CERIS : Civil Engineering Research and Innovation for Sustainability

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

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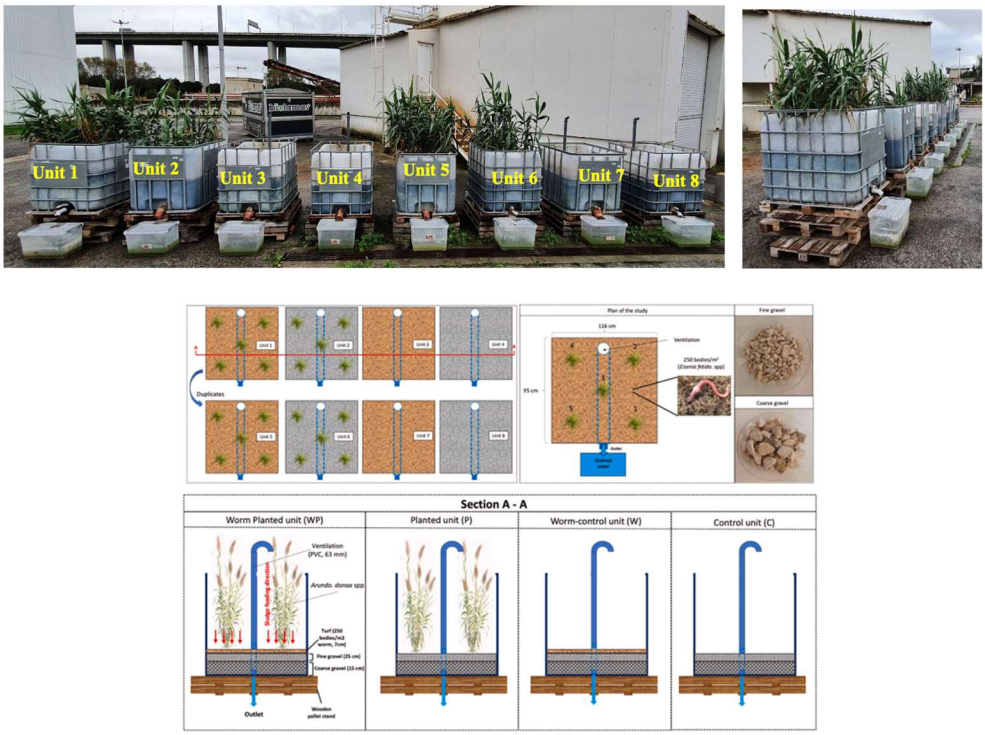
Summary

This study delved into possible resource recovery via sludge treatment reed bed (STRB), aiming to dewater sludge in 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 STRB system (W-STRB). Beirolas experiment included eight units of worm-planted (WP), planted (P), worm (W) and control (C) and its duplicates in which A.donax was studied. MS was fed every two-week for one year (sludge-loading rate (SLR): 43.5 kg.DS.m-2.year-1). In 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) in which SLRs of 50, 60 and 70 kg.DS.m-2.year-1 were assessed.

Beirolas experiment showcased 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. Horto experiment showed 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 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.