

Sludge treatment by earthworm-enhanced reed beds towards smart-cities

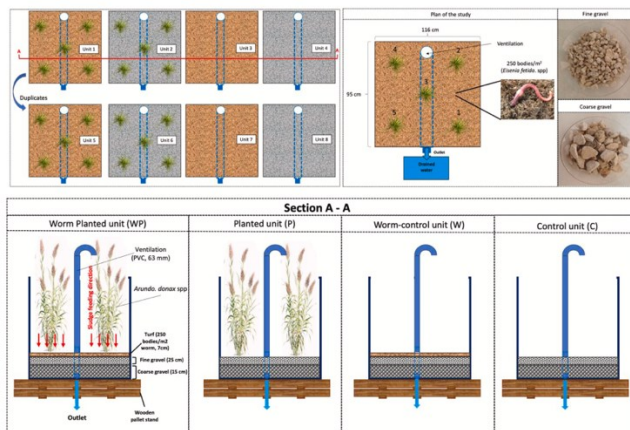
Summary

This study delved into possible resource recovery via sludge treatment reed bed (STRB), aiming to dewater sludge in a temperate climate. Mesocosms were developed at pilot scale in Beirolas WWTP and bench scale in ISA's Horto greenhouse. Innovative aspects include dewatering mixed sludge (MS) from primary and secondary treatment stages, using *Arundo donax* (*A. donax*) and incorporating earthworms into the STRB system (W-STRB). Beirolas experiment included eight units of worm-planted (WP), planted (P), worm (W) and control (C) and their duplicates, in which *A. donax* was studied. MS was fed every two weeks for one year (sludge-loading rate (SLR): 43.5 kg.DS.m⁻².year⁻¹). In the Horto experiment, *Phragmites australis* (*P. australis*) and *A. donax* were compared in six WP units and one C unit for eight months (April to November), during which SLRs of 50, 60 and 70 kg.DS.m⁻².year⁻¹ were assessed.

The Beirolas experiment showcased that WP units could increase 46% evapotranspiration and the rate of stabilization by 10% compared to P units due to the synergistic effect of plants and worms. WP units yielded 30% higher number of worms compared to W units, while WP units increased plant biomass production by 43% compared to P units. The released mass of contaminants in drained water (DW) was also significantly lower in WP units than P units. Residual sludge (RS) accumulation rate was 0.06 and 0.09 cm.year⁻¹ for WP and P units, reducing RS volume and heavy metals availability using worms. The Horto experiment showed that both *P. australis* and *A. donax* assisted with worms could be used for sewage sludge dewatering. *P. australis* showed 20% higher evapotranspiration than *A. donax* for the tested SLR, while the released mass of contaminants was lower using *P. australis*. This study underscores the potential of W-STRB as a nature-based solution for sewage sludge resource circularity and sustainable value creation.

Keywords

Nature-based solutions, resource recovery, sludge dewatering, earthworm, sustainable sludge management.



Sludge treatment reed bed (STRB) pilot study at Beirolas Wastewater Treatment Plant, Lisbon.



PhD student

Amir Gholipour

PhD program

Environmental Engineering (ISA, University of Lisbon)

Supervisor

Elizabeth Duarte (ISA, University of Lisbon)

Co-supervisors

Ana Galvão (CERIS, IST, University of Lisbon) and Rita Fragoso (ISA, University of Lisbon)

Period

2021-2024

Funding

FCT scholarship/2020