The role of Communities of Practice in the design of brine management plants

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Introduction

Community of Practice (CoP) is, according to Wenger, McDermott, and Snyder, "a group of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly" [1]. Today, the CoPs are increasingly being used to improve knowledge management and connect people within business, government, education, and other organizations. Based on the needs of each case, the CoP can serve as a platform providing a supportive environment for learning and growth, and it allows members to benefit from the collective knowledge and experience of the group. They can also help to foster innovation, collaboration, and networking, and they can contribute to the development of a shared culture and identity within an organization. Usually, through the implementation of a CoP, various activities take place, such as problem-solving, requests for information, seeking experience, coordination and synergy, mapping knowledge and identifying gaps [2]. The purpose, the involved stakeholders and the duration of a CoP meeting depend on the scope of each meeting that needs to be defined before the engagement of the relevant group of people [3].

In the framework of the EU-funded Water Mining project, a pilot system that treats saline water that is reclaimed from the Wastewater Treatment Plant (WWTP) of Larnaca was designed and operated by the National Technical University of Athens (NTUA). To evaluate the acceptance of the proposed solution and to identify any possible gaps and barriers, four CoP meetings were conducted involving key stakeholders from various sectors, including local authorities, industry representatives, and researchers.

Scope and methodology

The aim of the demo NTUA system is the treatment of the effluent originating from the WWTP of Larnaca city, Cyprus. The pilot is designed to treat the reclaimed saline water from the plant, providing high-quality water for irrigation and industrial use. The design of the pilot is based on the circular economy concept, which means that the principle of zero discharge is followed. Thus, the NaCl, divalent salts with Ca and Mg, and P that are present in the WWTP effluent should be recovered in the form of valuable products (salt of high purity for industrial use and P solutions that could be used in the fertilizer industry). This case study demonstrated the feasibility of achieving low salinity effluents using a treatment train that achieved ultra-low concentrations of P (<0.05 mg/l) in the effluent while upgrading the water quality through the application of suitable membrane and thermal technologies.

In total, four CoP meetings were conducted in the framework of this case study, with each one having a different goal and scope. The goal of the first one was to generally discuss the proposed solution for the treatment of the saline effluent and the identification of the most important problems that will arise during the promotion of the water treatment system in the market, along with the legislative issues and barriers that can arise from the operation of the system. The goal of the second CoP meeting was to conduct a Barrier Analysis Workshop where the main barriers and solutions were discussed. The third conducted CoP aimed to present the technoeconomic analysis of the process and discuss the possible concerns of the relevant stakeholders. Based on the proposed modification and the recommendations of the optimal scenario presented during the third CoP meeting, the fourth CoP centered on the revised design of the solution, whereby all the identified issues could be resolved.

Results and discussion

During the first CoP meeting, significant discussions aimed at the legal aspects regarding the usage of the recovered water. Stakeholders emphasized the need for legislation to specify minimum irrigation water parameters for each crop type and highlighted the importance of stricter penalties for non-compliance with water quality requirements. Eventually, a general revision of regional regulations was recommended. Market concerns were also addressed, with the high cost of post-treatment water identified as a major issue. The stakeholders noted that the current low cost of agricultural water would rise with the new treatment processes, suggesting that government subsidies for WWTP operation would be necessary. Despite these concerns, the existing market for recovered water was acknowledged. Furthermore, the need for continuous monitoring and careful distribution of increasing water use by the government was stressed. The acceptance of recovered products was another key point, with stakeholders suggesting that these products should be promoted post-project by consulting local authorities.

Through the second CoP meeting and the Barrier Analysis Workshop, several barriers and enablers for the proposed system were identified. Market mistrust of recovered products was a notable barrier, with stakeholders claiming that the products must meet market standards and have Material Safety Data Sheets to gain end-user acceptance. Capital Expenditure (CAPEX) was highlighted as a major barrier to full-scale implementation, while land use for pilot installations was not considered a significant issue except for renewable energy plant installations. High-energy demand was seen as a challenge that could be mitigated with renewable energy sources. Additionally, contamination of WWTP wastewater by illegal flows was identified as a potential issue at the pilot scale, though it was deemed manageable at full scale. These discussions provided a comprehensive understanding of the obstacles and potential solutions for the successful implementation of the system. The significance of each barrier is presented in the following Figure 1.

The third CoP meeting focused on the cost of the systems, where the technoeconomic analysis for full scale was presented and discussed. Stakeholders found the CAPEX and OPEX to be reasonable and within expected ranges, noting potential benefits such as improved efficiency, cost reduction, and sustainability through the use of renewable energy sources. An opportunity for brine management was identified, particularly in Cyprus, where a nearby desalination plant could utilize waste heat for high-thermal energy-consuming components. The discussion also covered the price of water, comparing the current cost of desalination at 1.2 euros/m³ with the proposed system's cost of 1.3 euros/m³. Although the proposed system's water cost is slightly higher, stakeholders believed it was manageable due to the high-water demand in Cyprus.

The fourth CoP meeting aimed at refining the proposed system based on feedback from previous meetings. Alternative scenarios were presented, with stakeholders rejecting those involving brine discharge. The preferred system configuration excluded the Nanofiltration unit, focusing instead on the Low-Temperature Evaporator and Reverse Osmosis units. This revised process allowed to address the issues of high-energy consumption, minimize CAPEX and OPEX, and refine the system design, ensuring that all barriers were effectively managed.

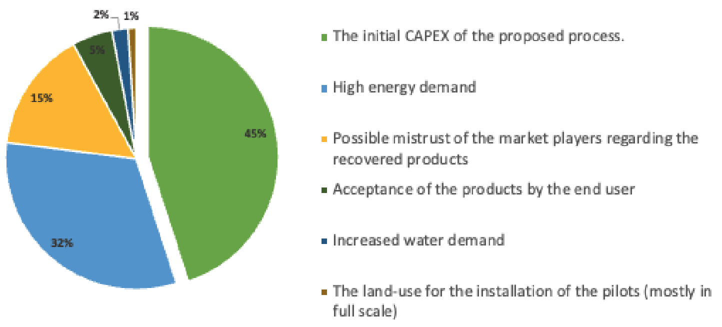

Figure 1. Identified barriers of the NTUA process

Conclusion

Through the conducted CoP meetings, the actual problems and issues of the design and implementation of a treatment system were discussed. With the outcomes of each CoP, the NTUA team each year optimized its process and tried to address the issues that emerged from the discussion, and the final proposed solution was optimal for the specific case study. With the involvement of the stakeholders, the proposed solution became closer to market and ready for full-scale implementation.

References

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