DIGITALIZATION OF WATER USE IN PROCESS INDUSTRIES

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ABSTRACT

For most industrial products, water is used during some stages of the production process. Industries strive to become water supply independent following the near-zero-liquid discharge[1] principle, where closed-loops are used so that all water is recovered and contaminants are reduced to solid waste. In addition to this circular transition, the process industry is currently engaged in the digital transition, being in the throes of Industry 4.0[2] and related Water 4.0[3] era. Key enabling technologies, including industrial internet of things, wireless communications and advanced modelling[4], enable the synthesis of cyber representations (Digital Twins)[5] of production facilities and the formation of Cyber-Physical Systems[6] that can sense and interact with the environment (including human), and support the industrial activities in real-time. Yet, it is the suitable combination of digital solutions with circular practices that offers a much greater potential and it is recognised that this digital and ecological/circular Twin Transition can only lead to success if it is understood as a joint task.

The content presented in this paper arises from an ongoing H2020 project (AquaSPICE). It follows a systemic approach in water management through an adaptation of appropriate technologies and practices in different levels, from a single industrial process (unit operation), to an entire factory, to other collaborating industries (industrial symbiosis) or other sectors. The main innovation presented is the WaterCPS, a Cyber-Physical System specialized to enhancing water efficiency in the Process Industry, in three directions: (a) diagnostic (monitoring water efficiency); (b) production chain enhancement (application of state-of-art water recovery technologies & practices); and (c) optimization (of water reuse processes). WaterCPS consists of a physical and a cyber (digital) part. The cyber part consists of the Digital Twins (incl. a knowledge core, models and intelligent/cognitive services) and the real time monitoring system. The integration of the cyber part with the water efficiency practices, creates significant added value for them and have a measurable impact by supporting the above mentioned three directions to water efficiency enhancement. The WaterCPS is demonstrated in four case studies, involving seven industrial actors: Dow) (Netherlands and Germany), BASF and Water-Link (Belgium), Solvay and ARETUSA(Italy), Agricola (Romania) and TUPRAS (Turkey).

KEYWORDS: Water Treatment, Process Industry, Circular Economy, Cyber Physical Systems, Digital Twins

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