Sewer Mining (SM) technology as a Distributed Intervention for Water-Energy-Materials in the Circular Economy: A Real World Demonstration in the Athens Plant Nursery

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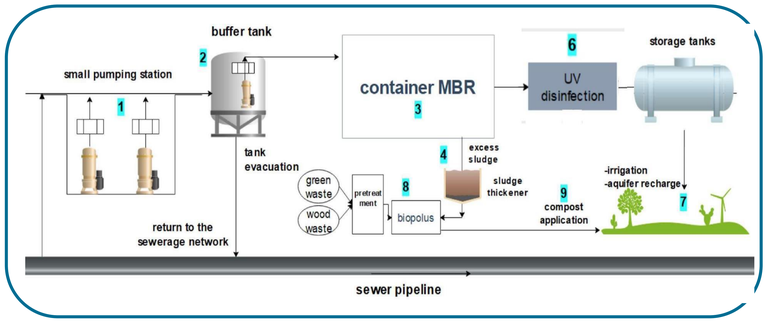
Implemented technology

Sewer Mining (SM) technology is a **mobile wastewater treatment** system in containers able to extract wastewater from local sewers, treat it directly and reuse at the **point of demand** in dense urban environments.
The unit consists of a **membrane bioreactor** unit (MBR) and a **UV disinfection** component and produces **high quality reclaimed water for irrigation** and for aquifer recharge during the winter.
The SM unit has an annual capacity of about **9.000 m³** of reclaimed water
Treatment residuals are collected, treated locally in the site and are transformed to an eco-friendly fertilizer (compost), when merged with green waste from pruning.



Methodology

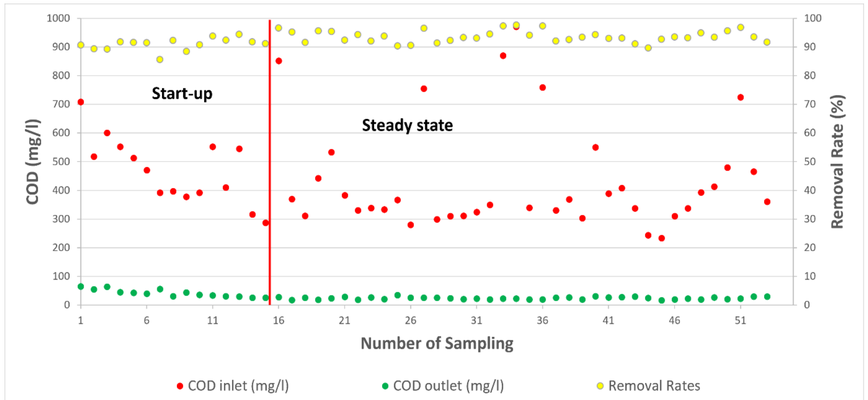
The sewerage is extracted through two pumps that work alternately, from about four meters below the surface to fill in a buffer tank. The process starts when filtered wastewater enters a denitrification tank, where anaerobic microorganisms turn nitrates to nitrogen gas which naturally leaves the system. The denitrification tank communicates with a nitrification or aeration tank, where aerobic microorganisms turn reduced nitrogen compounds to nitrates. Subsequently, the biologically treated wastewater is transferred to the membrane tank and then the permeate passes through the UV disinfection unit and the final disinfected product flows naturally toward a storage tank to be reused for irrigation purposes. The whole process is fully monitored through sensors and is automated using pneumatic actuated valves controlled by a PLC unit.
The excess sludge produced from the SM unit along with the green and wood waste goes through a rapid composting process to produce on-site fertiliser.
A heat exchanger and heat pump system recovers thermal energy from the wastewater to be reused for the technological processes of the compost production unit.

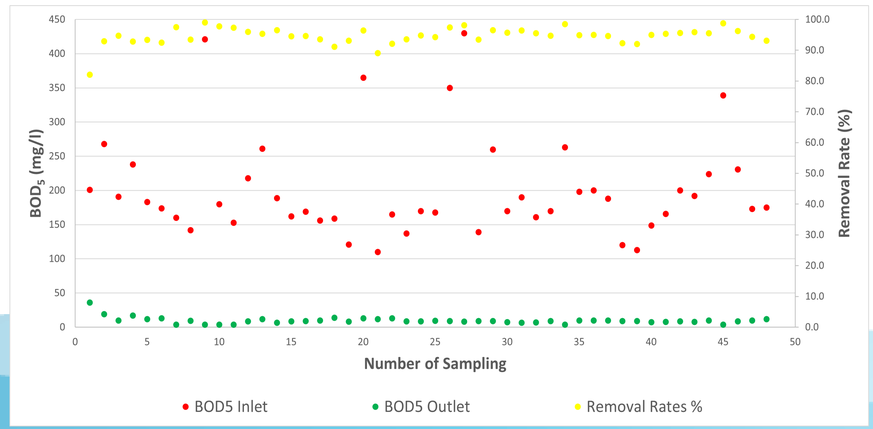
Results

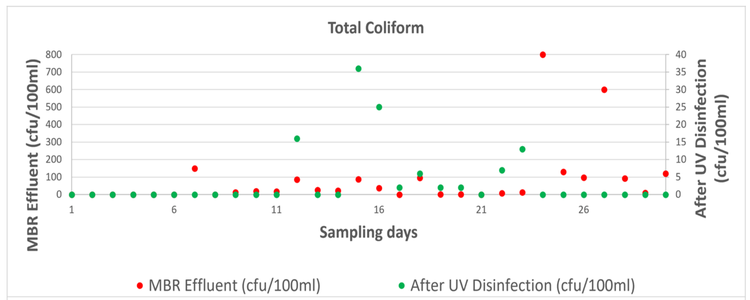
The technology has been tested for over 1.5 year. Sampling and analysis activities have been implemented at a weekly basis and the main results that are illustrated in the table and the diagrams are summarized below:

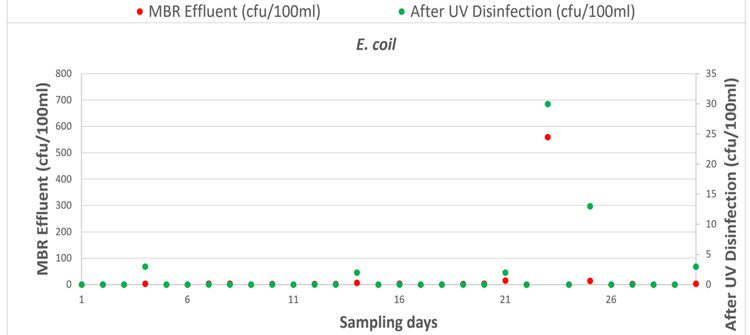
- SM produces water of a quality that meets all national and international criteria for unrestricted irrigation and urban use
- Complete elimination of organic carbon and pathogenic content
- Reduction of pathogens due to MBR filtration process (without addition of chemicals avoiding production of secondary pollutants)
- UV disinfection unit showed great performance
- System works automatically and is remotely monitored in terms of operation and quality performance.

Parameters	Influent	Effluent after UV disinfection	Legislation Limits
TSS	253± 97	≤ 2 for 80% of samples	≤2 for 80% of samples ≤10 for 80% of samples
BOD_5	216 ± 64	8,6 ± 2,4 [3] ≤10 for 87% of samples	≤10 for 80% of samples
COD	695 ± 97	24,2 ± 4,1 [3]	-
TN	81 (average)	5,5 ± 1,4 [3]	≤ 15
NH_4-N	5 ± 3	0,2 ± 0,19 [3]	≤ 2
TP	10 ± 1.4	1,57 (average)	-
Turbidity	-	2 (median)	≤ 2 (median)
Conductivity	1,109 ± 75	1,067 ± 0	-
pH	7.1 ± 0,2	7.5 ± 0,3	-
TC	>10	2 for 80% of samples 9 for 95% of samples	≤2 for 80% of samples ≤20 for 95% of samples
FC	>10	≤ 3	-
EC	>10	≤ 3 for 95% of samples	≤5 for 80% of samples ≤50 for 95% of samples









Conclusions

The Sewer Mining technology:

- requires limited space (small footprint)
- reduces waste and increases availability of resource
- saves energy as water is extracted, treated and reused at the same location
- is proved to be an autonomous, decentralized resource recovery system
- is suitable for real world dense urban environments and can be a blueprint for wide expandability
- demonstrated flexibility, scalability and replicability, important aspects for innovation uptake within the emerging CE context
- clearly enhances resilience of cities to climate change

nextGen Circular Water Solutions

Key partners: National Technical University of Athens; CITY OF ATHENS; EYDAP