FluoroNet Newsletter 3

The Newsletter for the NERC Network 'Fluorescence for the Water Sciences' May 2006

Welcome to the third Newsletter from FluoroNet, the regular newsletter containing information about member events, activities, publications, courses, projects, instruments, etc... This needs your input! Details on how to submit articles for the next issue can be found at the end of the Newsletter.

First Fluoronet Conference

"Fluorescence and the Water Sciences: novel techniques, new applications"

The first 1-day conference to be sponsored by the Fluorescence for the Water Sciences Network is on Wednesday 11th October 2006, to be held at the Staff House, University of Birmingham. Entitled "Fluorescence and the Water Sciences: novel techniques, new applications", the Birmingham venue will again permit a 'hands-on' laboratory session with delegates invited to 'bring their own samples'. The conference is being co-sponsored by the British Hydrological Society.

The conference will comprise a mix of oral presentations and posters, with a small number of invited speakers. Further details, including a call for oral presentations and posters, is on the final page of this Newsletter, and has just been sent to all British Hydrological Society members. If you would like to present either an oral or poster presentation, or space to display instruments or material, please contact Andy Baker (a.baker.2@bham.ac.uk) or Jamie Lead (j.r.lead@bham.ac.uk).

A registration form will be attached to the next newsletter.

Members Only Area

In addition to past issues of the Newsletter, the members only area of the website now contains pdf files of PhD and EngD theses, in order to help improve knowledge transfer of material that is otherwise hard to access. Two theses are uploaded at the time of writing, that of Lucy Bolton (2004, University of Newcastle) on coloured water in upland catchments, and Emma Goslin (2003; Cranfield University) on natural organic matter reactivity.

Further theses will be uploaded soon. Any material that network members would like to have mounted on the members only area of the website can be sent by e-mail to Andy Baker (a.baker.2@bham.ac.uk) or by post to Marian Jordan (address at the end of the Newsletter).

Selected Recent Journal Publications

Scientific publications that feature fluorescence analyses of waters and waste waters and which have been published in the last two months:

Hur, J, Williams, MA, Schlautman, MA.
Evaluating spectroscopic and chromatographic techniques to resolve dissolved organic matter via end member mixing analysis
CHEMOSPHERE, 63(3), 387-402
Real-time or near real-time in-situ monitoring of dissolved organic matter (DOM) composition in natural waters and engineered treatment systems provides critical information to water quality scientists and engineers, particularly when the monitoring techniques can provide some information about the chemical nature of DOM. The efficacy of various indices derived from rapid, low-cost spectroscopic and chromatographic techniques to discriminate DOM composition was tested for samples prepared from well-defined mixtures of purified Aldrich humic acid (PAHA) and Suwannee River fulvic acid (SRFA). Sensitivities of the discrimination indices were examined by comparing (1) the differences between measured values and those predicted based from mass balance and the end member characteristics, and (2) the linear correlations between index values and mass ratios of the DOM mixtures. Size exclusion chromatography (SEC) results revealed that the weight-average molecular weight (MWw) may be a useful approach for tracking DOM mixing processes, although the number-average molecular weight (MWn) may be better for distinguishing different DOM compositions. Specific ultraviolet absorbance measured at 254 nm (SUVA(254)) performed better as a discrimination index than did two previously recommended absorbance ratios, both in terms of making better predictions of intermediate compositions and in exhibiting a more linear correlation with PAHA mass ratio. Several well-defined peaks in the derivative absorption spectra (301 and 314 nm for the first derivative, 217 nm for the third derivative. and 211 and 224 nm for the fourth derivative) also were found to be promising potential DOM discrimination indices. Finally, a fluorescence ratio based on humic-versus fulvic-like fluorescence proved to be a superior DOM discrimination index for the two DOM end members studied here. In general, this study illustrates the evaluation process that should be followed to develop rapid, low-cost discrimination indices to monitor DOM compositions based on end member mixing analyses.

Saadi, I, Borisover, M, Armon, R, Laor, Y
Monitoring of effluent DOM biodegradation using fluorescence, UV and DOC measurements
CHEMOSPHERE, 63(3), 530-539
The potential of effluent DOM to undergo microbial degradation was assessed in batch experiments. Effluent samples from Haifa wastewater treatment plant and Qishon reservoir (Greater Haifa wastewater reclamation complex, Israel) were incubated either with effluent or soil

microorganisms for a period of 2-4 months and were characterized by dissolved organic carbon contents (DOC), UV254 absorbance and by fluorescence excitation-emission matrices. Three main fluorescence peaks were identified that can be attributed to humic/fulvic components and "protein-like" structures. During biodegradation, specific fluorescences (F/DOC) of the three peaks were increased at various extents, suggesting selective degradation of non-fluorescing constituents. In some cases increase in the effluent fluorescence (F) was observed thus proposing (i) the formation of new fluorescing material associated with DOM biodegradation and/or (ii) degradation of certain organic components capable of quenching DOM fluorescence. Based on the ratio between fluorescence intensity and UV254, different biodegradation dynamics for fluorescent DOM constituents as compared with other UV-absorbing molecules was delineated. Overall, about 50% of the total DOM was found to be readily degradable such that residual resistant DOC levels were between 8 and 10 mg l^{-1}. Enhanced levels of residual DOM in effluent-irrigated soils may contribute to the DOM pool capable of carrying pollutants to groundwater.

Elliott, S, Lead, JR, Baker, A
Thermal quenching of fluorescence of freshwater, planktonic bacteria
ANALYTICA CHIMICA ACTA, 564(2), 219-225
This study aims to determine the thermal quenching properties of pure bacterial cultures as a means of aiding the development of fluorescence measurement in natural waters. The bacterium Pseudomonas aeruginosa was isolated from the urban River Tame, Birmingham, UK, and planktonic bacteria were grown in sterile, sealed glass jars, in 100 mL of sterile growth media at 37 degrees C for a maximum of 24 h. Samples were taken at T = 6 h and at T = 24 h, and thermal fluorescence quenching measured at 5 degrees C increments between 10 and 45 degrees C over 30 min. 3D excitation-emission matrix (EEM) plots were generated from the fluorescence analyses over time. It was found that the fluorescence of a microbial culture was significantly thermally quenched, but the results were dependent on the fluorophore type and the stage of the bacterial growth curve. Quenching was sometimes non-linear, presumably due to fluorophore production exceeding thermal quenching during the growth phase of the bacteria. Thermal quenching has the potential to allow us to confirm the importance of microbes in fluorescence signals by the non-linear response to increasing temperature, and to utilize the thermal fluorescence quenching properties of molecules to differentiate between fluorophores present during bacterial growth.

Sheng, GP and Yu, HQ
Characterization of extracellular polymeric substances of aerobic and anaerobic sludge using three-dimensional excitation and emission matrix fluorescence spectroscopy
WATER RESEARCH, 40(6), 1233-1239
In this study three-dimensional excitation-emission matrix (EEM) fluorescence spectroscopy was applied to characterize the extracellular polymeric substances (EPS) extracted from aerobic and anaerobic sludge in wastewater treatment. Three fluorescence peaks were identified in EEM fluorescence spectra of the EPS samples. Two peaks were attributed to the protein-like fluorophores, and the third to the humic-like fluorophores. The effects of both pH and EPS concentration were significant on EEM fluorescence spectra of EPS, but the ionic strength had no substantial effect on EEM spectra of the EPS. The differences in the EPS fluorescence parameters, e.g., peak locations, intensities and ratios of various peak intensities, indicate the difference in the chemical structures of the EPS from various origins. EEM spectroscopy was proven to be an appropriate and effective method to characterize the EPS from various origins in wastewater treatment systems.

Fu, PQ, Wu, FC, Liu, CQ, Xu, C, Wang, J, Bai, YC, Wang, LY
Effect of sunlight irradiation on fluorescence properties of dissolved organic matter
SPECTROSCOPY AND SPECTRAL ANALYSIS, 26(3), 471-474
Three-dimensional excitation emission matrix fluorescence spectroscopy (3DEEM) was used to investigate the effect of sunlight irradiation on the fluorescence properties of dissolved organic matter (DOM) from Lake Hongfeng and Nanming River waters and a commercial fluka humic acid (FHA). The results show that the DOM samples and FHA fluorescence properties changed under sunlight irradiation. Interestingly, the photodegradation characteristics were different between aquatic DOM and FHA. The fluorescence intensity of the apparent peaks A, B and C of lake and river water DOM decreased with sunlight irradiation. The initial 3DEEM of Fluka HA had only one fluorescence peak at λex/λem = 275/500 nm, while two fluorescence peaks occurred at λex/λem =245/450 nm and 310/450 nm, respectively, after sunlight irradiation. λex and λem maxima of DOM decreased during 7 days of sunlight irradiation. Changes in r (A,C) of DOM and FHA with sunlight irradiation time suggest that fluorescence peaks A and C had different fluorescence loss rates, while peak C fluorophores were more susceptible to sunlight irradiation. FHA appeared to be less susceptible to photodegradation, and its r(A,C) remained almost the same before and after sunlight irradiation.

Funding Opportunities

The NERC still has one Knowledge Transfer opportunity that might be of interest to Network members.

Partnership Research Grants
NERC invites applications to the Partnership Research Grants scheme. This supports collaborative research in order to help the transfer of knowledge between the research and user communities. Partners can be public or private sector organisations. Closing date: **Saturday, 1 July 2006.** Further information on Partnership Research Grants can be found at http://www.nerc.ac.uk/using/partnershiprg.shtml

Material for future issues

Your articles are needed! These can be sent at any time to:
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or by post to her at:
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British Hydrological Society

Joint Meeting: NERC 'Fluorescence for the Water Sciences' and BHS Midlands Section

Water fluorescence: novel techniques, new applications

Wednesday 11 October 2006

University of Birmingham

Recent advances in fluorescence technology have revolutionised its use in the water sciences. Better and faster optics permits the rapid detection of the intrinsic fluorescence of natural and pollutant organic matte. Laboratory analyses of natural organic matter have provided answers about its structure and function. Recent studies have sought to link microbial activity, freshwater fluorescence and water quality.

This one day meeting, co-sponsored by the NERC Knowledge Transfer network 'Fluorescence for the Water Sciences' (http://www.gees.bham.ac.uk/research/fluoronet/) seeks to introduce the latest findings from the diverse field of water fluorescence. By focusing on novel techniques and new applications, the meeting aims to bring together the state-of-art, and will be of interest to academics, consultants and water managers who are interested in the use of artificial or natural fluorescent tracers, or in natural or anthropogenic organic matter and their interactions in rivers, lakes, waste and drinking water.

Expressions of interest to present papers or posters should be sent to:

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