Phosphorus retention in constructed wetlands enhanced by zeolite- and clinopyroxene-dominated lava sand

JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)

ID 4620320
Author(s) Alewell, Christine; Huang, Jen-How; McLaren, Timothy I.; Huber, Lea; Bünemann, Else K.
Author(s) at UniBasel Alewell, Christine ; Huang, Jen-How ;
Year 2021
Title Phosphorus retention in constructed wetlands enhanced by zeolite- and clinopyroxene-dominated lava sand
Journal Hydrological Processes
Volume 35
Number 2
Pages / **Article-Number** e14040
Keywords filter materials; NMR spectroscopy; organic P species; P recycling; P saturation; sequential P extraction; vegetated soil filters; waste water cleaning
Constructed wetlands (CWs) are engineered systems for treating wastewater by sequestering nutrients and contaminants. Our aim was to assess the main phosphorus (P) binding states in operating CWs to assess P saturation and indications on P recycling potential of filter materials, which might be necessary under future peak P scenarios. The investigated vertical flow CWs (operation time up to 16) are based on either fluviatile (Fluv) sand or zeolite- (Ze-LS) and clinopyroxene (Cl-LS)-dominated lava sand. Organic and inorganic P accumulated in all CWs independent of filter materials and showed a considerable increase with operation time. Concentrations of P decreased sharply with depth in the Fluv-CWs compared to only a slight decrease in the lava sand CWs, with P concentrations of deeper horizons approximating the relatively P enriched original lava sand substrates. Orthophosphate was the dominant pool in all CWs, while the sum of organic fractions ranged between 11% and 33%. Sequential extraction indicated that P was mainly associated with Fe and Al (hydr)oxides for Fluv-CWs and Ze-LS-CWs, while Ca and Mg bound mineral phosphates dominated in Cl-LS-CWs. Oxalate extractions pointed to a clear dominance of P fractions associated with poorly crystalline Fe- and Al-(oxy)hydroxides. Solution 31P NMR analyses revealed that inositol hexakisphosphates were a major pool of organic P in surface layers of CWs, which increased with operation time. With a maximum of 0.5% P content, filter sands do not appear to be a suitable fertilizer for direct application to agricultural fields. The dominance of inorganic, poorly crystalline P species point to potentially high desorption capacity which might be investigated further, to assess recycling potential of P or usage of filter materials as soil amendments with relatively high plant available P. The latter might become feasible and economically attractive under future P scarcity. Simultaneously, P saturation indexes (DPS) did not indicate an imminent P saturation of filters, since P accumulation was not restricted by binding to Al and Fe minerals.
Publisher Wiley
ISSN/ISBN 0885-6087
edoc-URL https://edoc.unibas.ch/83228/
Full Text on edoc No;
Digital Object Identifier DOI 10.1002/hyp.14040
ISI-Number 000624003800018
Document type (ISI) Article