

EGU2020-17490

<https://doi.org/10.5194/egusphere-egu2020-17490>

EGU General Assembly 2020

© Author(s) 2021. This work is distributed under the Creative Commons Attribution 4.0 License.



Influence of pH on the formation of organic and mineral colloids and the associated release of various elements from surface sludge deposits of vertical flow constructed wetlands.

Camille Banc¹, Mathieu Gautier¹, Blanc Denise¹, Lupsea-Toader Maria¹, Marsac Rémi², and Gourdon Rémy¹

¹Université LYON 1, INSA-LYON, DEEP, France (camille.banc@insa-lyon.fr)

²Université Rennes, CNRS, Géosciences Rennes, France

In the treatment of raw domestic wastewaters in vertical flow constructed wetlands (VFCW), a sludge layer is formed at the surface of the first-stage filters by the retention of wastewater's suspended solids. The deposits constituting this layer is now known to accumulate and degrade a large variety of contaminants during regular conditions of operation. The potential release of the contaminants from the sludge deposits under disturbed conditions or during off-site sludge reuse is therefore a major concern. This study investigated the influence of organic colloids on the mobilization of major and trace elements bound to VFCW surface sludge deposits.

Although the role of organic and/or mineral colloidal carrier phases in the transport of elements in natural systems has been extensively studied, little is known in contrast on the production of colloidal carrier phases from anthropic materials and media such as the sludge deposits considered here.

The acid/base neutralizing capacity (environmental assessment procedure ANC/BNC) (CEN/TS 14429) was carried out to assess the release at different pHs. Samples of sludge deposits were contacted with solutions in a wide pH range and the suspensions filtered through 0.45 µm acetate cellulose filters were subsequently analyzed. In addition, the suspensions were also treated by ultrafiltration using successively membranes of decreasing pore size (30 kDa, 10 kDa and 3 kDa). The leached organic molecules were thereby divided into three groups: (i) large colloids (30 kDa-0.45 µm), (ii) small colloids (10 kDa-3 kDa) and (iii) truly dissolved fraction (< 3 kDa). The permeates were analyzed for major and trace elements and organic particles. UV-vis spectra were also recorded to evaluate organic matter aromaticity.

Results showed that the molecular weight of the organic matter released was pH-dependent. Under very acidic conditions, the release of dissolved and poorly aromatic organic matter was mostly observed. At natural pH, close to neutrality, the sludge deposits released mostly large organic colloids. At higher pHs, the release of larger organic colloids was observed associated with an increase in the aromaticity of organic molecules.

The major and trace mineral elements released were found in the different fractions analyzed,

depending on their affinity with the organic colloidal carrier phases described previously. A first group of elements (As, P, B, V, Na, K) were mostly found in solution, and therefore poorly affected by colloidal transport regardless of pH conditions. A second group (Co, Cu, Ni, Cd, Zn) was found to be relatively uniformly distributed in the fractions associated with the large and small colloids as well as in the dissolved fraction. A third group (Cr, Ba, Mn, Ca, Li, Mg, Sr) was mostly associated to large organic and/or mineral colloids.

The results obtained in this study are a contribution to a better description of colloidal production and the release of associated elements and contaminants from VFCW sludge deposits. This is a key issue in the assessment of environmental risks related to the operation of the treatment plants or the reuse of the sludge material.