

Performance, Operational Optimization and Technical Evaluation of the HIPPOCRATES Demonstration Unit under Real Operating Conditions

E. Maragkaki¹, F. Galliou¹, A. Papadaki¹, C. Bouki¹, E. Viskadouraki¹, S. Dokianakis¹, M. Dragasaki¹, I. Daliakopoulos¹, G. Markakis¹, N. Katsarakis¹, N. Vidakis¹, T. Manios¹

¹Department of Agriculture, Hellenic Mediterranean University, Heraklion, Crete, Greece

Presenting author email: tmanios@hmu.gr

INTRODUCTION

The **HIPPOCRATES LIFE** project aims to evaluate the efficiency and operational stability of an innovative on-site hospital wastewater treatment system under real operating conditions. The demonstration unit was installed at the General Venizeleio Hospital in Heraklion, Crete, Greece, in order to assess the treatment efficiency of hospital effluents containing organic pollutants, nutrients, pathogens, pharmaceuticals, and contaminants of emerging concern (CECs).

The project focuses on decentralized hospital wastewater treatment before discharge into the municipal sewerage system, with emphasis on:

- pharmaceutical removal,
- pathogen reduction,
- nutrient management,
- operational optimization,
- and water reuse potential.

HIPPOCRATES UNIT



SAMPLING & MONITORING STRATEGY

Monitoring at critical stages for performance evaluation and water reuse potential



4 SAMPLING POINTS • INTEGRATED MONITORING
CONTINUOUS PERFORMANCE ASSESSMENT



WHAT WE MONITOR

Physicochemical
pH, EC, COD, BOD₅, TSS, NH₄⁺, NO₃⁻, TP, Turbidity, TOC, DO, Temperature

Microbiological
E. coli, Enterococci, Total coliforms, Pseudomonas spp., etc.

Pharmaceuticals & CECs
Target analysis of pharmaceuticals and contaminants of emerging concern

Monitoring & Automation
Remote monitoring, real-time data acquisition, control & alarming

Our Goal:
Safe treatment and sustainable water reuse

From influent to reuse – data-driven monitoring for a reliable and sustainable hospital wastewater treatment system.

OBJECTIVES

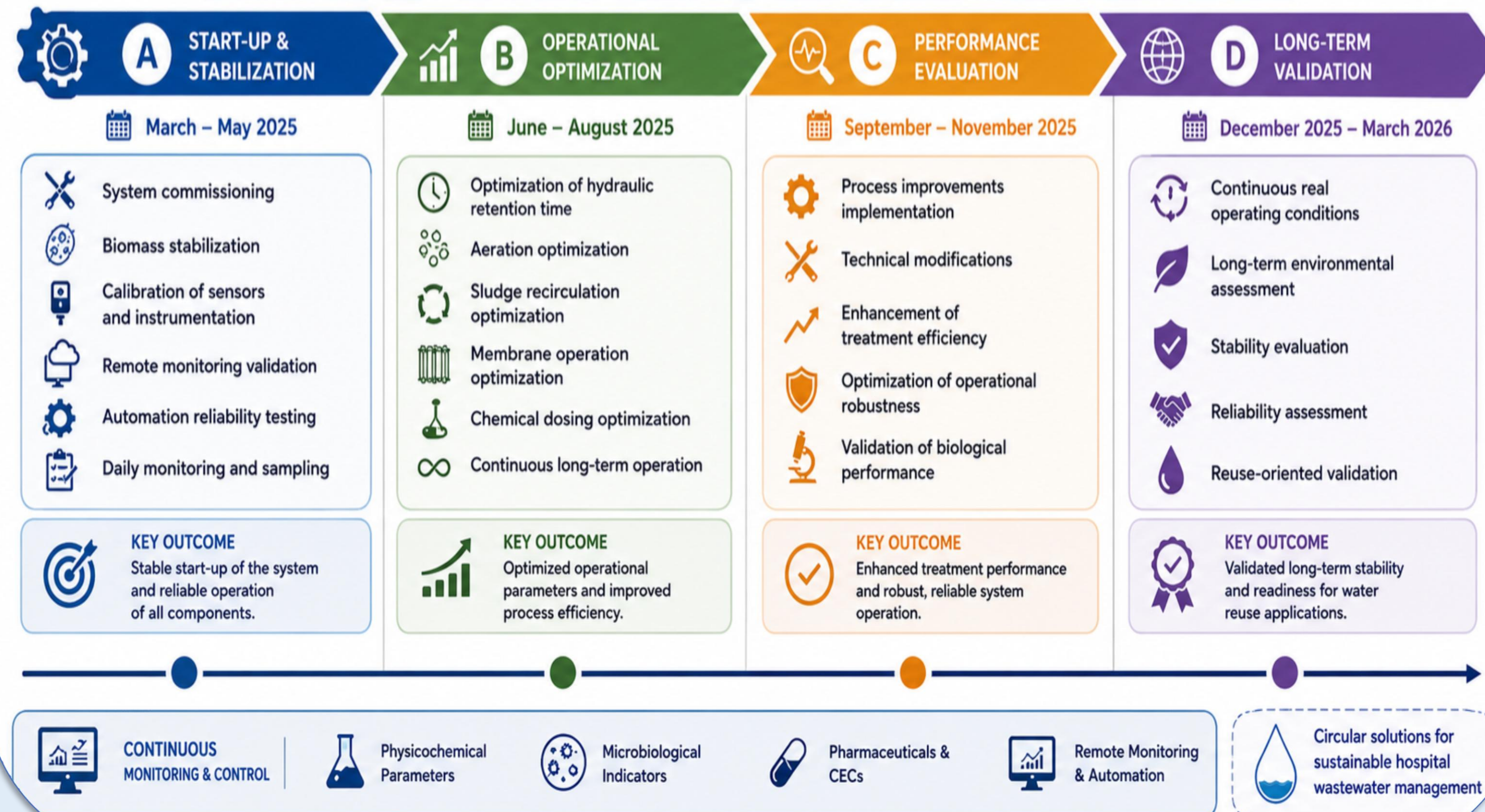
Main objectives of the HIPPOCRATES project:

- Evaluation of the operational stability of the demonstration unit
- Optimization of biological and membrane treatment stages
- Assessment of physicochemical and microbiological removal efficiency
- Investigation of AOP polishing performance
- Long-term validation under real hospital wastewater conditions
- Assessment of reuse-oriented treatment performance

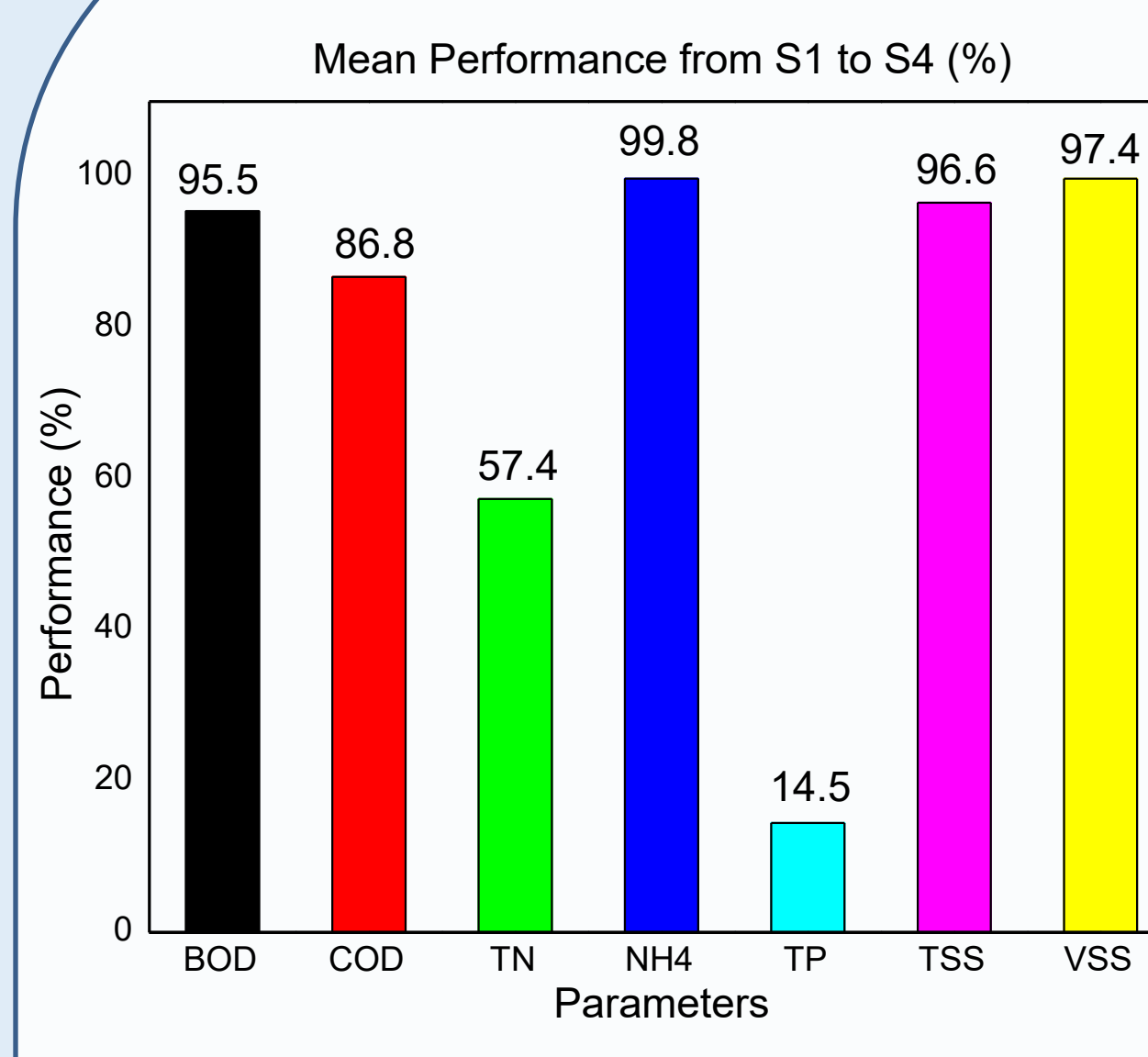
FIRST OPERATIONAL YEAR STRATEGY

HIPPOCRATES Demonstration Unit

The first operational year of the HIPPOCRATES demonstration unit was structured into four operational periods (A-D), focusing on system stabilization, optimization, performance evaluation, and long-term validation.



PRELIMINARY RESULTS



- Organic load removal remained particularly high, with BOD₅ and COD reductions reaching 95.5% and 86.8%, respectively.
- Excellent solids removal performance was observed, with TSS and VSS removals exceeding 97%.
- Stable nitrification was achieved, resulting in almost complete NH₄⁺ removal (99.8%).
- Nutrient removal performance remained satisfactory throughout the monitoring period.
- Operational optimization significantly enhanced treatment performance. Final optimized removal efficiencies reached 99.3% for BOD₅, 93.2% for COD, 66.9% for TN, 99.9% for NH₄⁺, 98.1% for TSS and 99.9% for VSS.

The optimized system consistently produced a high-quality effluent with strong potential for reuse-oriented applications.

Microbiological Performance

- Significant reduction of microbial indicators was observed throughout the treatment process.
- Near-complete removal of E. coli, total coliforms and Pseudomonas spp. was achieved at the final effluent.
- The combined MBR and AOP treatment stages substantially enhanced disinfection efficiency and effluent quality.

CONCLUSIONS

- ✓ The **HIPPOCRATES** system demonstrated stable operation under real hospital wastewater conditions.
- ✓ Biological and membrane treatment stages achieved high pollutant removal efficiencies.
- ✓ Operational optimization significantly improved system robustness.
- ✓ The AOP stage enhanced final effluent polishing and disinfection.
- ✓ The system presents strong potential for future full-scale decentralized hospital wastewater treatment applications.

ACKNOWLEDGMENTS

This research was co-funded by the EU LIFE+ project with name “A Holistic Approach towards onsite hospital wastewater treatment”, project number 101113941 and project acronym “LIFE22-ENV-EL-HIPPOCRATES”