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ASTEP: Application of Solar Thermal Energy to Processes. Current status and progress.

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TOPIC: ENERGY EFFICIENCY AND SUSTAINABILITY IN BUILDINGS AND INDUSTRY

1. Introduction

Solar Heat for Industrial Processes (SHIP) is becoming increasingly relevant as one of the ways to meet the high thermal energy demand required for industry. This involves a double benefit: firstly, by using a renewable energy source, fossil fuel consumption is reduced and so is the emission of pollution and greenhouse gases into the atmosphere; secondly, heat for industrial processes becomes a different market niche for solar technology, which can lead to a decrease in the cost of solar collectors through economies of scale in manufacturing and learning-curve advances in deployment.

This paper presents the ASTEP (Application of Solar Thermal Energy to Processes) project, which creates an innovative SHIP concept, as well as the current progress, gathering the project outcomes up to date.

2. ASTEP concept and case studies

ASTEP is a project funded by the European Commission involving 16 partners of 8 different countries, led by UNED and with a significant Spanish contribution. The proposed concept is a SHIP solution is based on modular and flexible integration of two innovative designs for the solar collector (SunDial), conceived by UPM and UNED, and the Thermal Energy Storage, based on Phase Change Materials, led by UPCT. These technologies are integrated via a control system which will allow flexible operation to maintain continuous service. ASTEP should demonstrate its capability to cover a substantial part of the heat demand of the industrial processes at temperatures above 150 ºC and for latitudes where current designs cannot supply it.

The concept will be tested at two industrial sites. The first one is a steel industry from ArcelorMittal, with a heating demand above 220 ºC for preheating tubes before painting, in a factory located at a latitude of 47.1 N (Iasi, Romania). The second one is the dairy company MANDREKAS, located at a latitude of 37.93 N (Corinth, Greece) with a heating demand for steam at 175 ºC and a cooling demand at 5 ºC.

After its first 20 months of execution, the different designs are finished, and the project is preparing the acquisition of the different equipment and components that will be tested on the UPM (Sundial) and UPCT (thermal storage system) premises.

3. Outcomes of the project up to date

Among the first technical and open results of the project, those related to the theoretical integration of the concept in a dairy industry [1-2], those related to the analysis and design of the solar collector [3-6] and the thermal storage system [7], and the preliminary steady and dynamic simulation of the ASTEP concept [6, 7] stand out.

This set of results are now completed and are being disseminated in the present 12CNIT conference in separate works. These new six works are listed below:

- The basic design of the Sundial for the two end-users, ArcelorMittal and Mandrekas;
- The analysis of the Sundial concept sited in Corinth and working at different temperatures and with different thermal demands;
- The assessment of the effect of the inertia on the transient behaviour of the system;
- Description of the design and sizing of the accumulator of the thermal storage system;
- A preliminary exergy analysis to the ASTEP concept;
- And a detailed description of the behaviour of a water-ammonia absorption chiller driven by the Sundial.

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