Overview

Optical Brighteners (OBAs) or Fluorescent Whitening Agents (FWAs) are added to products, such as laundry soaps, detergents, or cleaning agents. They adsorb to fabrics or materials during the washing or cleaning process. 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 (5-80%) 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 that may greatly impact ecosystems.

Studies have shown a correlation between fluorescence of brighteners and fecal coliform levels in aquatic environments. Water quality is currently being assessed by fecal coliform standards through federal, state, and municipal agencies. Public access to water bodies such as lakes, rivers, or beaches that do not meet these standards can be restricted thereby impacting tourism and ultimately the local economy. The main problem in prevention of increased fecal coliform levels is the inability to determine the source of the contamination (human/non-human). Laundry wastewater is typically discharged through the household sewer or septic systems thus brighteners are a component of sewage wastewater. Brightener correlation to fecal coliform levels can provide valuable information to help researchers determine if contamination sources are attributed to human waste.

Brighteners are highly susceptible to adsorption. They are removed from surface and ground water by adsorption onto soil and organic material. This allows researchers to also assess the effectiveness of natural cleansing of wastewater by determining brightener concentrations in ground or surface waters.

Sampling Methods

There are various sample processing methodologies for optical brightener determination; the underlining factor among them is that fluorescence is mandatory for the determination of brightener concentration.

One fluorometric method that is currently being used takes advantage of the fact that brighteners are highly susceptible to adsorption. Cotton is used as the adsorbent material for capturing brighteners. It is submerged for a period of time then recovered and washed. Then ultraviolet light is used to detect the fluorescence intensity of the adsorbed brighteners.

Other methods use High Pressure Liquid Chromatography or Solid Phase Extraction to isolate specific brighteners, followed by fluorescence analysis. This method may prove to be quite expensive and is geared more towards analysis of specific brighteners such as, 2,5-(di-5-tert-butylbenzoyl)Thiophenate, 2,2'-(1,2-Ethenediyldi-4,1-phenylene)bisbenzoxazole, or 2,2-(1,4-Naphthalenediyl)bis-benzoxazole.

Fluorescence Methods

There has recently been increased interest in detection of brighteners using *in situ* fluorescence analysis of natural water samples. This interest might be largely due to the potential public health risks that may be avoided by evaluating brightener concentrations in the natural environment. Turner Designs currently manufactures fluorometers that detect optical brightners such as the 10-AU and Aquafluor Handheld fluorometer, which have been used in studies conducted by county health departments and water municipalities. Turner Designs has now developed a submersible *in situ* fluorometer for detection of optical brighteners, the UV Cyclops-7, to further facilitate sample analysis.

Submersible

Figure 1 shows instrument linearity for the Cyclops-7 Optical Brightener Fluorometer. Its large dynamic (>5000 parts per million) range allows it to operate in most aquatic environments and its high resolution increases instrument accuracy.

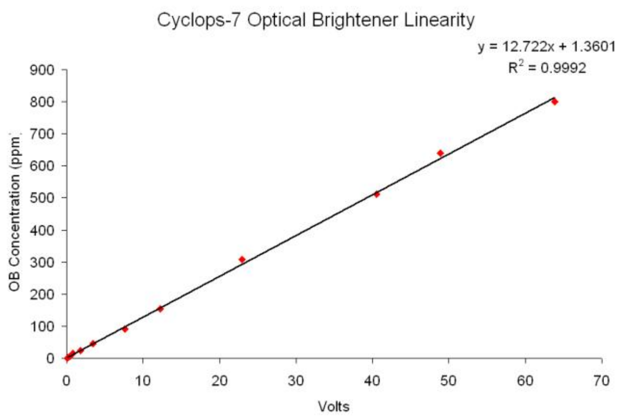

Figure 1: Good Day Ultra Laundry Detergent with Bleach Alternative was diluted to various concentrations and measured by Cyclops-7 Optical Brightener Fluorometer. (Note: different detergents will have different brightener concentrations)

Continuous Flow

The Turner Designs benchtop fluorometer, 10-AU, has proven to be very useful for the determination of brightener concentrations in aquatic environments.

A study, looking at the impact of wastewater systems on water quality on the coast of Virginia (Hagedorn et al 2002), used a flow through system to measure continuous data and concluded that the 10-AU could locate specific sites where on-site wastewater systems were entering rivers.

Figure 2: The Turner Designs 10-AU Fluorometer set up for flow through sampling of Brighteners (Hagedorn et al 2002).

Discrete Sampling

O'Connor (1996) used the Turner Designs 10-AU for discrete sampling in Owasco Lake Watershed. The goal of the study was to determine if the fluorometer could be used to identify sources of fecal coliform contamination. Results of this study concluded that the 10-AU Fluorometer is useful for tracking water quality parameters, which provides additional information that explains sources of contamination.

Figure 3 shows results from an Aquafluor Handheld fluorometer being used for discrete sampling. The post calibrated response of the Aquafluor to low brightener concentrations has perfect linearity (r^2=1). The calculated Minimum Detection Limit for brightener applications using the Aquafluor is 0.5 ppm (0.05% of linear limit).

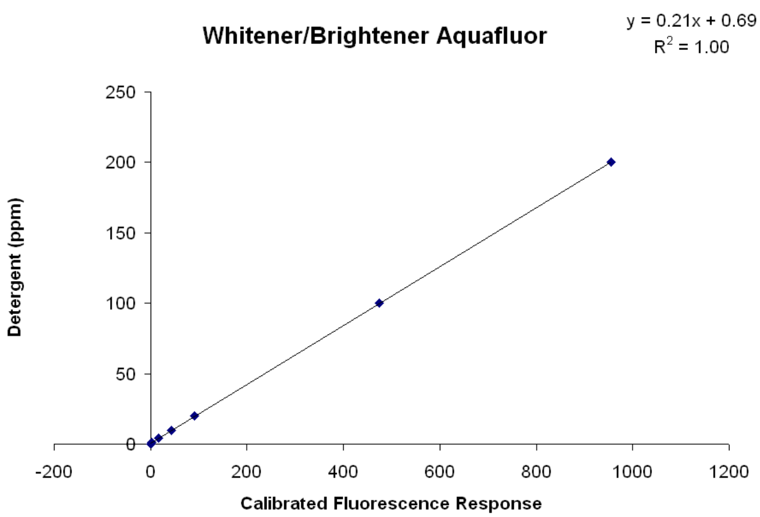

Figure 3: Good Day Ultra Laundry Detergent with Bleach Alternative was diluted to low concentrations and measured by the Aquafluor Handheld Fluorometer, post calibration. *(Note: different detergents will have different brightener concentrations)*

Turner Designs fluorometric determinations of brightener concentrations in natural water samples have been useful in finding wastewater sources and contaminations for Health Department studies as well as general research.

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.