Sensors for real-time monitoring of drinking water quality and treatment processes

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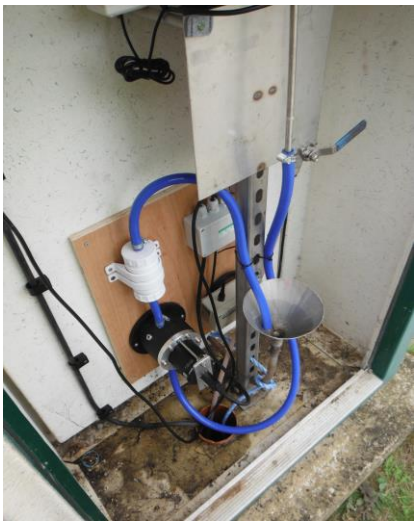
Inactivation of pathogens with chlorine is an essential part of drinking water treatment. However, chlorine also generates harmful disinfection by-products from reactions with natural organic matter (NOM). There is a need for real-time sensors to monitor these processes in-situ, due to the time required by established microbiological and, chemical analyses, as well as the transient nature of pathogen contamination and NOM in raw water supplies. Better understanding of the dynamic nature of links between pathogen contamination and disinfection-by product formation potential will facilitate more efficient use of treatment technologies. It will also improve understanding of the hydrological processes that control pathogen contamination, including those related to intense episodic rainfall events. This research aims to improve the monitoring, protection and management of drinking water supplies, with potential applications in water utilities and private supplies in both developed and developing economies.



Sensor installation at a public water supply site, UK

Fluorescence sensor

This research project will focus on the application of novel in-situ fluorescence sensors for monitoring protein and humic signatures, which can be used as proxies for pathogens and disinfection by-product production e.g. trihalomethanes, in drinking water supplies and downstream treatment and water supply networks (e.g. Sorensen et al 2015; Yang et al., 2015). Groundwater, the most abundant drinking water source globally, is the focus of this PhD. A network of sensors including high frequency in-situ measurements of raw water supplies using telemetry will be undertaken and combined with roaming spot checking from within the supply network and water treatment plant. Laboratory batch experiments will be undertaken to better understand the sensor detection capability and differentiate between different sources of fluorescence signal. In partnership with water supply utilities in the UK the novel application of a new technology will be tested. There is scope for exploring opportunities for deploying and using this technology for understanding water quality dynamics in municipal drinking water supplies in India or Africa as part of this research project.

Training opportunities:

In the first year, you will be trained as a part of a single cohort on research methods and core skills at University of Surrey. Throughout the PhD, training will progress from core skills sets to MScclasses specific to the student's

projects and themes. Specifically they will be able to attend modules on the University of Surrey's renowned MSc in Water and Environmental Health Engineering. Specific training in fieldwork skills, statistics, hydrogeology and analytical data analysis will also be given by the NERC and Surrey. The student will be based in a professional research office of BGS, Wallingford. In-kind assistance and hands on experience in field and analytical methods needed to undertake the research will be provided by BGS and Surrey.

Student profile:

This project would be suitable for students with a good degree (First ideally) in a range of either environmental or physical sciences (including but not limited to chemistry, biology, biochemistry, geography or engineering) and/or students with a relevant MSc (e.g. engineering, hydrogeology, hydrology, public health). Previous experience in undertaking fieldwork would be highly desirable, as high level of numeracy and some level of experience in undertaking laboratory analysis and familiarity with GIS and statistical packages. A willingness to undertake fieldwork and laboratory work is essential - this will form key activities for the PhD.

References: (optional)

Sorensen, J. P. R. et al. (2015). In-situ tryptophan-like fluorescence: a real-time indicator of faecal contamination in drinking water supplies. Water Research, 81, 38-46.

Yang, L., et al. (2015). Assessing trihalomethanes (THMs) and N-nitrosodimethylamine (NDMA) formation potentials in drinking water treatment plants using fluorescence spectroscopy and parallel factor analysis. Chemosphere, 121, 84-91.

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