13th IWA Specialized Conference on Small and Wastewater Systems

5th IWA Specialized Conference on Resources-Oriented Sanitation

Promoting on-site urban wastewater reuse through MBR- RO treatment

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PRESENTATION AIM&LAYOUT

Aims

- Present Athens DESSIN's sewer mining unit
- Examine MBR-RO performance
- Confirm effluent water's superior quality
- Cross validate results with Greek legislative framework

Layout

- Introduction to Sewer Mining
- Athens demo site and SM unit presentation
- Operating parameters and quality monitoring
- Plotted results
- Conclusions

CURRENT SITUATION

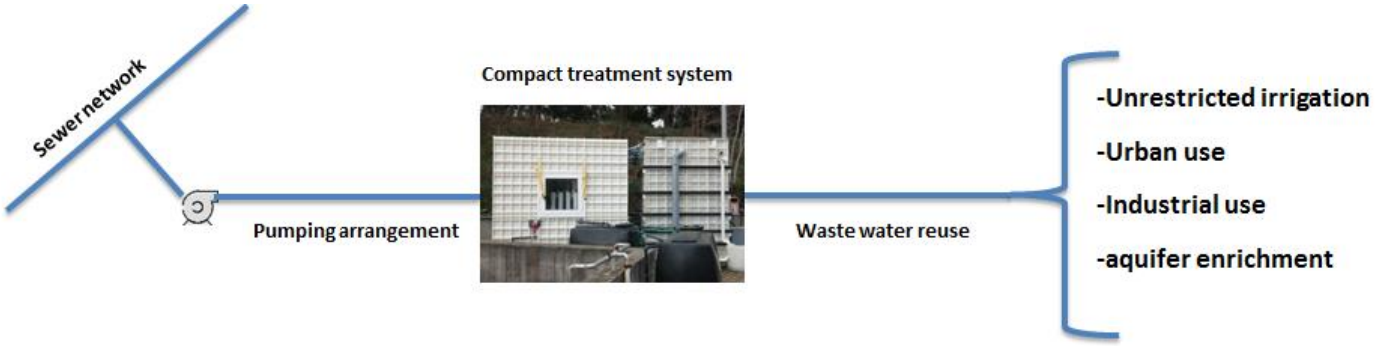
Financial crisis
Population growth
Rapid urbanization
Climate variability

→ Environmental degradation
Water scarcity

There is a **need** for innovative management options and technologies for water reuse

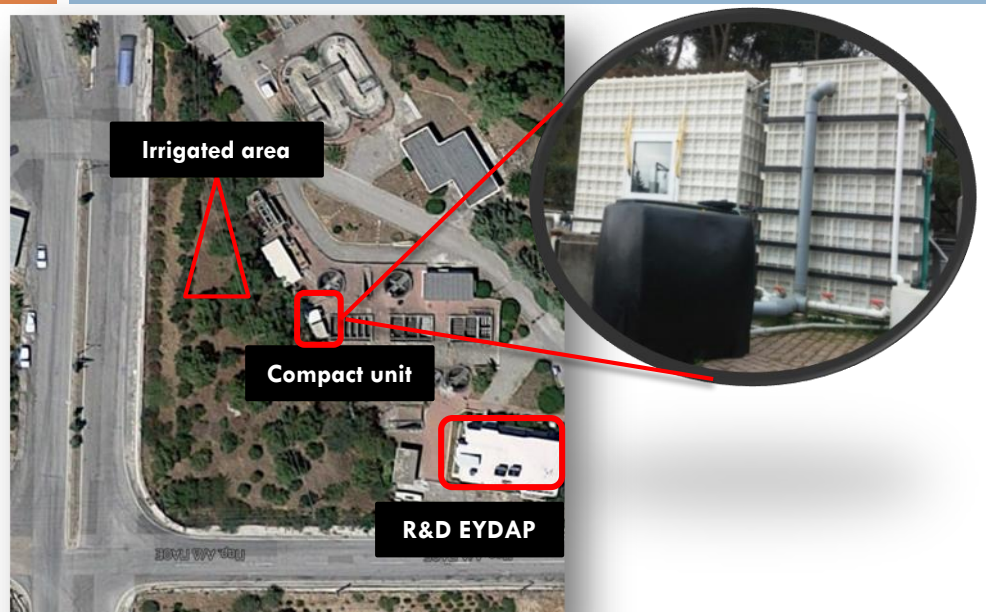
SEWER MINING TECHNOLOGY

Sewer mining is the process of tapping into a wastewater system, and extracting wastewater, which is then treated and used as recycled water



Compact sewer mining systems protect the environment in many ways, such as **saving fresh water** while creating **green spots** without further stressing the finite water resources, and all that in a cost efficient way

ATHENS UNIT

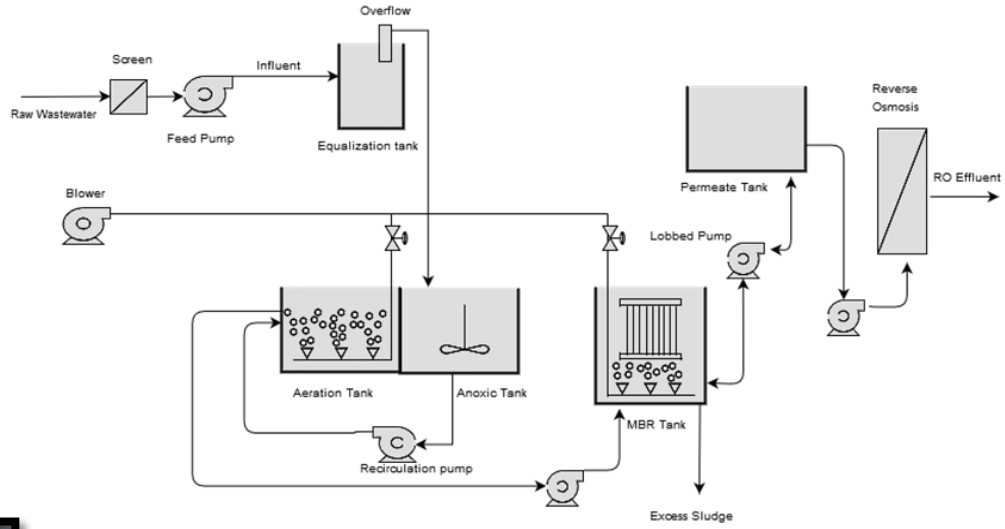


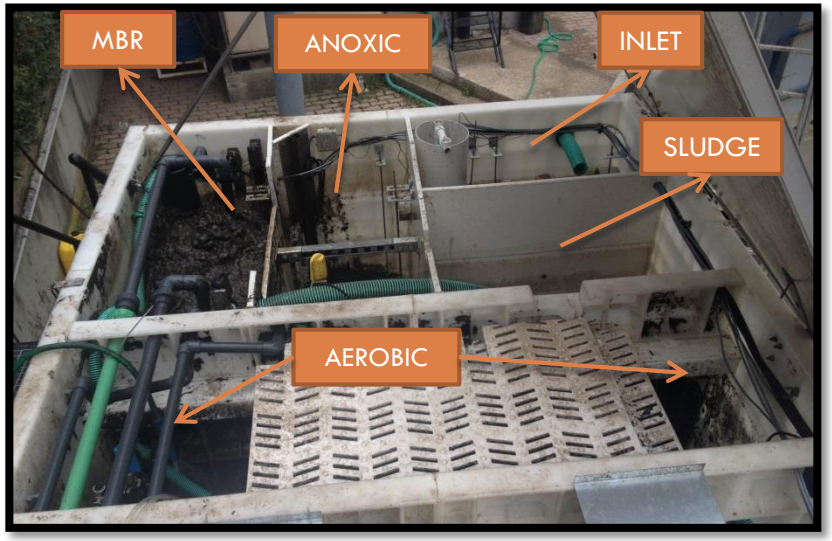
Innovations of Athens's SM unit:

- minimum landscape disruption
- close to the point-of-use ⟶ ⟶ low transportation costs
- advanced sewage treatment methods
- fully independent function
- remote management of several sewer mining units

DESCRIPTION OF THE PILOT-SCALE MBR-RO PROCESS

Dual membrane process
- Membrane Bioreactor (MBR)
- Reverse Osmosis (RO)





OPERATING PARAMETERS

Operation time	8 months
Capacity	10 m^3/d
Temperature	15-25°C
MLSS in MBR tank	8-9g/l
MLSS in anoxic-aerobic tank	6g/l
Sludge Retention Time (SRT)	20d

Operation cycle

- 10 min filtration
- 1 min back flushing

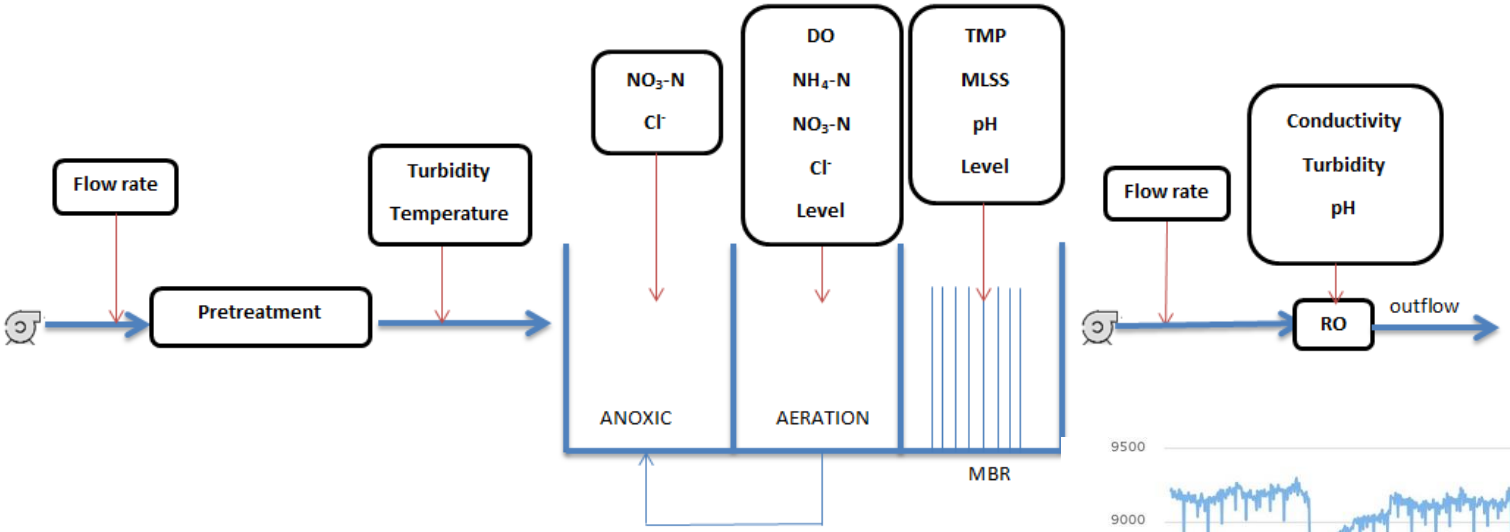
Maintenance cycles

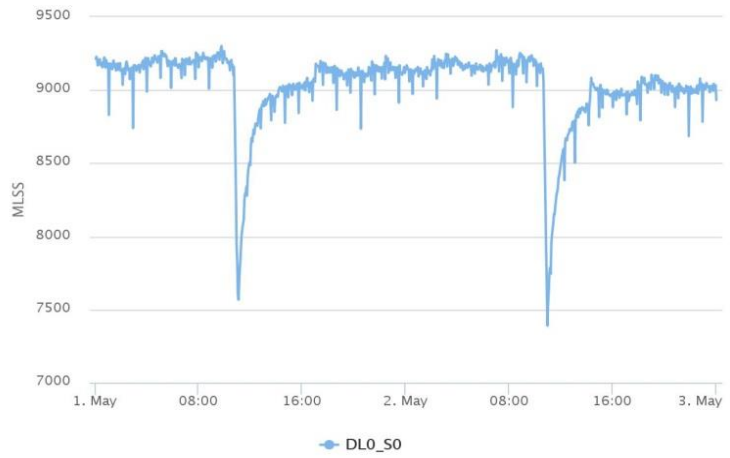
- 1oxidizing cleaning per day
- 1 acid maintenance per week

	Quantity (g/cycle)	**Duration (min)**
NaOCl (14%)	43	30
Citric Acid (30%)	340	40

MONITORING SYSTEMS

Low energy field sensors have been installed in several key points that upload data on a web platform ⟶ ability of **remote monitoring & real time alerting**



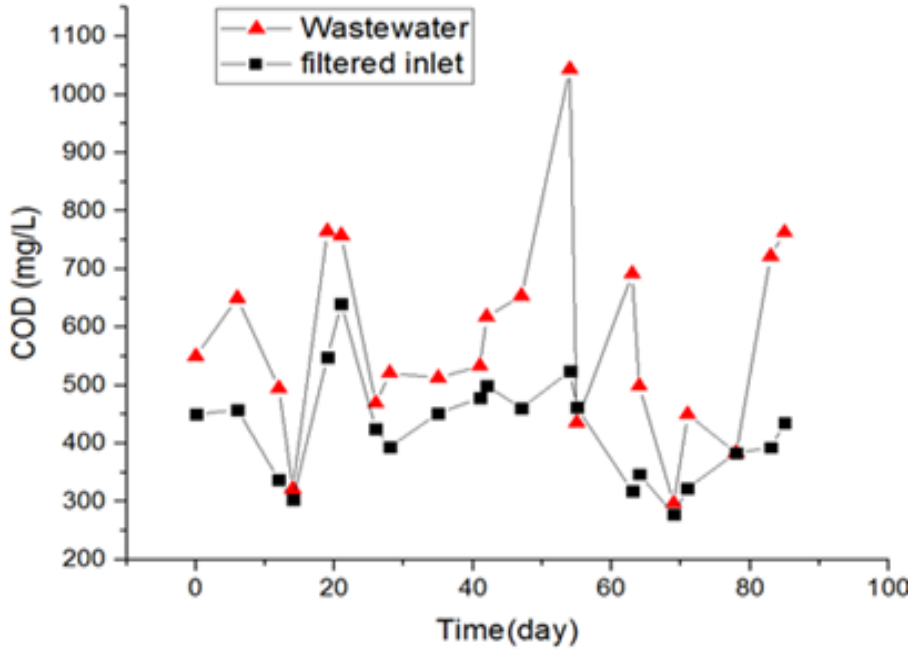


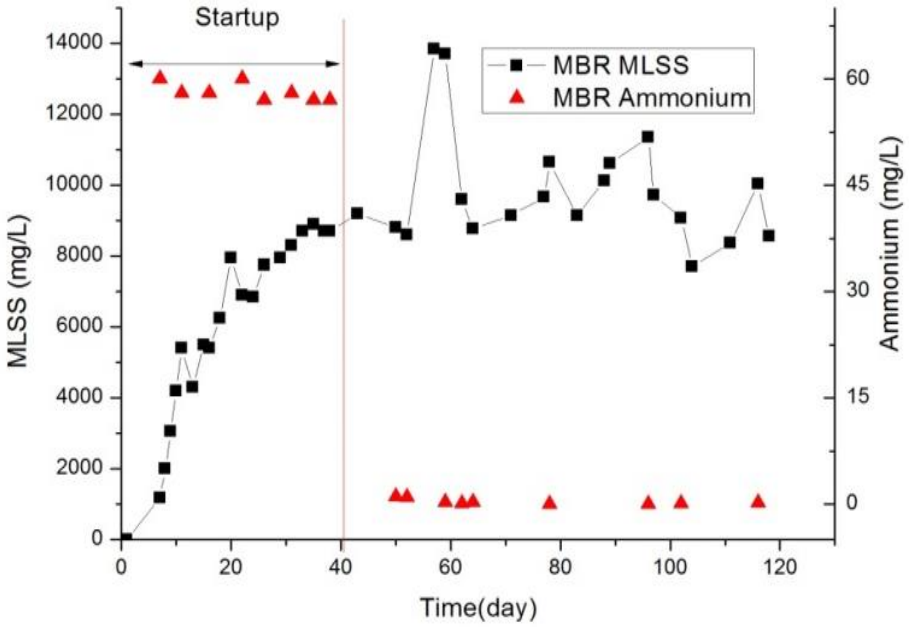
LABORATORY ANALYSIS

Laboratory analysis is held at the **ISO qualified laboratory** for chemical and microbiological analysis in the Research and Development department of EYDAP :

- Ensures the unit's proper function, by measuring key variables such as COD, CODs, SS, VSS, SVI, BOD, TP, TN, NH_4-N^+, NO_3-N^-, Cl^-, TC, EC
- Makes a cross validation with the sensors' measurements ⟶ provision of feedback on the status of the sensor

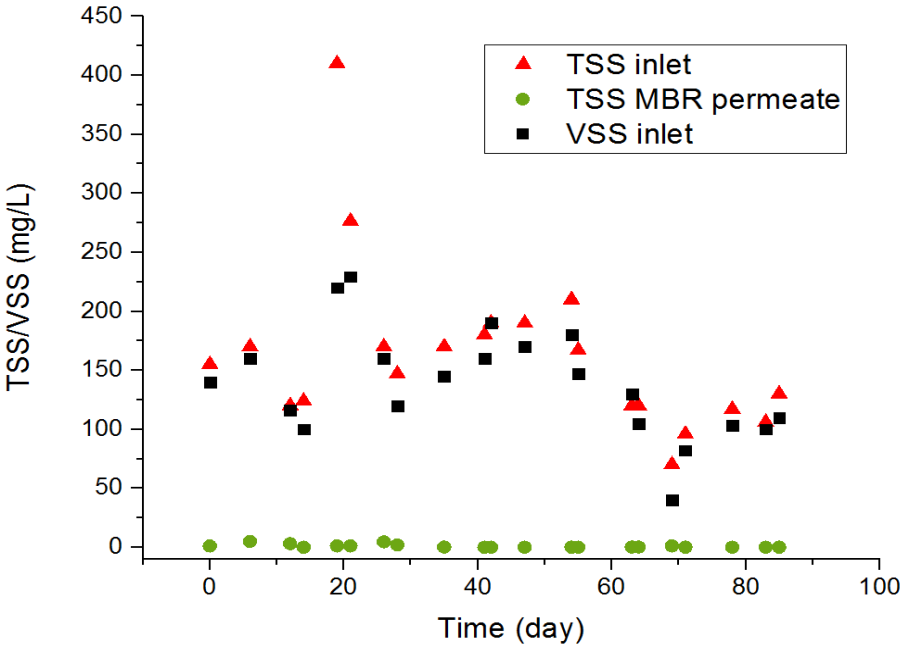
PRIMARY PLOTTED DATA

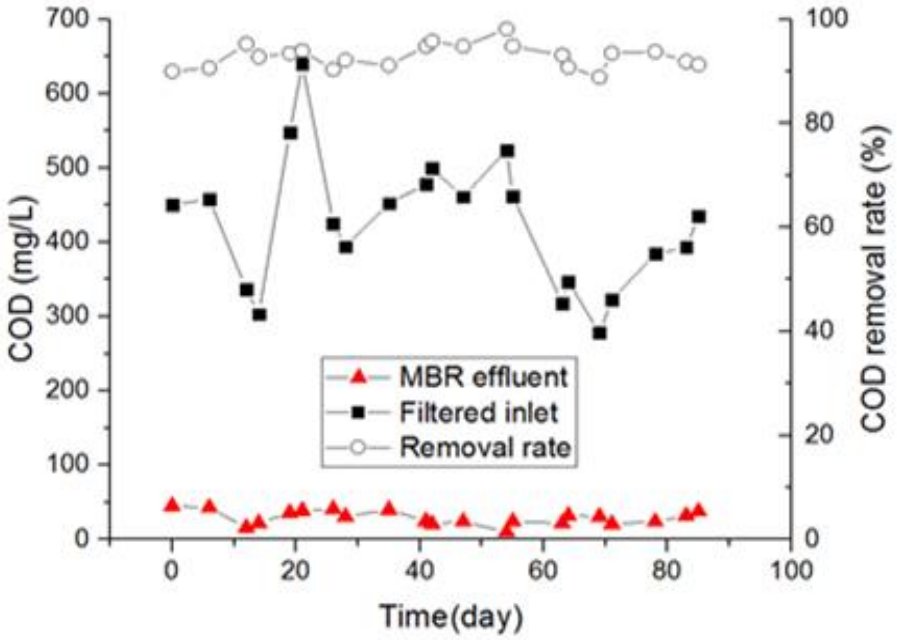




- COD of raw and pretreated water
- Start-up period of the unit

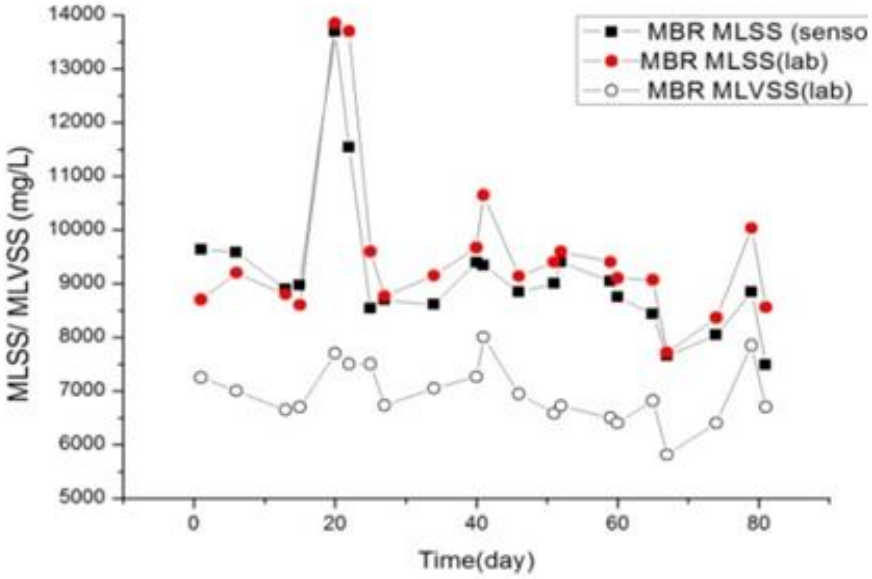
MBR PERFORMANCE AND PERMEATE QUALITY (1)

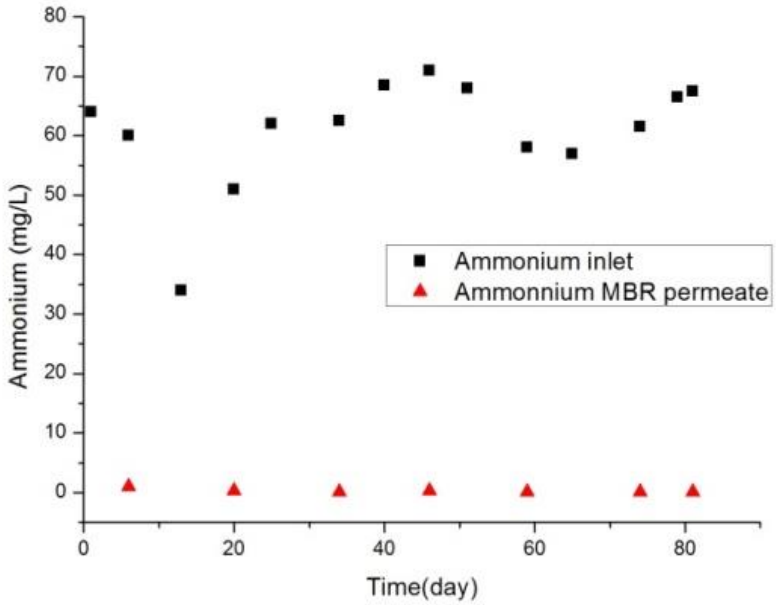




- MBR performance in TSS
- MBR performance in COD

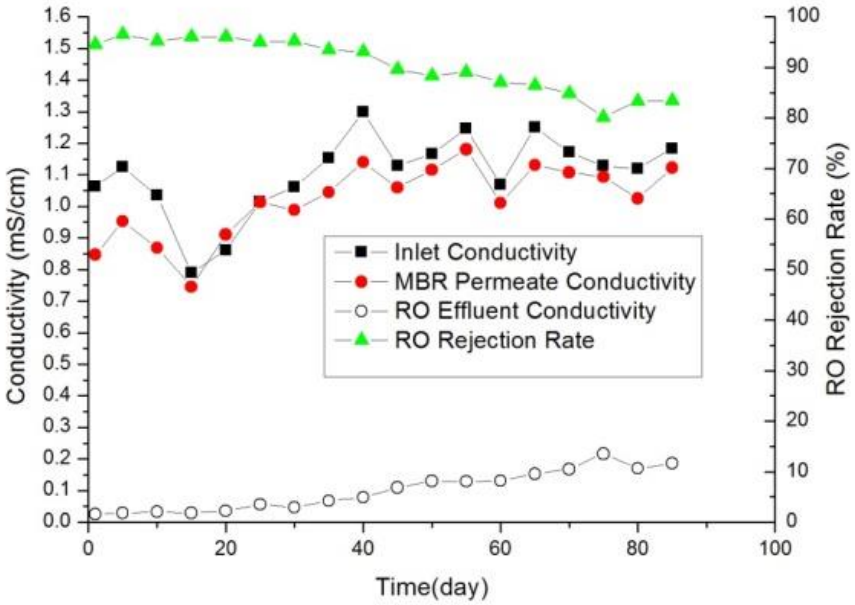
MBR PERFORMANCE AND PERMEATE QUALITY (2)

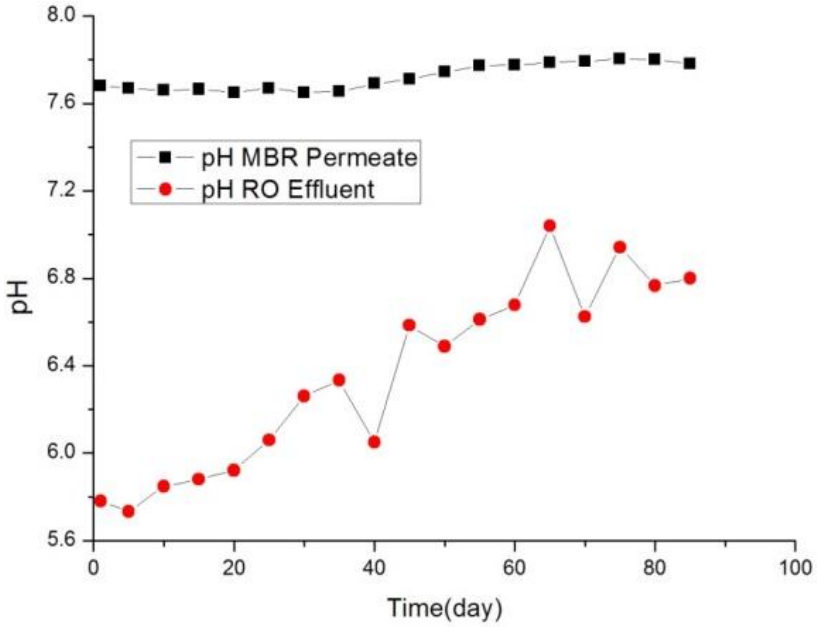




- MBR performance in MLSS
- MBR performance in Ammoniacal Nitrogen

RO PERFORMANCE AND EFFLUENT QUALITY





- Conductivity (left) and pH (right) data retrieved from the installed sensors

AGGREGATED RESULTS VS LEGISLATION

Parameters	Mean Value (Standard Deviation) MBR effluent	RO effluent	Legislation limits (JMD 145116, 2011)
TSS (mg/L)	<2	<2	≤2
VSS (mg/L)	<2	<2	-
COD (mg/L)	23(9,53)	<10	-
CODs (mg/L)	29(10)	<10	-
BOD_5 (mg/L)	0,9	0,8	≤10
TP (mg/L)	5,9 (1,2)	<0,5	
TN(mg/l)	-	12(7,8)	≤15
NH_4-N^+ (mg/L)	0,25(0,32)	-	≤2
Cl^- (mg/L)	172(75)	42(24)	≤100 for sprinkler irrigation
Turbidity (NTU)	0,32 (0,1)	-	≤2
Total Coliform (cfu/100ml)	307 (393)	ND	≤2
Faecal Coliform (cfu/100ml)	1,09 (1,86)	ND	-
E.Coli (cfu/100ml)	0,82 (0,98)	ND	≤5

CONCLUSIONS

- System presents high stability
- Sensors provide trustworthy data
- MBR ⟶ Ideal pretreatment for the RO
- TMP remains steadily at low values ⟶ no necessity for recovery cleaning
- Excess sludge: 7L for every m^3 of recovered water
- RO effluent fully met reuse water standards as dictated by the Greek legislation
- RO rejection rate has decreased by 15%, indicating that a chemical cleaning is necessary
- Total removal of COD and microbial pollutants
- Future steps: -Heavy metals, microorganic & priority pollutants
  -GHG emissions
  -System Optimization

ACKNOWLEDGMENT

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