Trilogy™ Laboratory Fluorometer

Application Note:
Optical Brightener Module for the Trilogy Laboratory Fluorometer

Application Overview

Optical Brighteners (OBAs) or Fluorescent Whitening Agents (FWAs) are added to products such as laundry soaps, detergents, and cleaning agents. They adsorb to fabrics or materials during the washing or cleaning process and when illuminated by ultraviolet light they fluoresce and make products and fabrics appear brighter.

Laundry wastewater is the largest contributor of brighteners to wastewater systems. FWA or OBA contributions to the total volume of most laundry detergents is less than 0.5%, however a large portion (up to 80%) can remain in discharged wastewater as dissolved compounds (molecular). The presence of brighteners in water systems, to which wastewater is being discharged, could mean failing septic systems, sewage leaks, or complete lack of water treatment. Therefore, detection of Optical Brighteners in aquatic systems can help water municipalities or researchers correct system failures and avoid increased anthropogenic input, which may greatly impact ecosystems.

Optical Brightener Module

Turner Designs manufactures and sells an Optical Brightener Module (PN 7200-047), which can be used with the Trilogy Laboratory Fluorometer, to detect the fluorescence of Optical Brighteners in water samples or systems. Trilogy modules contain the LEDs and filters necessary for the application of choice. The Optical Brightener Module uses a UV LED to excite samples resulting in a fluorescence signal at a 90 degree angle, which is read by the Trilogy fluorometer and displayed in relative fluorescence units. The types of cuvettes or test tubes that may be used for sample analysis are:

- 12 x 35 mm screw top glass test tubes (requires test tube adapter)
- 12 x 75 mm round bottom glass test tubes (requires test tube adapter)
- 10 x 10 mm plastic (polystyerene or methacrylate) cuvettes

Test Data

Most detergent manufacturers do not clearly state the type or the concentration of the brightener/whitening agent that is added to their product. This produces variability in fluorescence intensities among the different detergent products available to consumers.

The Trilogy fluorometer with Optical Brightener Module was tested to determine linearity, range, and detection limits. Three detergents were compared (Tide, Tide with Downey, and Good Day Laundry detergent with Bleach) to show variability in fluorescence properties among different detergent products.

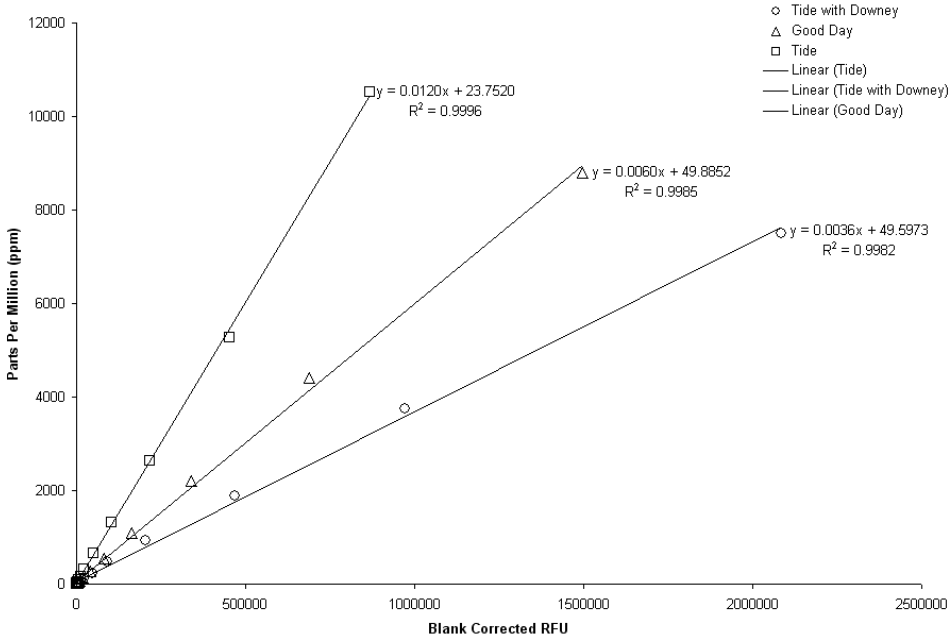

Figure 1 (left): Optical Brightener Module's fluorescence responses (RFU's) of varying concentrations from three different detergents. A linear regression for each detergent is shown with its respective slope equation and r-squared value.

TURNER DESIGNS
Reliable Instruments for an Unreliable World
www.turnerdesigns.com

The three different slopes in figure 1 are indicative of three different types or groups of brightener(s) added to detergents, respectively. We investigated the detection limits for each detergent to show how the detection limits may differ among detergents with brighteners. Table 1 lists the lower detection limits for the three detergents being tested along with their corresponding maximum linear range.

Detergent	Lower Detection Limit	Maximum Linear Range
Tide with Downey	0.60 ppm	15,000 ppm
Tide	0.50 ppm	10,000 ppm
Good Day with Bleach	0.10 ppm	9,000 ppm

Table 1: Parts per million (ppm or mg/L) concentrations represent amount of detergent in water. Variability of brightener limits among different detergents.

Quenching occurs when the fluorescence output of a given substance decreases as a response to increasing concentrations as shown by the dynamic range limit in figure 2. Although fluorescence responses outside of the linear range may be measured, they are unreliable and do not reflect absolute concentrations unless a correlation has been determined for that part of the curve. It is recommended that any solutions exhibiting a fluorescence response falling within the quenched part of the curve be diluted so that they may be analyzed within the linear part of the calibration curve allowing for a more accurate estimate of the fluorophore of interest.

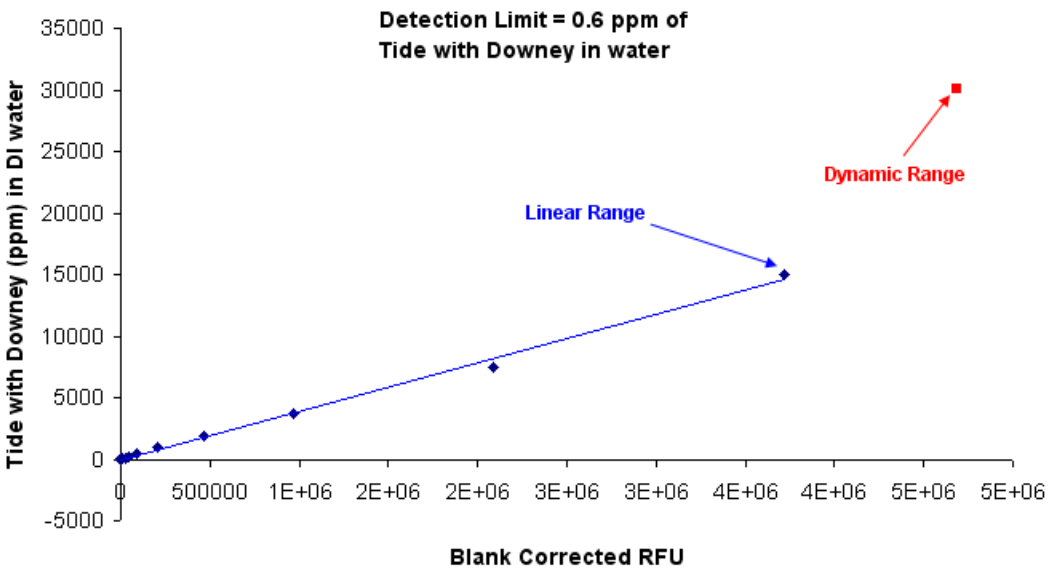

Figure 2: Linear range for Tide with Downey is plotted showing the linear limit and dynamic limit for detection of this detergent. r2 = 0.99 for linear regression.

Optical Brightener Correlations

Optical Brightener's fluorescence responses can be correlated to standards of known concentrations such as fecal coliform levels.

Water quality is also currently being assessed by fecal coliform standards through federal, state, and municipal agencies. Studies have shown that correlations can be made between Optical Brightener concentrations and fecal coliform levels. Correlating Optical Brightener fluorescence responses to fecal coliform levels can provide valuable information to help researchers determine if contamination sources are attributed to human waste.

References

C. Hagedorn, R.B. Reneau, M. Saluta, and A. Chapman 2002. Impact of Onsite Wastewater Systems on Water Quality in Coastal Regions. Virginia Coastal Resources Management Program. Virginia Department of Health. pg. 1-22

E.A. Cioffi and G.L. Goblick 1999. Fluorescent Whitening Agents As Facile Anthropogenic Pollution Indicators in Estuarine and Surface Water. Division of Environmental Chemistry Preprints of Extended Abstracts. Vol.39(2)

E. O'Connor 1996. Utilizing Brightening Agents As Indicators of Septic System. Environmental Health Division. Cayuga County Health Department. Auburn, New York.