CDOM absorbs ultraviolet light and fluoresces visible blue light. The fluorescence of CDOM is used in many applications such as continuous monitoring of wastewater discharge, natural tracer of specific water bodies, ocean color research and the effect of CDOM on satellite imagery, and investigations of CDOM concentrations impacting light availability used for primary production.

Cyclops-7 CDOM Submersible Fluorometer

There are many methods for the determination of CDOM in water but the simplest and most cost efficient way is *in situ* fluorescence. Turner Designs has developed an *in situ* Cyclops-7 CDOM fluorometer that uses ultraviolet (UV) excitation for CDOM detection. Realizing there are different CDOM sources that may emit a range of wavelengths, we have chosen a broad range emission filter that will detect different sources of CDOM found in the natural environment.

The Cyclops-7 fluorometer can be integrated into a Turner Designs C6 Multi-Sensor Platform or any other third party datalogger that will provide power and accept 0-5 volt analog output.

Quinine Sulfate used as a Primary Standard

Quinine is a strongly fluorescent alkaloid that is extracted from the cinchona tree. Because it absorbs UV light and has high quantum fluorescent yield it has often been used as a standard in fluorometric analyses. Maximum fluorescence yield can be achieved if diluted in weak acids. It has an excitation wavelength of 350nm and emission wavelength of 450nm, similar to many CDOM compounds. This is why it is primarily used as a proxy for CDOM when calibrating or determining fluorometer specifications.

Quinine Sulfate Performance Testing

Linearity and Dynamic Range

Quinine Sulfate was diluted in a weak acid (0.05 Molar H^2SO^4) to different concentrations and was analyzed by the Cyclops-7 CDOM fluorometer (Figure 1). The regression curve drawn through the points in figure 1 shows a linear correlation to 1000 parts per billion (ppb) solution of quinine sulfate, however the dynamic range of the Cyclops-7 CDOM fluorometer is 2500 ppb quinine sulfate.

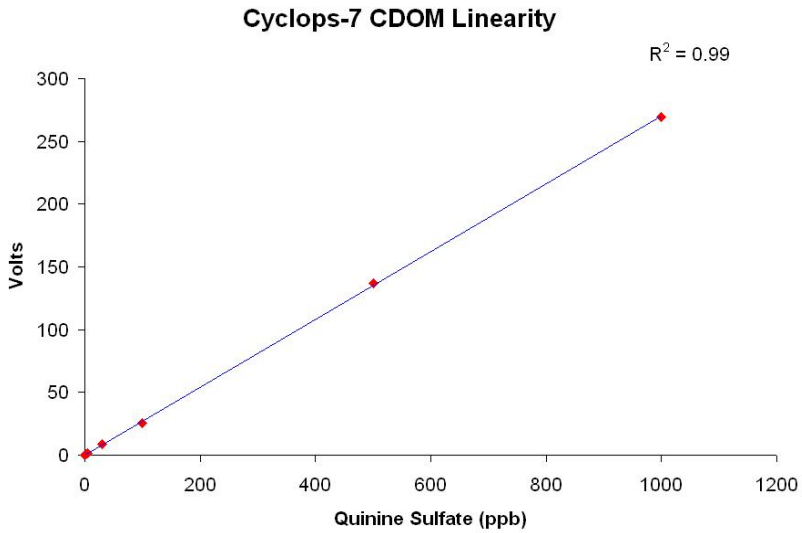

Figure 1: Linear regression of quinine sulfate dilutions from 0-1000 ppb (r^2=0.99).

Low End Resolution

The Cyclops-7 CDOM fluorometer is capable of detecting low concentrations of CDOM **(Minimum Detection Limit = 0.4 ppb quinine sulfate solution).** Quinine was diluted to low concentrations ranging from 0-30 ppb in weak acid (0.05 Molar H^2SO^4) and analyzed by Cyclops-7 CDOM fluorometer. The regression curve shows a good linear relationship for low concentrations of quinine sulfate solution.

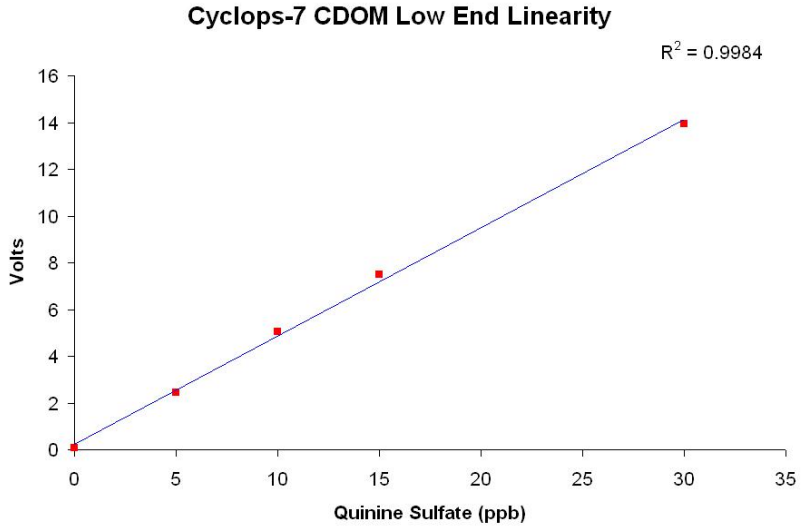

Figure 2: Quinine sulfate solutions from 0-30 ppb analyzed by Cyclops-7 CDOM fluorometer (r^2=0.99).

Turbidity rejection

Amco Clear Turbidity Standards were used to determine how well the Cyclops-7 CDOM fluorometer rejected turbidity. Solutions from 0-400 NTU were analyzed by the Cyclops-7 CDOM fluorometer (marked in blue; figure 3). Results show that a 400 NTU solution, which represents highly turbid conditions, produced a response, which was <1 ppb quinine sulfate solution. These results indicate that cross talk between excitation/emission filters is minimized, thereby maximizing CDOM's fluorescence signal.

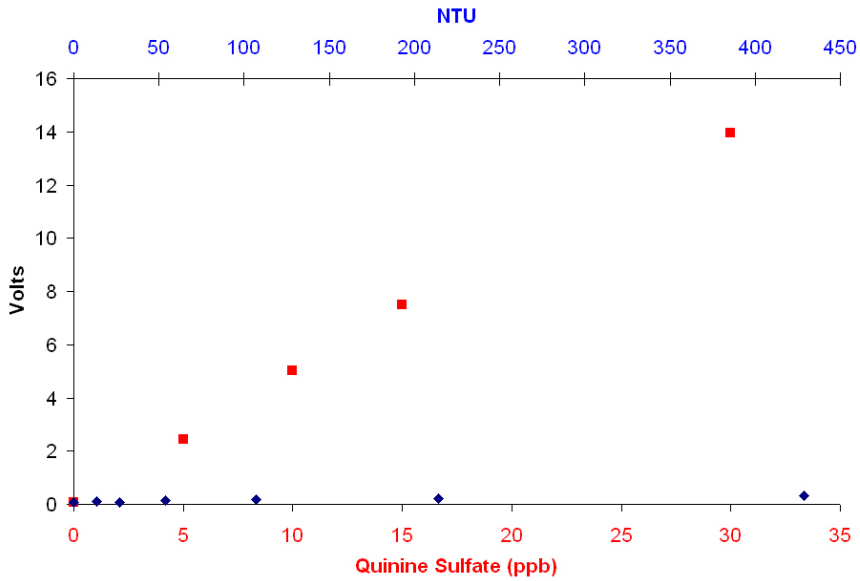

Figure 3: Cyclops-7 CDOM fluorometer response for varying turbidity solutions ranging from 0-400 NTU (Blue) compared to quinine sulfate low concentration solutions (Red). Results show good turbidity rejection.

References

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