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Detection of fluorescent whitening agents in mountain streams

Marie-Noelle Pons (1), Aziz Assaad (), and Olivier Potier ()

(1) Laboratoire Réactions et Génie des Procédés, Nancy Université, France (marie-noelle.pons@ensic.inpl-nancy.fr), (2) Laboratoire Réactions et Génie des Procédés, Nancy Université, France (aziz.assaad@ensic, (3) Laboratoire Réactions et Génie des Procédés, Nancy Université, France (olivier.potier@ensic

Fluorescence whitening agents or optical brighteners are used in detergents (60%) and in industries (paper, textile, plastic manufacturing). These molecules are highly soluble and poorly biodegradable. They are likely to get through biological wastewater treatment systems and to be discharged into the aquatic environment where they can be photodegraded by sunlight. Several streams of the Vosges mountains (north-east part of France) are possibly exposed to these micropollutants as paper and textile mills have been established along their banks since the XIXth century. A global assessment of the presence of optical brighteners has been done by differential fluorescence, i.e. by comparing the fluorescence properties of waters ample prior and after irradiation at 365 nm for 15 min (Hartel et al., 2007).
The method was first validated on four commercial optical brighteners (2 DiAminoStilbenes (DAS-1 and FB28) and 2 DiStyrylBiPhenyls (Tinopal CBS-X et Tinopal DMA-X) in solution in deionised water and on mountain river water collected upstream of any pollution source). Excitation-emission matrices and synchronous spectra (with a difference of 50 nm between excitation and emission) as well as UV-visible spectra were collected for irradiation times between 5 min and 1 hr. An irradiation time of 15 min was found to be optimal in terms of extent of fluorescence decay and reaction time. Synchronous spectra were finally preferred, for fluorescence assessment at they can be acquired quickly, with a good resolution of the fluorescence bands. The decay rates are function of the optical brightener. The possible interferences due to natural organic matter, wood humic substances, dyes (dilute solutions) and tryptophan-like substances (related to untreated domestic sewage) were tested.
River samples were then collected along mountain streams (Moselotte, Vologne, Upper Meurthe) during the winter season to minimize the possible photodegradation by sunlight. The samples were also analyzed in terms of dissolved organic carbons and ion species (nitrate, phosphate, ammonium). The results will be discussed in function of the localization and type of mills and of the domestic pressure (number of inhabitants in the watershed, localization of wastewater treatments plants).
Hartel et al., exposing water samples to ultraviolet light improves fluorometry for detecting human fecal contamination, Water Research 41 (2007) 3629-3642.