THERMAL ENERGY STORAGE FOR BUILDING COOLING AND HEATING: COOLSPACES 4 LIFE

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Energy storage is crucial for renewable energy sources, but also very relevant in conventional non-renewable sources, to overcome fluctuations in the demand or production, or profit from price variations. Different forms of energy can be stored in several ways, but thermal energy is particularly convenient for applications related to temperature control, such as space cooling and heating. In this case, the use of phase change materials (PCM) is widely spread due to their high density of energy, the narrow range of temperature variation during energy storing and releasing, and their reduced cost. On the other hand, PCMs must be typically encapsulated, what hinders the heat transfer with the external fluid, reducing the overall effectiveness of thermal storage in phase change materials.

The research center for solar energy of the University of Almeria, CIESOL, is focused on the use of solar energy for different applications, with a total working area of 389 m² and around 70 workers daily. The current heating and cooling system is driven by solar thermal energy, collected by an array of flat-plate collectors with a total surface of 160 m², and uses water as working fluid. The cooling demand in summer, which is much larger than the heating needs in winter, is covered by a chiller that follows an absorption cycle with a LiBr-H_2O solution and dissipates heat via a cooling tower or a geothermal system. This chiller has a rated thermal power of 70 kW and provides cold water between 5.5ºC and 7ºC. Cold water can be fed directly to the air-conditioning splits in the building, or stored in two tanks with a total volume of 5000 liters, or in two tanks with approximately 4000 kg of PCM and 1000 liters of water. The PCM has a melting point of 11ºC and is encapsulated in prismatic nodules of 3.5 kg each.

COOLSPACES 4 LIFE is a consortium running an EU Life project, lead by the Wroclaw University of Science and Technology (WUST) and participated also by the University of Almeria (UAL) and two companies (PROZON, from Poland, and Hedera Helix, from Spain). In this project, we aim to substitute the solar driven absorption chiller by a compression refrigeration cycle driven by electricity collected with PV panels, and a PCM based thermal storage system. In order to provide water at around

6ºC, the refrigeration cycle must produce cold fluid at -10ºC, with the melting temperature of the PCM around -3ºC.

In this work, we will present the current status of the CIESOL refrigeration system, focusing on the heat storage systems (PCM tanks and chilled water tanks). The analysis indicates that a significant saving can be achieved when thermal storage in PCMs is used in combination with the solar driven absorption chiller, larger than 40% when compared to conventional air-conditioning. Using water as thermal storage provides also an important saving, above 35%. The modifications in the actual system due to the ongoing COOLSPACES project will be described, and details about the low temperature storage system given.