

## ECOPOOL+++ – Innovative heated pools with reduced thermal losses and integration of smart energy and water management systems

### Summary

**Scope** – Heated outdoor pools involve very high energy and water consumption. Finding solutions to minimize energy losses, mitigate water leaks, integrate renewable energy production and storage systems and control energy and water systems in a predictively and intelligently way will make a decisive contribution to its sustainability.

This project aims to design an innovative thermal insulation system for the interior of the pool and the cover of the water surface. It also aims to develop an intelligent and predictive control and monitoring system (SMART), which enables the optimization of multiple variables, and decision-making regarding the systems that make up the pool. It also includes the development of a web application to carry out control operations remotely.

**Main objective** – The ECOPOOL+++ project aims to design a sustainable and innovative pool solution containing thermal insulation inside the tank, thermal coverage of the water surface and an intelligent and predictive control and monitoring system capable of providing high energy and water efficiency:

- Develop and characterize the thermal, mechanical and durability performance of an innovative thermal insulation system, with high durability and low maintenance;
- Develop and characterize the performance of new mortars (base layer, waterproofing mortar, pastille bonding mortar, joint mortar) to be integrated into the thermal insulation system;
- Conceive, characterize and optimize a thermally efficient cover for the water surface;
- Integrate solar energy capture systems through the use of solar panels and heat collecting floors;
- Analyse the possibility of integrating heat storage systems, through the use of reserve tanks containing phase change materials (PCM);
- Integrate electricity production system through photovoltaic panels;
- Design optimized hydraulic circuits to increase the efficiency of filtration and regeneration systems (backwashing);
- Design an intelligent and predictive control and monitoring system (SMART), which allows the management of energy supply and consumption systems, water consumption (including filter regeneration

operations), leak detection in the tank and in piping, and water temperature control;

- Study the feasibility of reusing filter washing water to irrigate green spaces;
- Establish application conditions for new products;
- Validate the performance of new products under laboratory conditions with regard to the technical specifications and, in particular, to the innovative characteristics;
- Validate the final performance of new products under real conditions, giving them high commercial value and high export potential;
- Promote a wide dissemination of the results achieved with the project, guaranteeing an effective acceptance of the new products in the global market.

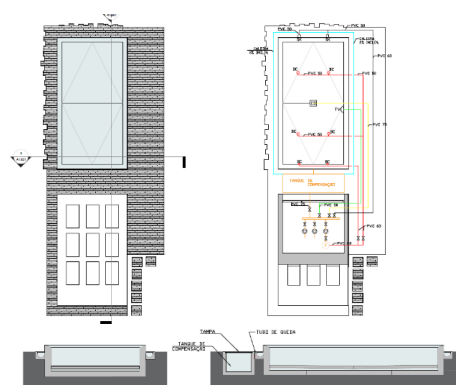


Figure 1. Prototype Scheme.

### Project activities and expected results

#### Preliminary studies and concept development

The aim of this industrial research activity, which took place over the first 13 months of the project, was to acquire knowledge related to the market (national and international), technology (existing products and solutions, new materials) and methods (characterizations and methodologies). Throughout this activity, the performance requirements of the systems and technological solutions that make up the pools were defined, considering thermal insulation, resources management systems (energy and water) and others. The final cost of the solution over its lifecycle was a concern.

#### Development of studies and elaboration of systems



### Project Reference

ALG-01-0247-FEDER-047231 / CENTRO-01-0247-FEDER-047231

### Leading Institution

Cristal Construções – Materiais e Obras de Construção Civil Lda. (Portugal)

### Partners

ITELMATIS Lda. (Portugal), Universidade do Algarve (Portugal), Itecons – Instituto de Investigação e Desenvolvimento Tecnológico para a Construção, Energia, Ambiente e Sustentabilidade (Portugal)

### Collaboration

WEBER Portugal

### CERIS Principal Investigator

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### CERIS Research Team

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### Funding

Portugal 2020

### Period

2021-2023

### Total

697 749.86€

### CERIS

Coimbra Hub: 215 525.41€

### Project Website

[www.itecons.uc.pt/projectos/ecopool/index.php?module=sec&id=920&f=1](http://www.itecons.uc.pt/projectos/ecopool/index.php?module=sec&id=920&f=1)

In this activity, the ECOPOOL+++ solution was designed. It corresponds to the activity with the longest duration (14 months), which took place in partial overlap with the first activity, and consists in the design, development and study of the systems that make up the final solution. Simultaneously with the consolidation of the knowledge acquired during the first activity, the development process of all products and systems, and of the integrated solution has begun. This industrial research activity was extremely important to fulfil the requirements of structural safety, hygiene, health, sustainability, etc., inherent to the challenges proposed in the project. At this stage, all efforts to develop the solution were focused in the different solution strands, namely mortars and thermal insulation, covering of the water surface, systems for capturing solar gains and heat storage, systems for detecting leaks and reuse of water, monitoring, automation and control systems, and the electrical installation of equipment. The different solutions were characterized and optimized through numerical simulation and in a laboratory environment, with the necessary carrying out of tests, to evaluate and optimize the various components of the solution and, subsequently, the set.

#### Prototyping and validation

This experimental development activity, lasting 13 months, aims to transpose the study to a real scale, with the construction of a swimming pool prototype. At this stage, the intention was to evaluate and monitor the performance of products and systems under development, in service conditions, introducing improvements, if necessary. This sustainable pool prototype is expected to have a positive effect in promoting the solution, increasing market

confidence. At the end of this task, the evaluation of the performance of all systems in terms of optimizing the set was completed.

#### Definition of manufacturing, transport and assembly instructions

The prototyping and validation of the developed systems allowed the stabilization of all the information related to the systems implementation rules. Thus, throughout activity 4, the instructions for manufacturing, transport, handling and assembly of all systems was defined. The characteristics of the materials, production instructions and final properties of all components was compiled in technical sheets and the transport conditions and delivery scenarios on site and the handling instructions was defined. Plans were also produced with all the necessary indications for assembly on site.

#### Promotion and dissemination of results

The development of the project's visual identity and website is of great importance from an early stage of the project, as it also facilitates communication. As a result of the planned developments, it was expected to have relevant information to start promoting and disseminating results, especially from the intermediate stages until the conclusion of the project. This disclosure was carried out at technical and scientific events, at conferences, congresses and technological fairs, and scientific articles and multimedia content was produced.

#### Technical project management

The project's technical management activity took place throughout the entire project, with a total duration of 30 months, simultaneously with the other activities.

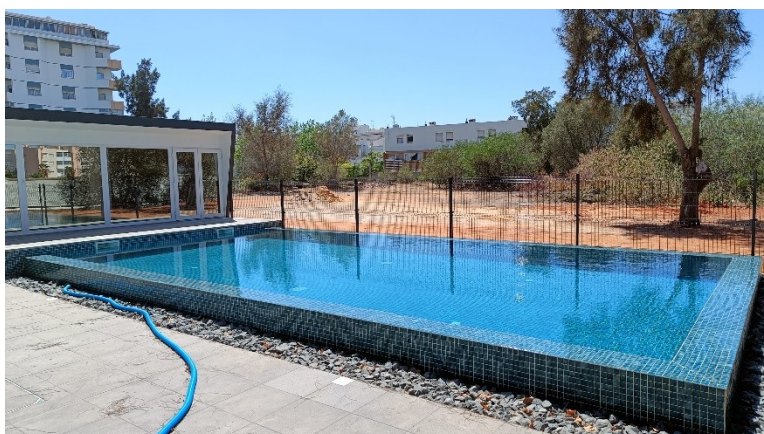


Figure 2. Concluded prototype.