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Abstract

Deliverable D4.2 summarises the construction and installation of the EcoSites. This deliverable gathers the information related to the construction process of the four pilot plants (Spain, Austria, Denmark and Greece) and the installation and integration in their final locations. This report describes the construction process of each EcoSite, including photographs of the different units of the pilot plants, list of deviations and/or delays occurred during the construction process, as well as demonstrative photographs of their placement in their final location and the next steps to carry out for a successful start-up of the operation at each EcoSite.

List of Abbreviations and acronyms

Abbreviation	Meaning
AC	Adsorption Column
AnMBR	Anaerobic Membrane Bioreactor
ATEX	Atmosphere Explosible
BMP	Biochemical Methane Potential
BW	Biowaste
CH_4	Methane
FHW	Fermentable Solid Household Waste
GRP	Glass Reinforced Plastic
H_2	Hydrogen
HVNR	High Value-Added New Resources
MMV	Magnetic Membrane Vibration
WW	Wastewater
WWTP	Wastewater Treatment Plant

Index

Index of figures

1. Executive Summary

This deliverable (D4.2) presents a general description of the construction status of the four EcoSites, as well as their installation at the final locations. Moreover, the deviations and delays that occurred during the construction phase of the four pilot plants are detailed, as well as all the relevant information regarding the installation of the plant at its final location and its commissioning. Demonstration images of the assembly of all the components, as well as their integration in the final locations previously selected, are included.

2. Objectives

The objective of this deliverable is to summarise the work carried out during the last few months (M12-M18) at the different EcoSites, demonstrating the pilot plants' construction and installation at their final location, as well as to establish the next steps to be taken for their correct start-up.

3. Description of the work

The current status of each of the pilot plants of the different EcoSites is defined below.

3.1. Spanish EcoSite

The main objective of the Spanish EcoSite is to treat industrial and urban WW from the municipality of Alcoy together with organic solid waste (BW) from the town of Muro de Alcoy to produce green H_2, high quality reclaimed water and HVNR through AnMBR with MMV innovation and tertiary treatment.

The Spanish Ecosite has been built and will be operated by the following partners:

- Asociacion de Investigacion de la Industria Textil (AITEX); manager of the EcoSite.
- Sociedad de Fomento Agricola Castellonense, S.A. (FACSA); manager of the WWTP.
- Fomento Valencia Medioambiente SL (FOVASA); waste collection company.
- Katholieke Universiteit Leuven (KUL); MMV system builder.
- Francisco Jover SA (JOV); textile industry.
- Germaine De Capuccini SAU (GERM); cosmetics industry.

3.1.1. Brief description of the current/final status of the pilot project.

As of 30 November 2023, the pilot plant of the Spanish EcoSite is built and located in its fine location, i.e. in the Alcoy WWTP in the municipality of Cocentaina.

All the components of the plant have been built and assembled on the GRP platform over the last few months. All components were planned and selected during the design stage by the partners involved in the Spanish EcoSite (FACSA, FOVASA and KUL). As described in deliverable D4.1, the pilot plant consists of the following main units:

- BW Treatment Unit
- Anaerobic Digestion Unit
- Membrane Units

The Project partner FACSA has been in charge of the design of the pilot plant as well as its construction.

Over the next few weeks, the electrical and hydraulic connections of all the components will be completed, as well as the commissioning of the entire pilot plant. For the time being, the installation of the general electrical outlet has been completed, as well as the hydraulic installation of the WW pump. This pump will be responsible for carrying the urban and industrial WW from the WWTP, after the pre-treatment stage, to the pilot plant's rotary sieve. Likewise, the installation of a reclaimed water line (treated water from the treatment of the Alcoy WWTP) has been carried out for the cleaning of equipment and roads, and a potable water line as a safety system for operators. In the coming weeks, the installation of the roof will be carried out to protect the pilot plant from weather conditions and assure the durability of the equipment. The tasks of integrating the pilot into the WWTP are expected to be completed during the first half of December 2023.

The pilot will be launched at the end of December, starting with the inoculation of the anaerobic digester, which will be inoculated with the digested sludge of the methanogenic digester of the Alcoy WWTP, the same sludge that has been used during the BMP tests carried out in task 1.1 at AITEX facilities.

3.1.2. Deviations/delays in the construction process.

During the construction phase of the pilot plant, there have been no significant delays in the start of the process operation. The only minor and expected delay encountered was the delivery of the membranes for the magnetic vibration system supplied by the project partner, KUL. The reactor, as well as the motor responsible for the magnetic vibration, have already been built and installed in the pilot plant. However, during the construction phase, it was determined that the delivery and installation of the membrane plates would be delayed since the membranes must be constantly immersed either in a buffer solution such as 10% isopropanol or in the WW, in which case the water cannot be stagnant. During the construction phase, integration into the WWTP and preliminary tests, these conditions cannot be guaranteed for the membranes, so delivery was planned for mid-December to coincide with the start-up of the process.

3.1.3. Photos verifying the construction of the pilot.

Below are the following images that verify the construction and installation of the different components of the pilot on the GRP platform. The construction phase was carried out inside one of the workshops to facilitate its assembly in the face of weather conditions that might arise, and it was later moved to its final location in the WWTP.

1. **BW treatment unit.**

The shredder for the organic fraction of municipal solid waste was the first integrated component of the pilot (Figure 1). This is currently installed inside the pre-treatment building of the Alcoy WWTP and has been in operation to carry out the different tests carried out during task 1.1. It is planned to be moved together with the rest of the pilot plant, located in front of this same pre-treatment building.

Figure 1: Electrolux brand commercial shredder installed in the Spanish EcoSite.

The storage tanks for the BW liquid concentrate, as well as the 100µm rotary sieve, are installed on the GRP platform along with the rest of the components of the pilot plant (Figure 2).

Figure 2: Rotary sieve (left) and auxiliary components installed on the GRP platform in the Spanish EcoSite (right)

As mentioned above, the installation of the pre-treated WW pump has also been carried out inside the pre-treatment building of the WWTP, having completed the installation of the pipe (150 linear meters) until its connection to the pilot plant.

Figure 3: WW drive pump installed at the Spanish EcoSite.

2. Anaerobic Digestion Unit

The 2m^3 anaerobic digester has been constructed in AISI 316 stainless steel to avoid future corrosion problems (Figure 4). After its construction, it has been installed on the GRP platform next to the feed pump and the two recirculation pumps. A biogas meter has also been installed, together with a condensate tank, and a non-contact heating system with a thermal insulation jacket. A small temperature sensor is installed for monitoring.

Figure 4: Anaerobic digester of the AnMBR system of the Spanish EcoSite.

The network of pipes for the recirculation of biogas to the membrane unit has been made of stainless steel, and an ATEX blower has been installed for its impulsion (Figure 5). Once again, the construction and installation of a condensate vessel has been carried out prior to the entry of the biogas into the blower to prevent the condensed water in the biogas network from causing breakdowns in the equipment. Likewise, a pressure sensor has been installed at the outlet of the blower to detect possible faults.

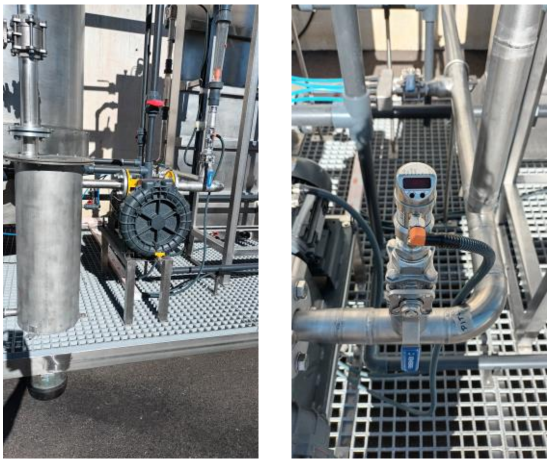

Figure 5: Biogas blower installed in the Spanish EcoSite along with its condensate vessel and pressure probe.

3. Membrane Units

First, the construction and installation of the commercial ultrafiltration membrane module (Koch brand) has been carried out on the platform (Figure 6). This has been complemented by the construction of a small degasser at the permeate outlet. This degasser will facilitate the elimination of biogas bubbles that are retained inside the membrane, thus avoiding the loss of useful permeate surface. In addition, the system has been complemented with a series of automated valves that will allow PI control of the different stages of the filtration process.

Figure 6: Commercial ultrafiltration membrane reactor (KOCH) installed at the Spanish EcoSite.

Secondly, the construction of the reactor that will contain the microfiltration membranes with magnetic vibration system developed by the partner KUL has been carried out, as well as the reception in Spain of the magnetic vibration system (Figure 7). Currently, the magnetic vibration engine is located outside the reactor to ensure its correct storage until the membrane plates are received at the WWTP in mid-December, coinciding with the start-up of the pilot plant.

Figure 7: Membrane reactor with MMV system (KUL) installed in the Spanish Ecosite.

Both membrane units have been constructed in AISI 316 stainless steel and are equipped with a lobe permeate pump, as well as the necessary sensors for the correct control of the filtration process: level probe, pressure probe, etc. Both units are also equipped with a chemical cleaning system, either by backwashing or by immersion. For the dosing of the reagents, two dosing pumps have been installed together with a small storage tank.

Figure 8: Auxiliary components of the membrane units of the Spanish EcoSite.

3.1.4. Photos verifying installation at final location.

The following images show the Spanish EcoSite at its final location at the Alcoy WWTP facilities, managed by project partner FACSA, awaiting the completion of connections and the construction of the roof to leave the pilot protected against adverse weather conditions (Figure 9).

Figure 9: Pilot plant of the Spanish EcoSite integrated into its final location at the Alcoy WWTP.

3.2. Austrian EcoSite

The main objective of the Austrian EcoSite is to treat WW and organic residues from a meat processing company (Fleischwaren Berger GmbH (BER)) to produce biomethane (CH_4), cleaned process water and a high value fertilizer.

The Austrian EcoSite has been built and will be operated by the following partners:

- University of Natural Resources and Life Sciences (BOKU); manager of the EcoSite.
- Fleischwaren Berger GmbH (BER); meat processing company.
- AAT Abwasser- und Abfalltechnik GmbH (AAT); engineering company.
- Gemeindeabwasserverband Südöstliches Tullnerfeld (GST); municipality operating the WWTP.
- Spitzer GesmbH (SP); engineering company.

3.2.1. Brief description of the current/final status of the pilot project.

As of 30 November 2023, the Austrian EcoSite pilot plant is built and located at its final site, i.e. at the headquarters of the meat processing company Fleischwaren Berger Schinken in the village of Sieghartskirchen.

All the components of the plant have been assembled inside the containers over the last months. These components were planned and selected during the design stage by the partners involved in the Austrian EcoSite (BER, AAT and SP). As described in deliverable D4.1, the pilot plant consists of the following containers and tanks:

- 15 m^3 buffer tank for WW
- Containers with flotation unit
- Container with biogas digester + biogas storage
- Container with membrane units
- 15 m^3 underground concrete tank for the collection of flotation sludge

Project partner BER was in charge of the earthworks, the preparation of the concrete foundation and the 15 m^3 underground concrete tank to collect the flotation sludge. Over the next few weeks, the hydraulic and electrical connections of the various components will be completed, as well as the commissioning of the entire pilot plant. Currently, the first inoculation tests of the biogas digester have begun. The first inoculation was carried out with inoculum from the project partner GST (Südöstliches Tullnerfeld WWTP). The digester, which has a working volume of approximately 3.00 m^3, has been heated and fed with BER's mixture of WW and BW (blood). The first results show that methanogenic archaea are working successfully since the production of biogas has begun, filling the gas bag for subsequent flaring burning. The next step will be to start the testing phase of the flotation unit, and check that all the units of the EcoSite work correctly together. Once the process starts, the monitoring plan will be initiated with the most important parameters (quality of the substrate, quantity and quality of biogas, parameters of the digester, quality of the digestate), thus verifying the correct operating conditions.

3.2.2. Deviations/delays in the construction process.

During the construction process of the pilot plant, there have been no significant delays in the start of the operation of the process. The only delay has been the delivery of one of the parts of the membrane unit. At the moment, only the nanofiltration membranes have been delivered, therefore the ultrafiltration membranes are pending, which will be delivered during the first week of December.

3.2.3. Photos verifying the construction of the pilot.

Below are the images that verify the construction and assembly of the different components of the pilot inside the containers (Figure 10-15).

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1. Flotation Unit

The containers and buffer tank of the flotation unit from the German company ClearFox were the first integrated components of the pilot plant. The flotation tanks are in one container, while the mixing and dosing unit for the flocculants is in the other container.

Figure 10: Flotation unit installed at the Austrian EcoSite.

2. Biogas plant

The following diagram shows the different components that make up the biogas stage (AnMBR) of the process: the substrate tank (with mixture of WW + BW/blood), biogas digester, biogas storage/bag, and biogas flare.

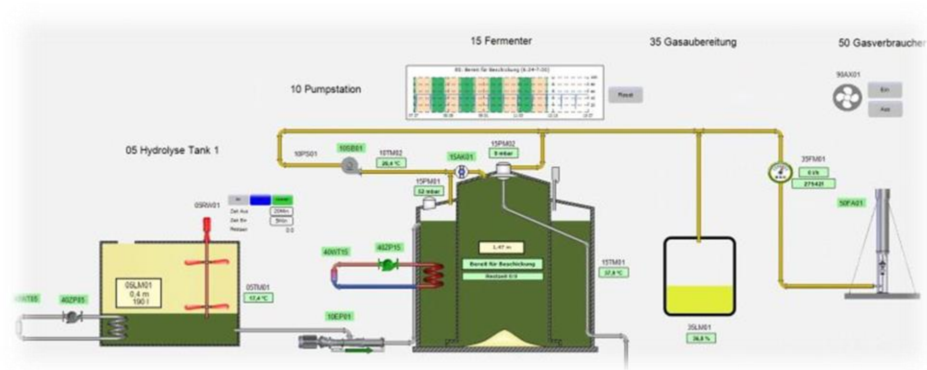

Figure 11: Diagram of the biogas production stage of the Austrian EcoSite.

In the image on the left, you can see the biogas container, built by the project partner AAT, while the image on the right shows the substrate tank (for sewage sludge and blood) (Figure 12).

Figure 12: Container for the biogas production stage and substrate tank installed at the Austrian EcoSite.

The biogas digester with a working volume of around 3,00 m^3 and the biogas storage/biogas bag, placed in an additional container on top of the biogas container, are shown in Figure 13.

Figure 13: Biogas digester and biogas storage bag installed at the Austrian EcoSite.

3. Membrane units (ultrafiltration + nanofiltration)

The membranes for the filtration/recirculation of the digester have been installed in another container. In the following image (Figure 14) you can see the nanofiltration system that will be used to further clean the permeate of the ultrafiltration, which is expected to be delivered during the first week of December.

Figure 14: Austrian EcoSite nanofiltration membrane unit.

3.2.4. Photos verifying installation at final location.

The following pictures show the Austrian EcoSite and the pilot plant plan at the location of the project partner BER.

Figure 15: Pilot plant of the Austrian EcoSite installed in its final location at the facilities of the partner BER.

3.3. Danish EcoSite

The main objective of the Danish EcoSite is to treat industrial (bewery WW) and urban WW together with municipal organic solid waste (BW) from the town of Svaneke to produce green CH_4 and high-quality reclaimed water by the AnMBR and the AC.

The Danish Ecosite has been built and will be operated by the following partners:

- Bornholms Waster Water/Bornholms Energi and Supply (BEOF); manager of the EcoSite.
- Bornholms Regionskommune (BOFA); waste collection company.
- Frennegård (GARD); Danish farm benefiting from reused water.
- Svaneke Bryghus (BRYG); brewing industry.

3.3.1. Brief description of the current/final status of the pilot project.

As of November 30, 2023, the pilot plant of the Danish EcoSite is under construction and is expected to be completed by the end of January 2024.

As described in deliverable D4.1, the pilot plant consists of the following main units:

- BW Treatment Unit
- Anaerobic Digestion Unit
- Membrane Unit

It is a twin pilot plant to the Spanish EcoSite, so its design and construction process has been linked to that of the Spanish pilot plant. It will start operating once the Spanish plant has been commissioned, which is expected to happen by the end of January 2024. Project partner FACSA was in charge of the design of the pilot plant, while project partner BEOF was in charge of its construction.

3.3.2. Deviations/delays in the construction process.

During the construction phase of the pilot plant, minor changes have been made to the design presented in the Deliverable D4.1 to adapt the design to the needs of the Danish EcoSite. The changes are detailed below:

- Addition of a biogas degassing unit to increase biogas yield by recovering biogas on the permeate side.
- Addition of a second tank with a metering pump for chemically enhanced cleaning/backwashing. This will allow for both alkaline and acidic cleaning.
- Addition of stirred tanks with dosing pumps for the two WW streams.
- Sizing and specification of the permeate and biogas blower pump suitable for AlfaLaval's FSM membranes.
- Preparation of the electrical panel for the installation of a second membrane reactor if necessary.
- Division of the pilot plant into two connection units: a container-based unit and a platform-mounted unit. The container contains the BW shredder, the feed tanks, the regulation tank, the dosing pumps, the drum filter and the electrical cabinet. The platform contains the digester and membrane tanks. The platform will be designed as a semi-open structure for biogas safety reasons and in compliance with ATEX standards.

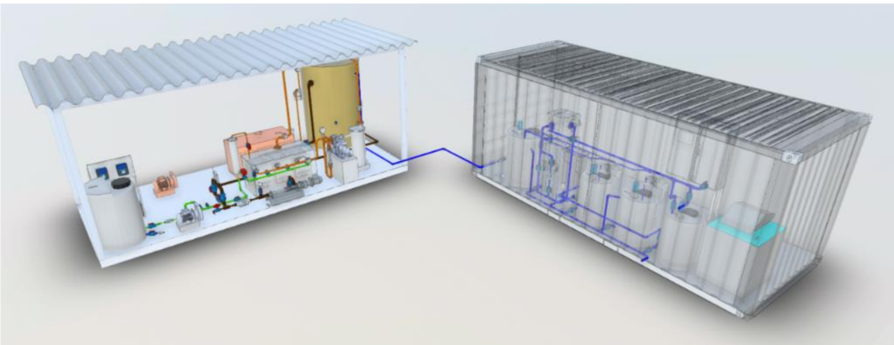

Figure 16: 3D drawing of the Danish EcoSite pilot plant.

Likewise, the actual location of the container and the platform in the Svaneke WWTP will be modified, as these elements will be close to the main buildings and will feed the water streams, sewerage, electricity supply, etc. Below is an overview of the new location and equipment location.

Figure 17: Location of the Danish EcoSite at the Svaneke WWTP in Bornholm

The small changes made, together with the dependence on the design and construction of the Spanish pilot resulted in a delay in construction of two months, however, this will not affect the start-up of the Danish EcoSite.

The construction phase is being carried out indoors in one of the workshops to facilitate assembly in the event of weather conditions. It is scheduled to be moved to its final location outside the Svaneke WWTP in early February and its integration and commissioning is expected to start in mid-February 2024, after the commissioning of the Spanish EcoSite has been completed.

3.3.3. Photos verifying the construction of the pilot.

Below are the images that verify the start of the construction and assembly of the different components of the pilot.

1. BW treatment unit.

The shredder for the organic fraction of solid urban waste has already been purchased and is awaiting for its installation on the GRP platform (Figure 18).

Figure 18: Danish EcoSite commercial shredder.

2. Anaerobic Digestion Unit

The construction of the 2m^3 anaerobic digester has been completed and is awaiting installation on the GRP platform (Figure 19).

Figure 19: Anaerobic digester from the Danish EcoSite pilot plant.

3. Membrane Units

For the time being, the AlfaLaval membranes have been re-piped and the construction of the degasser that will be installed at the permeate outlet has been completed (Figure 20).

Figure 20: AlfaLaval membranes and degasser from the Danish EcoSite membrane unit.

3.3.4. Photos verifying installation at final location.

The Danish EcoSite pilot plant will be installed and connected at the WWTP at the beginning of February.

3.4. Greek EcoSite

The main objective of the Greek EcoSite is to treat industrial and urban WW as well as fermentable solid household waste (FHW) originated and collected from the municipality of West Achaia via a brown bin collection network.

The Greek Ecosite has been built and will be operated by the following partners:

- National Technical University of Athens (NTUA); manager of the EcoSite.
- SIRMET S.A (SIRMET); developer of the EcoSite.
- Municipality of Western Achaia (MWA); municipality operating the WWTP.
- Elaiourgikes Epiheiriseis Patron S.A. (EEP); olive oil industry.

3.4.1. Brief description of the current/final status of the pilot project.

As of 30 November 2023, the pilot plant of the Greek EcoSite is built and stored at the facilities of the project partner EEP pending the performance of electrical and hydraulic tests to define and optimize the operational parameters of the process. After completing the relevant tests, the pilot plant will be transferred to the MWA WWTP. It is expected to be installed in its final location by the end of January 2024.

All the components of the pilot plant have been built and assembled on the galvanized platform over the last few months. All components were planned and selected during the design stage by the partners involved in the Greek EcoSite (NTUA and SIRMET). As described in deliverable D4.1, the pilot plant consists of the following main units:

- Brown Container Net System:
- FHW Treatment Unit
- Dark Fermentation Unit (CSTR1)

- Conditioning/Inertia Tank:
- Anaerobic Digestion Unit (CSTR2)
- Membrane Unit
- Advanced Water Treatment with Adsorption Column

SIRMET was in charge of the construction of the pilot system for the Greek Ecosite. The pilot will be launched in early February 2024. Both the acetogenic and methanogenic reactors will initially start their operation using only WW as feedstock, when the reactors reach the steady-state phase, the two waste streams will be added (liquid phase of food waste and WW from the olive oil industry). The screw press and shredder/dryer will be used for the pre-treatment of the food waste stream after the reactors reach steady-state mode.

3.4.2. Deviations/delays in the construction process.

During the construction phase of the pilot plant, a small modification has been made with respect to the design presented in the Deliverable D4.1 in order to optimize the efficiency and management of the resources of the pilot system.

A closed-loop system has been implemented for the liquid effluent (substream) from the membrane tank to the anaerobic reactor (CSTR 2). The addition of the closed-loop system and valve network strengthens the pilot's resilience and adaptability to changing conditions without compromising operational performance. The continuous circulation of the effluent not only ensures stability within the reactor, but also minimizes the need for unnecessary withdrawals of liquid charge from the conditioning tank. This is particularly advantageous during periods when there is no additional organic load from the brown bin network or periodic EEP operations, aligning seamlessly with sustainable and resource-efficient practices.

3.4.3. Photos verifying the construction of the pilot.

Below are the following images that verify the construction and assembly of the various pilot components on the galvanized platform. The construction phase was carried out inside the facilities of the partner EEP to facilitate its assembly in the face of climatic conditions that may arise, and it was later moved to its final location in the WWTP.

1. **Brown Container Net System**

The brown bin net system, designed to transport solid waste to the facility, has been successfully procured. This critical infrastructure was unveiled in the Alissos area during an event hosted by MWA on September 15, 2023. In addition, the system has been strategically installed in the designated locations, as outlined in D4.1. It is important to note that the brown container network will be operational on a bi-weekly schedule.

Figure 21: Brown containers purchased from the Greek EcoSite for FHW collection.

2. FHW Treatment Unit

The screw press will be the first step in treating solid waste from brown bins. It has been built in AISI 304 stainless steel and has a high strength and elasticity screw with anti-corrosion protection. Food waste enters the screw channel, is compressed, and discharged into a collection container. The compression drain is directed through a special drainage arrangement into the grate channel.

The pressed fraction of the FHW is then directed to a commercial food waste shredder/dryer, which can handle the corresponding quantities in less than 9 hours, thus reducing the volume of food waste by up to 90%.

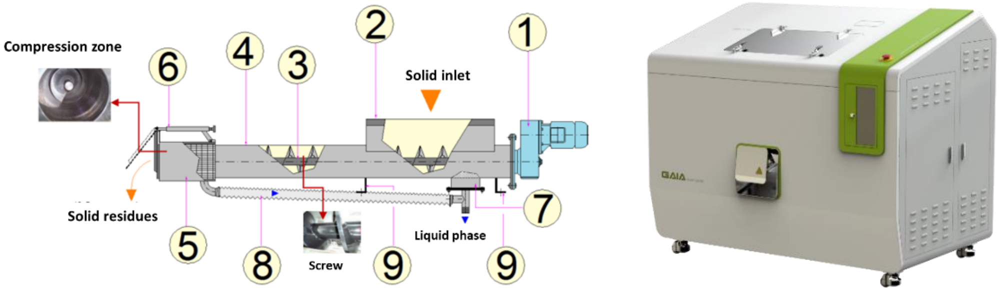

Figure 22: Screw press and commercial shredder/dryer installed at the Greek EcoSite.

3. Dark Fermentation Unit (CSTR1)

The 350L bioreactor designed to carry out the dark fermentation stage (acidogenic) has been assembled on the galvanized platform along with all the auxiliary components necessary for the seamless operation of this stage. This includes essential equipment such as pumps, agitators, temperature sensors, pH meters, and level measuring devices.

Figure 23: Dark fermentation unit (CSTR1) built and installed at the Greek EcoSite.

4. Conditioning/Inertia Tank

The conditioning/buffer tank has a robust design that offers a significant usable capacity of 3.4 m^3. This tank has been constructed of AISI 304 stainless steel, which ensures durability and corrosion resistance. To further enhance its performance, the tank has been meticulously insulated, helping to maintain the desired temperature whilst preventing energy losses.

Likewise, a motor-driven continuous mixing system has been incorporated into the conditioning/inertia tank. This mixing system ensures that all incoming waste streams, including urban WW, EEP effluent and CSTR 1 effluent, are mixed thoroughly and evenly.

Figure 24: Greek EcoSite conditioning tank.

All peripheral components required for the conditioning/buffer tank have been efficiently procured and installed next to the tank on the galvanized platform. These include feed pumps, valves, metering pumps, and tanks for acid and nutrients. In addition, essential measuring instruments, including pH meters, temperature sensors, and level meters, are ready.

5. Anaerobic Digestion Unit (CSTR2)

The 5.5m^3 Anaerobic Digester (CSTR2) has been constructed from AISI 304 stainless steel, ensuring durability, corrosion resistance and compliance with the highest industry standards. It has also been equipped with an internal motor for continuous mixing.

Figure 25: Anaerobic digester (CSTR2) installed in the Greek EcoSite pilot plant.

The auxiliary components have been purchased and reassembled next to the reactor on the galvanized platform. These include the feed pump, the recirculation pump to the buffer tank, the internal recirculation pump, and all the necessary measuring tools, including the biogas meter.

6. Membrane Unit

The 1.9m^3 membrane tank has been precisely designed and constructed in AISI 304 stainless steel. Inside this tank, advanced modules of flat sheet membranes are employed, with a collective surface area of 10m^2. These membranes are characterized by a pore size of 0.04 μm, which ensures the effective removal of even the finest particles and impurities from WW.

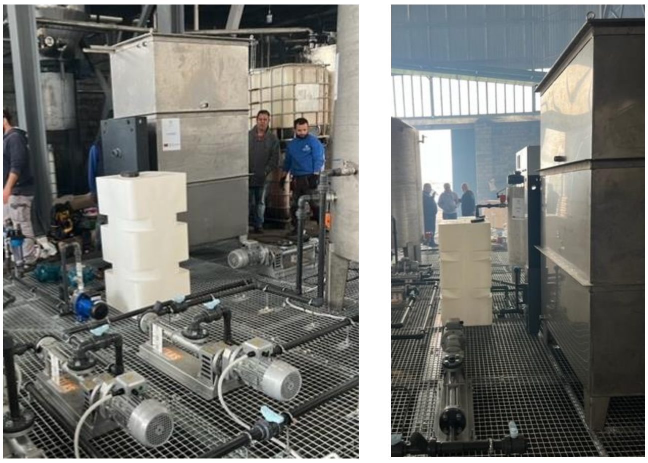

Figure 26: Membrane unit built and installed in the Greek EcoSite.

As indicated above, in order to maintain the delicate balance of operations, an internal recirculation system has been installed, which facilitates the recirculation of a portion of the untreated liquid back to CSTR 2.

To ensure smooth and efficient operation of the membranes, an MBR extraction/backwash pump system has been carefully integrated into the configuration. This system is designed to remove and backwash the membranes, preserving their effectiveness and extending their useful life. In addition, all auxiliary components required for the membrane tank, including pumps, valves, MBR modules, and auxiliary tanks such as CIP tank and dosing tanks, have been meticulously procured and installed next to the tank on the galvanized platform.

7. Advanced Water Treatment with Adsorption Column

The adsorption column system has been purchased and installed, along with an automatic suction pump that allows the efficient transfer of the treated water from the membrane tank to the adsorption column.

Figure 27: Adsorption column of the Greek EcoSite pilot plant.

3.4.4. Photos verifying installation at final location.

The Greek EcoSite pilot plant will be installed and connected at the MWA WWTP between the end of January and the beginning of February 2024.

4. Conclusions

The construction and installation of the pilot plants of the Spanish and Austrian EcoSites in their final locations has been carried out successfully, pending receipt of the last components of the respective membrane units, as well as the completion of the relevant connections to the WWTP.

The Greek EcoSite has carried out the construction of the pilot plant, which is in the hydraulic and electrical testing phase at the facilities of partner EEP, with plans to be transferred to the WWTP at the end of January.

Finally, the Danish EcoSite pilot plant is still in the construction phase, which is expected to finish by the end of January 2024. Given its dependence on the Spanish EcoSite, the start of its operation has not been affected, since this is expected in early February once the Spanish pilot plant completes its start-up.