

Invitation to Ph.D. defense

The **REVERSAAL** research unit from the French National Institute of Research in Agriculture and Environment invites you to the Ph.D. defense of the thesis entitled :

Study of Vertical Flow Treatment Wetlands by X-ray Computed Tomography

By :

German Dario MARTINEZ CARVAJAL

PhD candidate - University of Lyon – Claude Bernard

Supervised by :

Pascal MOLLE : INRAE

Laurent OXARANGO : University of Grenoble Alpes

On :

Tuesday 4th February 2020 - 14 :00

At :

INRAE - 5 rue de la Doua - Villeurbanne 69100 – Salle Rhône

Abstract

Fouling and clogging are major concerns regarding Treatment Wetlands (TW) operation and performances. Several techniques are currently used to assess these phenomena indirectly based on their relation with physical (e.g. hydraulic conductivity), chemical (e.g. fouling material composition) and biological parameters (e.g. enzymatic activity) of TW. Few of them focus on the geometrical structure of porous media, which is essential to understand the mechanisms governing solids filtration. This work presents the use of X-ray Computed Tomography (CT) as an imaging methodology to study French Vertical Flow (VFTW). It is a non-destructive technique that produces 3D images of an object at high resolution which show its inner structure. Images from samples of French VFTW show the presence of three phases: voids, fouling material, and granular media (gravel). A methodology to extract, and scan the samples and segment the phases in the images is developed. The use of state-of-the-art image processing algorithms to measure pore scale properties is demonstrated. The spatial representativity of pore scale measurements is assessed: (i) a 2D-Representative Elementary Volume (REV) for the volume fraction of the phases was determined. It suggests that the sample diameter should be larger than 1.5 cm. To avoid significant shear stress during the sample extraction, the minimum recommended diameter is however 5 cm. (ii) pore scale properties were compared between samples extracted from different locations in a large homogeneous region of a mature French VFTW determined using Frequency Domain Electromagnetic Methods. Several similarities among the samples at the pore scale are highlighted. Finally X-ray CT was used to study the structural changes of porous media in French VFTW during the rest period and their influence on fouling and clogging processes. Despite a limited evaporation rate (2 mm/d), a significant reduction of the deposit layer thickness that is formed above the filter has been observed (with values dropping by 12% to 34%). Effects within the gravel filter were also noticed and the importance of the rest period to maintain a macropore network and to allow air to enter the microporosity has been proven.

Key words

Clogging, Fouling, Constructed Wetland, Pore Scale, Spatial Representativity, Rest Period, Drying, Porosity

