Open Master Internship position

Title: “Synthesis and characterization of materials for the passive sampling of norovirus”

Keywords
Virus, capture, adsorbents, activated carbon, biopolymer, adsorption/desorption, genomic analysis, water

Objectives
The main aim of this project is to synthetize efficient porous carbon materials for the capture/desorption of enteric virus in water Other objectives are: (i) to increase the knowledge in knowledge of interaction of viruses with solid surface; (ii) to provide methods and guidelines for the development of a passive sampling method of enteric virus in various type of aquatic system.

Position and tasks
BLOOMING, "Bio-chemicaL apprOaches fOr sMart water quality monitorING" is a 2-year research project, funded by the “ASSPOSAN” association, in collaboration with Normec-Abiolab laboratory. It involves 3 academic partners (EDYTEM, ASPOSAN and ENSIP-Poitiers), and one private laboratory (Normec-Abiolab laboratory). The EDYTEM laboratories is one partner of this project. The aim of BLOOMING is to gain a better understanding of the relationships between the genomic quantification of gastroenteritis viruses (by RT-qPCR) and the nature of the water. From a methodological point of view, this will involve studying the analysis of viruses by using adsorbent materials (spiked murine Noroviruses) in waste water filtered successively by microfiltration and nanofiltration methods in order to determine the influences of the water matrix on the analysis.

The work of internship dedicated to a task of BLOOMING will consist in preparing appropriate materials inform of films or beads with mesopores (2nm < pore diameters < 50 nm) to physisorb/desorb enteric virus in various kind of water (tap water, ground water and waste water).

The major trends towards globalization combined with the present overpopulation of our planet are significantly accelerating the large-scale circulation of quantities of more or less pathogenic viruses. The fight to limit the spread of these viruses as well as their dangerousness, constitutes the main part of my current research. Enteric viruses can be transmitted by various means, including drinking water, and have the potential to cause illness and death. Among these viruses, human noroviruses are the primary culprits responsible for gastroenteritis. However, their cultivation in the lab is complex, highlighting the importance of developing an extraction method for these autochthonous viruses. Such a method is crucial for effectively cleaning water, investigating their characteristics, and monitoring their evolution. Currently, the methods used for their analysis in wastewater require large quantities of water contaminated with pollutants (metals, organic matter, sediments), which can inhibit the techniques used to analyze the genome of these viruses. In addition, viruses in water are dispersed and interact with pollutants in wastewater, making them even more difficult to recover. This is why this project aims to develop materials with controlled porosity for the concentration and analysis of human noroviruses (virus of gastroenteritis) in wastewater and drinking water.

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At first, materials with controlled mesoporosity (2 nm < pore size < 50 nm) will be prepared and specifically shaped by mixing different types of carbons such as mesoporous templated carbon, carbon black, carbons particles obtained from hydrothermal treatment, and binders such as chitosan and PVDF (PolyVinyliDene Fluoride), for subsequent use in virus capture in aquatic medium. Chitosan-based materials, such as millimetric hydrogel beads and films, will be also prepared using a gelation method, to obtain materials with controlled mesopore diameters. The gelation of hydrogels will be achieved through the reaction of acidic chitosan solutions with a base. Some magnetic nanoparticles (e.g. Fe3O4) will be added to the materials to allow the magnetic separation of the materials from water medium. Some films will be prepared by using embossed templates in order to try develop a nanostructured surface appropriate for virus adsorption.

The prepared materials will be observed by Scanning Electron Microscopy (observations of the surface of the freeze-dried hydrogels or films, in order to investigate the multiscale porosity including macropores (pore size > 50 nm) and mesopores able to host the studied viruses. The materials' porosity and specific surface area will be determined from N2 physisorption isotherms (at 77 K). The zeta potential of the chitosan hydrogels, the carbons and the composite materials will be measured.

To investigate the influence of OM (Organic Matter) on the virus adsorption/desorption, selected samples with various OM amounts will be prepared by filtration of water from the Waste Water Treatment Plant (WWTP) of Grand Chambery (https://www.grandchambery.fr/). The water quality will be characterized by TOC (Total Organic carbon) analysis, TN (Total Nitrogen) BOD (Biological Oxygen Demand), COD (Chemical Oxygen Demand) and TSS (Total Suspended Solid).

The prepared materials will be applied for grown murine norovirus (MNVs) (diameter □ 35 nm) sampling studies in various conditions targeting both virus adsorption and release in various kind of water media. In these experiments, the non-pathogenic grown MNVs suspension will be used as a model for human noroviruses medium. The amount of virus adsorbed and desorbed on the prepared materials will be determined by Reverse Transcription-quantitative Polymerase Chain Reaction (RT-qPCR) analysis of remaining viruses in the supernatant.

The prepared materials (films and beads) will also be tested in an automated passive sampling apparatus (named "BABASO") designed and built by our team allowing the determination of the evolution of virus concentration with time. "BABASO" maims at in-situ cleaning up the gastroenteritis viruses in the outflow of Chambery wastewater treatment plant. It can also be easily used in river and lake waters.

Link with Erasmus program

Candidate funded by an Erasmus program may follow some courses/practicals /projects of the Master of Green Chemistry and Eco-innovations of the University Savoie Mont Blanc.
(https://www.univ-smb.fr/scem/formations/departement-de-chimie/master-chimie-verte-et-eco-innovations/)

Period of the internship

The position is open for a period of 6 months in 2025 or 2026.

Profile

The candidate is a student in Master of Science or Engineer in materials science or chemistry or Environment. He/She possesses a background in materials chemistry or chemistry-physics or

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environmental chemistry. Good experience in the laboratory experimental work in chemical and analysis techniques is required. Knowledge in analytical chemistry will be positively considered.
The candidate is expected to produce independent and original research in the defined area, to be capable of working highly autonomous, to interact with the members of the group, to write progress reports, and to participate in dissemination activities such as progress meetings.

Required documents for the application
- Short Curriculum Vitae and a covering letter showing your interest and especially addressing your professional project
- 1 Recommendation letter.
- Scores and rank in the last formation

The selected candidates will be first interviewed by videoconference.

Contacts
Laurent Duclaux (Prof.), **Laurent.Duclaux @univ-smb.fr** +33 (0)479 758 805
Laurence Reinert (Assistant Prof.), **Laurence.Reinert @univ-smb.fr** +33 (0)479 758 122

Workplace
EDYTEM, University Savoie Mont-Blanc, Le Bourget du Lac – Rhône-Alpes Auvergne – France

Employer
University Savoie Mont-Blanc
With 14 000 students, a rich variety of multidisciplinary education and 19 research laboratories internationally renowned, the University Savoie Mont-Blanc is a human-sized institution which combines proximity with its territories and a wide perspective on Europe and the world.
The campus sites at Le Bourget-du-Lac offers particularly attractive living and studying conditions, at the center of an exceptional environment, between lakes and mountains.
The aim of the University Savoie Mont Blanc is, on the one hand to develop international projects, joint award qualifications, and programs delivered in English, and on the other hand, wherever possible, to encourage mobility for students, lecturers and researchers as well as for administrative staff. Although present in 5 continents, with its 240 bilateral agreements, it has been able to take full advantage of its outstanding location on the borders of Switzerland and Italy to develop strong, special relationships with the higher education establishments of these two countries.

Laboratory Environment Dynamics and Territories of the Mountain (EDYTEM)
With a truly interdisciplinary approach, EDYTEM looks at the environment in the widest sense (its climate, chemistry, biology and ecology as well as the social, economic and political aspects), studying archives, resources, changes and vulnerabilities and the players' terms of commitment. EDyTEM (Environnements, Dynamiques et Territoires de Montagne, UMR Université de Savoie Mont Blanc/CNRS 5204) and its « Matières » team are focused on green chemistry synthesis and biomass valorization processes, and particularly on the synthesis and characterization of porous activated carbon materials for environmental adsorption applications. Over the past decade more than 60 articles have been published in international scientific journal on porous carbon preparation and application, and more than 15 communications have been made in national and international research projects on carbon materials; more than 10 research contracts have been operated with private companies. More details are on the web site of "EDYTEM" (in French): https://edytem.osug.fr/

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