Centre for Sustainable & Circular Technologies

UNIVERSITY OF BATH

Centre for Sustainable and Circular Technologies; University of Bath

Project Title:	**Water fingerprinting with mass spectrometry for environmental and public health assessment**
Lead Supervisor and co-supervisors:	Lead supervisor: Prof Barbara Kasprzyk-Hordern Co-supervisor: Professor Julie Barnett Co-supervisor: Dr Kishore Jagadeesan Industrial co-supervisor: Mr Richard Standerwick
Industrial Partner:	Wessex Water

Project Summary

There is a need to reduce pharmaceutical levels in the aqueous environment due their impact on natural environment and humans, as well as to comply with changing water quality regulations. Pharmaceuticals in the environment are mainly attributed to the discharge of treated effluent from wastewater treatment works. To reduce the load of pharmaceuticals in the environment, greater control and treatment at wastewater treatment works would be required. However, this would lead to a significant increase in the costs of wastewater treatment, embedded and operational carbon in addition to an increase in water bills. This is in addition to the wider costs of illness to society, which pays twice to exacerbate a problem. The current situation is therefore unsustainable and needs disruptive change. The intention of this project is to provide the data and evidence to help prompt that change.

This project will focus on the development and application of water fingerprinting approaches with utilisation of powerful mass spectrometry techniques: triple quadrupole analysis for selected pharmaceutical targets and high-resolution mass spectrometry for non-target/retrospective analysis of environmental and public health determinants. Water fingerprinting (or wastewater-based epidemiology) has the potential to revolutionise health-care provision as it can provide real-time and cost-effective community-wide public health diagnostics, since urban water can be considered as a diagnostic medium for the health status of a community and surrounding environment.

The year 2020 witnessed a crisis in healthcare systems due to the COVID19 pandemic. SARS-CoV-2 has had an unprecedented impact on humanity globally. It exposed the acute inability to manage the virus due to lack of reliable surveillance systems focussed on rapid identification of SARS-CoV-2 hotspots. WBE has since enabled SARS-CoV-2 surveillance in the UK. Post-COVID applications will include the development of new approaches that will be explored in this project. The project will:

Objective 1. Develop mass spectrometry focussed frameworks for spatiotemporal water fingerprinting of existing digitally frozen samples in EChPH group repository.

Objective 2. Undertake analysis of urban water samples to establish spatiotemporal trends in environmental and public health determinants (pharmaceuticals, metabolites, endogenously formed markers).

Objective 3: Undertake data triangulation to verify environmental and public health status and risk assessment

Subject to the signing of a contractual agreement, the project will be carried out in collaboration with Wessex Water.

Supervisory team: Prof B. Kasprzyk-Hordern (UoB, environment fingerprinting, mass spectrometry), Prof Julie Barnett (UoB: public health) and Dr Kishore Jagadeesan (UoB: modelling in R and mass spectrometry) and Mr Richard Standerwick (WW: water systems).

Training: Training in a range of modern analytical and bioanalytical techniques including cutting-edge state-of-the-art chromatography coupled with tandem mass spectrometry techniques will be provided. In addition, he/she will work with the leading water utility company in the UK, Wessex Water. Experience of academic / industrial research and development at the cutting edge of water quality analysis, and development of legislation and water policy, will provide an exciting opportunity for further personal development.

Sustainability issues addressed

In today's increasingly global and interconnected world, over half of the world's population lives in urban areas. The coming decades will bring further profound changes to the size and spatial distribution of the global population. The proportion of the world's population living in urban areas is expected to increase to 66% by 2050. As the world continues to urbanize, sustainable development challenges will be increasingly concentrated in cities. The unprecedented speed of urbanization constitutes globally substantial risks to the resilience of cities with public health and welfare being the most critical concern. Urban environments can affect public health in many different ways, e.g. via exposure to pollutants in water, poor sanitation, rapid spreading of infectious diseases due to high density of population. Furthermore, cities are also powerful drivers of population mobility, which increase regional and global communicable disease risks. The 21st century has already seen the epidemic of SARS (2003), H1N1 (2009), Ebola (2014), Zika virus (2015) and SARS-CoV-2 (2019). This highlights global vulnerability to infectious diseases and shared global responsibility for surveillance and disease control.

To increase sustainability of urban dwellings, there is a need for an early warning system (EWS) identifying public health threats within the cities, which will (i) collate spatial and temporal datasets including real-time estimates of public health status and (ii) rapidly respond to environmental, policy or other changes within the surveyed system with the aim of disease prevention, and public and environmental health promotion. Such robust EWSs are currently not available. However, if operated in real-time and if linked with timely response systems, they could allow public health threats to be identified rapidly, at low cost, and instantly dealt with, reducing in this way burden on public health in Europe and ultimately worldwide. Urban water fingerprinting provides an ultimate solution.

Eligibility criteria and selection process

Application:

Formal applications should be made via the University of Bath's online application form for a PhD in Chemistry. Please ensure that you state the full project title and lead supervisor name on the application form.

http://www.bath.ac.uk/guides/how-to-apply-for-doctoral-study/

Funding Eligibility:

This studentship is for 3.5 years' duration and includes Home tuition fees, a stipend (£15,609 per annum, 2021/22 rate) and a budget for research expenses and training.

Information may be found on our fee status guidance webpage, on the GOV.UK website and on the UKCISA website.

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