Master 2 – Internship proposal

Title: Particle-mediated PFASs transport in flow-through column experiments

Background

The topic of per- and polyfluoroalkyl substances (PFASs) is a late-breaking issue due to its high environmental relevance (toxicity, persistence and bio accumulation) and due to the detection of PFASs as contaminants in environmental compartments such as groundwater, surface water and soil. Once as a substance in the hydrologic water cycle, PFASs can contaminate drinking water and cause severe health problems. PFASs enter the environment for instance through industrial, agricultural, and house-hold induced pathways. Since 2019, perfluorooctanoic acid (PFOA), known for its exceptional stability due to a perfluoroalkyl tail group, has been evaluated as a persistent organic chemical under the Stockholm Convention and thus got included in the list of restricted substances. Restricted PFASs have often been replaced by similar molecules of the same family with shorter carbon chains so that nowadays around 3000 different molecules of PFASs can be found. Even though PFASs have been manufactured by anthropogenic activities since the 1940s, research of treatment or transport of these chemicals in water and soil is still not fully investigated yet.

Previous studies have already found out that retention of PFASs depends on various factors such as the PFASs type (e.g. molecular structure and weight) [1] [2], the soil properties (e.g. amount of organic carbon, pH) [1] [3], or the conditions of the pore water (e.g. degree of water saturation, ionic strength) [4] [5]. Therefore, different adsorption mechanisms of PFASs onto the soil were detected depending on the environmental conditions.

Objective

It is vital to know if adsorption also occurs for released particles during the flow-through experiments with PFASs, since PFASs are known for their adsorption behavior onto solid phases [1] [6]. It is expected to observe a correlation between colloidal particles and the transport of PFASs since it is known that natural soil colloids can facilitate the mobility of contaminants that have a high affinity for soil constituents and would otherwise have low mobility [6] [7] [8] [9]. Thus, natural soil colloids can contribute to the mobility of e.g. long-chain PFASs, which are considered to be poorly mobile in soils due to their affinity with the supposedly immobile organic matter [10]. So far, only two investigations have been working on colloid-facilitated PFASs transport and both were using disturbed soils and solutions spiked with only one molecule of the PFASs group. In our case, particle-mediated PFASs will be studied in undisturbed soils, which were previously contaminated by human activities with a mixture of PFASs molecules.

Expected work

The Master student will work closely with the PhD student and their work will contribute to the IPANEMA project funded by ADEME. During the internship, the Master student will test different flow-through scenarios with the objective to define tendencies under which environmental conditions the particle release in/decreases in combination with an in/decrease of PFASs concentration.

These experiments will be performed in soil columns which will be exposed to successive simulated rainfall events, where meanwhile the effluents will be collected and later on their colloid concentration determined. Particular attention will be paid to the separation of PFASs in colloidal and dissolved phase to be able to indirectly determine the adsorbed PFASs onto the particles by measuring the PFASs concentration in the liquid phase of the effluent.

It is planned to start with a literature study about particle release and adsorption mechanisms of PFASs, which helps to develop meaningful scenarios of PFASs transport in leaching experiments in soils. Later on, the scenarios will be executed in flow-through experiments and analyzed for particles and PFASs. The Master student will write a detailed scientific report including all steps executed during the internship of 6 months.

Candidate profile

Master (M2) or engineering student with an interest in environmental chemistry and/or willingness to learn key issues in this field. Knowledge of and/or experience with laboratory experiments and chemical analysis is preferable but not mandatory.

Supervision

Denis Courtier-Murias (denis.courtier-murias@univ-eiffel.fr) and Elisabeth Fries (elisabeth.fries@univ-eiffel.fr)

Localisation

Laboratoire Eau et Environnement, Université Gustave Eiffel, campus de Nantes (Allée des Ponts et Chaussées, CS 5004, 44344 Bouguenais cedex)

Duration

6 months from 01.02.2021 (duration and starting date to be adjusted according to the availability of the candidate)

Renumeration

between 446 and 603 €/month (depending on the number of working days in the month)

Application form

CV, motivation letter, and excerpt of Master courses to be sent to Denis Courtier-Murias (denis.courtier-murias@univ-eiffel.fr) and Elisabeth Fries (elisabeth.fries@univ-eiffel.fr)

References

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