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4SM Project. Advanced tools for sustainable sewer management

4SM SPREAD SEWER SENSING FOR SUSTAINABLE MANAGEMENT

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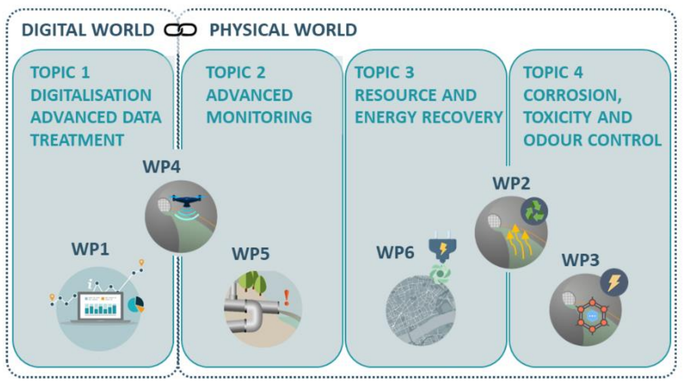
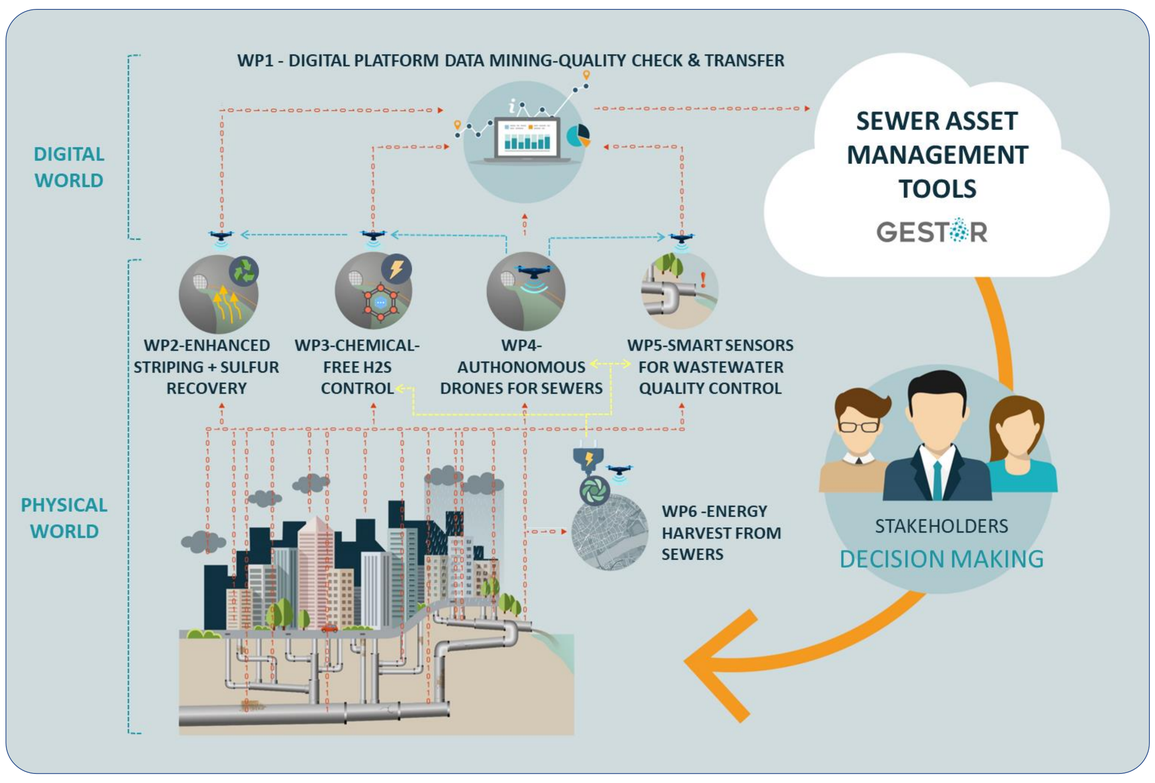
The main objective of the 4SM is to set a new advanced tools to address four of the most important challenges for optimal sewer management such as:

i) **Promote the digitalization process of sewer networks.**
ii) **Improve capabilities of current tools.**
iii) **Tap into resource and energy recovery from sewers.**
iv) **Develop highly innovative methods for corrosion, toxicity, and odours control.**

4SM aims to develop advanced sustainable management of the infrastructure in order to connect digital world with physical world. To achieve this, 6 specific objectives has been executed, each one related to a work package



WP1. 4SM DIGITAL PLATFORM DEVELOPMENT
WP2. ENHANCED STRIPING + SULFUR RECOVERY
WP3. CHEMICAL-FREE H2S CONTROL
WP4. AUTHONOMOUS DRONES FOR SEWERS
WP5. SMART SENSORS FOR WASTEWATER QUALITY
WP6. ENERGY HARVEST FROM SEWERS



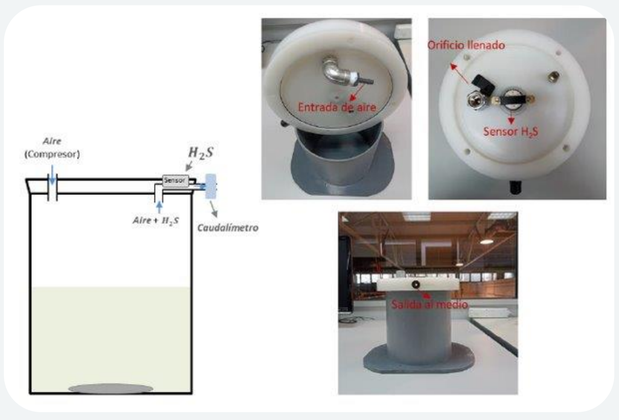
PRELIMINARY RESULTS

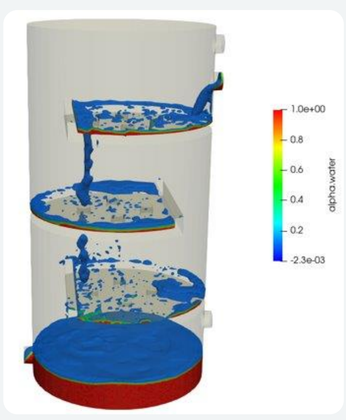
WP1. 4SM DIGITAL PLATFORM DEVELOPMENT

Work Package 1 focuses on the development of a digital platform for sewer management. The objective is to create an Internet of Things (IoT) based platform that collects, integrates, and visualizes data from the physical world. This platform will enable advanced standards for data analysis and decision-making in sewer management.

WP2. ENHANCED H2S STRIPPING UNITS FOR SULFUR RECOVERY

In WP2, the project aims to design a sulfide stripping process unit to extract and concentrate sulfide for recovery. Preliminary designs for a pilot plant have been proposed, and experiments are being conducted to determine the desorption velocity between gas and liquid phases. These efforts will contribute to the removal of hydrogen sulfide from sewer systems.

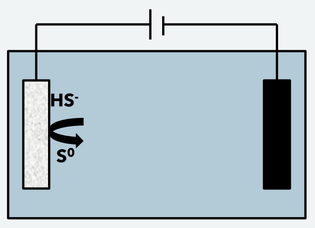




WP3. CHEMICAL-FREE SULFIDE CONTROL BASED ON ELECTROCATALYTIC SYSTEMS AND LOW-COST NANOMATERIALS

WP3 explores a ground-breaking method for sulfide control that relies on electrocatalysis and low-cost nanomaterials. The objective is to test the effectiveness of this method in controlling sulfide gas without the use of chemicals. Initial evaluations of electrocatalytic sulfide removal from wastewater have been conducted, and further experiments using low-cost materials are planned.

Direct oxidation of sulfide to elemental sulfur particles
Lower bioavailability for HS- reformation



$Mn(IV)O_2 + HS^- \rightarrow Mn(II) + S^0$

Anode potential applied

$Mn(II) \rightarrow Mn(III) + e^-$
$Mn(II) \rightarrow Mn(IV) + 2e^-$

WP4. AUTONOMOUS DRONES FOR AUTOMATIC DATA RETRIEVAL AND INSPECTION

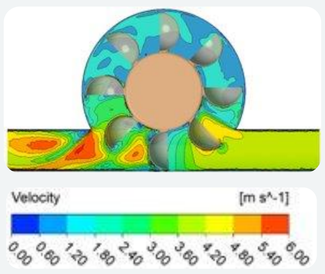
The primary goal of WP4 is to develop a semi-autonomous drone for data collection and visual assessment in sewer systems. A prototype drone has been created, and initial tests have been conducted in real manholes. This drone will enable automatic data retrieval and inspection, improving the efficiency and accuracy of sewer management.

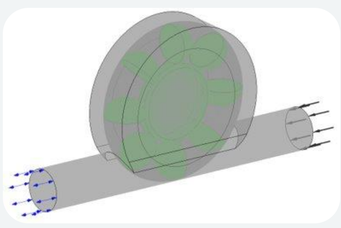
WP5. SMART SENSORS FOR WASTEWATER QUALITY CONTROL

WP5 focuses on the integration of smart sensors for real-time wastewater quality control. The project aims to test wastewater quality sensors that can be incorporated into CSO detection equipment. Online water quality sensors for COD and TSS are being tested in the field, along with mechanisms for sensor protection against clogging and cleaning. Also, temperature sensors from the SENVES concept developed at ICRA are being tested in conjunction with a level sensor.

WP6. ENERGY HARVEST FROM SEWERS

Work Package 6 investigates energy recovery from sewers. Various options for energy recovery have been explored, with a focus on Pico-Hydraulic Turbines commonly used for energy recovery in water supply or irrigation tubes. However, the challenge lies in the presence of urban solids and fibers in sewer systems, which can obstruct the hydraulic flow. Efforts are underway to estimate the energy generated and optimize the design of the Pico-Hydraulic Turbine for sewer applications.





The 4SM project aims to modernize sewer management by leveraging advanced tools and sustainable approaches. Through digitalization, enhanced sulfide control, autonomous drones, smart sensors, and energy recovery, the project strives to connect the digital and physical worlds of sewer infrastructure.
The results and findings from the project will contribute to the development of efficient, sustainable, and environmentally friendly sewer management practices.

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