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Real-time water and wastewater quality monitoring using LED-based fluorescence spectroscopy

John Bridgeman and Yulia Zakharova
University of Birmingham, United Kingdom (y.s.zakharova@bham.ac.uk); (j.bridgeman@bham.ac.uk)

In recent years there have been a number of attempts to design and introduce into water management tools that are capable of measuring organic and microbial matter in real time and in situ. This is important, as the delivery of safe water to customers, and the discharge of good quality effluent to rivers are primary concerns to water undertakers. A novel, LED-based portable fluorimeter 'Duo Fluor' has been designed and constructed at the University of Birmingham to monitor the quality of (waste)water continuously and in real time, and its performance has been assessed in a range of environments.
To be of use across a range of environments, special attention must be paid to two crucially important characteristics of such instruments, i.e. their sensitivity and robustness. Thus, the objectives of this study were:
1. To compare the performance (in terms of their sensitivity and robustness) of the Duo Fluor and two other commercial fluorescence devices in laboratory conditions.
2. To assess the performance of the Duo Fluor in situ, in real time at a 450,000PE WwTW.
Initially, the impact of quinine sulphate (QS), a highly fluorescent alkaloid with high quantum fluorescence yield, on peak T fluorescence in environmental waters was examined for the Duo Fluor and two commercially available, chamber-based fluorimeters, (F1) and (F2). The instruments' responses to three scenarios were assessed:
1. Deionised water (DW) spiked with QS (from 0.05 to 0.4 mg/L);
2. Environmental water (pond water, PW) spiked with QS (from 0.05 to 0.4 mg/L);
3. Different water samples from various environmental source.
The results show that the facility to amend gain settings and the suitable choice of gain are crucial to obtaining reliable data on both peaks T and C in a wide range of water types. The Duo Fluor offers both of these advantages whilst commercially available instruments currently do not.
The Duo Fluor was subsequently fixed at the final effluent (FE) discharge point of a WwTW and FE was pumped into the cuvette. The instruments, along with other sensors, were checked twice a week. The Duo Fluor successfully collected data continuously from 10th August 2015 to 7th September 2015 (∼500 hrs). Data analysis showed that the Duo Fluor demonstrated very good correlation with the other instruments; albeit, some commercially available instruments measure only peak T or peak C, whereas Duo Fluor measures both. The results also identified rainfall events in the catchment, which manifested themselves via decreases in both peak C and peak, suggesting that a dilution of organic and microbial matter had occurred.