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Truths from the Field: Operating the Heraklion Hospital Wastewater Treatment Pilot Unit. Results and Optimisation Proposals Within the LIFE-HIPPOCRATES Project

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Abstract

Hospital wastewater constitutes a major source of contaminants of emerging concern (CECs), antibiotic-resistant bacteria (ARBs) and antibiotic resistance genes (ARGs), which are largely diluted and undetected once discharged into municipal sewage systems. The LIFE-HIPPOCRATES project (101113941, LIFE22-ENV-EL-HIPPOCRATES) addresses this challenge through the design, installation and operation of an on-site demonstration treatment unit at the Venizeleio General Hospital of Heraklion, Crete, designed to remove CECs, ARBs and ARGs directly at source, prior to discharge into the main sewage network.

Following installation in early 2025, the unit entered a structured operational framework comprising four distinct phases, start-up and stabilisation, operational optimisation, full performance evaluation and long-term validation, allowing systematic technical assessment under real hospital effluent conditions. Continuous monitoring was carried out at four critical sampling points along the treatment train (raw influent, mixed liquor, membrane bioreactor output, and final effluent after advanced oxidation and disinfection), covering both physicochemical parameters (BOD, COD, TSS/VSS, nitrogen species, total phosphorus) and microbiological indicators.

This presentation reports the key operational findings from the unit's first year of real-world operation. Results demonstrate high mean removal efficiencies for BOD (95.5%), COD (86.8%), TSS (96.7%), VSS (97.7%) and ammonium nitrogen (99.8%), alongside substantial reductions in total coliforms, E. coli, enterococci and Pseudomonas spp., confirming effective organic matter, solids and microbiological removal. In contrast, total nitrogen (56.4%) and total phosphorus (8.4%) removal were markedly lower, highlighting specific process limitations related to incomplete denitrification and limited phosphorus removal capacity.

Critically, the initial treatment configuration required in-field reconfiguration to meet performance targets under real operating conditions, and a dedicated three-week consecutive-sampling campaign revealed that the hospital's existing aerated holding tank was unintentionally pre-treating the wastewater and masking the true variability of the raw influent. Based on these findings, the installation of a dedicated equalisation tank fed directly from the upstream sewer manhole was proposed and implemented, aimed at homogenising influent characteristics, reducing shock loads, and improving feed stability to the biological process.

By presenting real operating data alongside the practical troubleshooting and optimisation measures that followed, this work offers field-tested guidance for the operation, replication and scale-up of decentralised on-site hospital wastewater treatment systems, in line with the

broader objectives of the LIFE-HIPPOCRATES project.

Keywords: hospital wastewater, on-site treatment, pilot unit operation, process optimisation, antibiotic-resistant bacteria, LIFE-HIPPOCRATES

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