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Deliverable Report

D2.6 Electrics and control unit

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Lead beneficiary:	SolarSpring
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1 Introduction to the project SERPIC

The project *Sustainable Electrochemical Reduction of contaminants of emerging concern and Pathogens in WWTP effluent for Irrigation of Crops – SERPIC* will develop an integral technology, based on a multi-barrier approach, to treat the effluents of wastewater treatment plants (WWTPs) to maximise the reduction of contaminants of emerging concern (CECs). The eight partners of the SERPIC consortium are funded by the European Commission and by six national funding agencies from Norway, Germany, Italy, Spain, Portugal and South Africa. The official starting date of the SERPIC project is 1st September 2021. The project has a duration of 40 months and will end 31st December 2024.

The overall aim of the SERPIC project is to investigate and minimise the spread of CECs and antimicrobial resistant bacteria/antibiotic resistance genes (ARB/ARG) within the water cycle from households and industries to WWTPs effluents, and afterwards via irrigation into the food chain, into soil and groundwater and into river basins, estuaries, coastal areas, and oceans with a focus on additional water sources for food production.

A membrane nanofiltration (NF) technology will be applied to reduce CECs in its permeate stream by at least 90 % while retaining the nutrients. A residual disinfection using ozone gas produced electrochemically will be added to the stream used for crops irrigation (Route A). The CECs in the polluted concentrate (retentate) stream will be reduced by at least 80 % by light driven electro-chemical oxidation. When discharged into the aquatic system (route B), it will contribute to the quality improvement of the surface water body.

A prototype treatment plant will be set-up and evaluated for irrigation in long-term tests with the help of agricultural test pots. A review investigation of CECs spread will be performed at four regional showcases in Europe and Africa. It will include a detailed assessment of the individual situation and surrounding condition. Transfer concepts will be developed to transfer the results of the treatment technology to other regions, especially in low- and middle-income countries.

2 Report summary

The report contains a description of the main devices installed in the SERPIC prototype plant to facilitate the automation and control of the plant. These devices were delivered and installed in the prototype plant located at the facilities of the University of Castilla-La Mancha (UCLM) by SolarSpring. The main parameters to be controlled were the inlet and outlet pressure of the nanofiltration membrane as well as the permeate and concentrate flow rates and key temperatures in the ozone and persulfate electrogeneration process. However, the robustness of some of the devices installed was not adequate, causing damage to the automation system.

3 Deliverable description as stated in the Project Description

Based on task T2.7, the entire controls system and remote data acquisition system will be ready for installation on site of UCLM.

4 Introduction

In order to carry out the proper operation of the SERPIC prototype treatment plant, it is necessary to ensure its continuous operation, monitor the most relevant parameters of the plant such as flow rates, temperatures, or pressure, among others, and install control software in the plant that allows the plant to be managed continuously. SolarSpring, responsible for the design and installation of the automation and control of the SERPIC prototype treatment plant, studied the process and defined 18 measurements and 15 control variables. Once these meters and sensors

were tested in their facilities, they were sent to be installed in the UCLM facilities, where the treatment plant is located.

The automation of this plant is based on an alarm management system, where the plant stops if some of the measured parameters are below the setpoint value.

5 Results

Solar Spring designed a program to control the SERPIC prototype plant. For the control itself, three Siemens PLC´s Logo! 8 control relays were connected to each other in network mode. An LTE router from INSYS was used for remote monitoring. The device is specially tailored to the Logo! 8 and, after defining limit values, can report events and warnings in different ways (e.g. email, SMS). The LTE router establishes a secure connection to a VPN server via the mobile network, which can be accessed via FTP. The measurement data from the systems can be displayed online on a web server and saved offline on an SD card. All measurement and control technology was wired into an electrical panel on the UCLM premises, as shown in Figure 1.

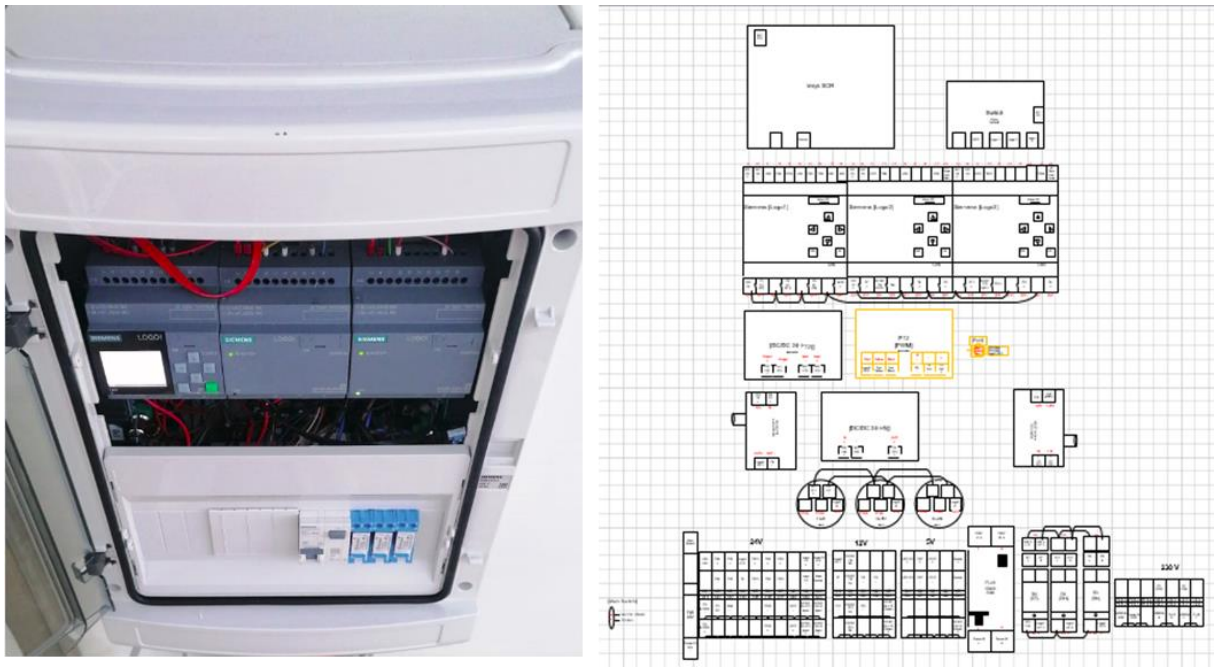

Figure 1: Control cabinet for measurement data acquisition and control of the SERPIC prototype plant

During the on-site installation, the sensors were calibrated and minor adjustments were made to the software to adapt it to the needs of the treatment plant. The installed sensors and meters are shown in Table 1.

Table 1: Sensors and meters installed in the SERPIC prototype plant.

Element name	Element type	Location unit
LS8	Level	Feed tank
LS9	Level	Feed tank
MV8	Solenoid valve	Feed tank
PS4	Pressure	Pre-filter nanofiltration
PS5	Pressure	Before nanofiltration
FS6	Flow	Concentrate flow
FS10	Flow	Permeate flow
VS11	Voltage	Ozone cell
CS11	Current	Ozone cell
TS12	Temperature	Ozone cooling unit
VS7	Voltage	Persulfate cell
CS7	Current	Persulfate cell
TS8	Temperature	Persulfate cooling unit
H1	Humidity	Crops WW
H2	Humidity	Crops Tap water
H3	Humidity	Crops SERPIC

Some of these elements installed in the treatment plant are shown below. In Figure 2: MV8, solenoid valve installed in the feed tank to the treatment plant, Figure 3: flow meters FS6 and FS10 installed in the concentrate and permeate stream respectively and in Figure 4: pressure gauge located at the entrance to the membrane of the nanofiltration system.

Figure 2: MV8 Solenoid valve installed in the feed tank.

Figure 3: PS4 pressure gauge in the nanofiltration unit.

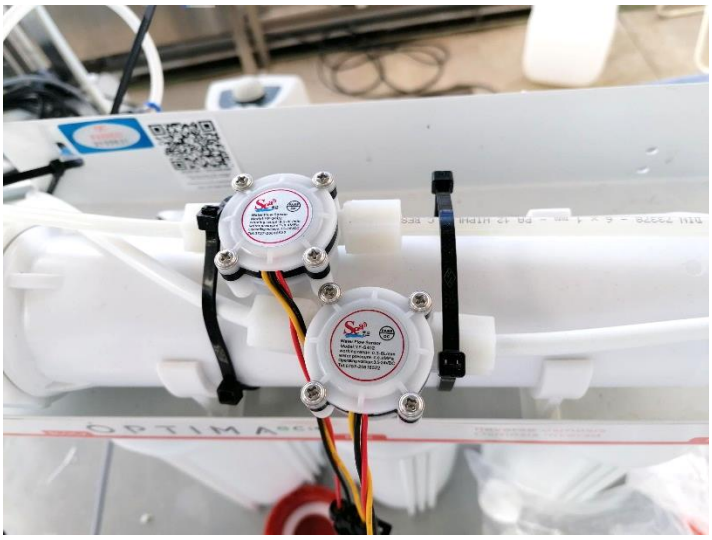

Figure 4: Flow meters in the concentrate and permeate flow.

The robustness of some of the installed sensors did not have that the plant required, so due to corrosion and overheating, some sensors failed after a few months, causing the plant to be without the automation system while waiting to be installed.