Research examines some losses in the devices that convert solar energy into useful heat

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Engineer Fabienne Sallaberry has calculated the losses sustained by solar thermal collectors, devices that convert the sun's energy into useful heat, when one of their components is not correctly focusing direct solar radiation. This researcher is also proposing that certain sections included in the Spanish standards and in the international ones should be revised so that the global output of these devices can be better determined.

This thesis has focused on solar thermal energy, which involves processes to convert solar energy into useful energy. "Today, we know that it can provide a considerable fraction of the current and future world demands for thermal energy in the industrial as well as in the domestic sector," said Fabienne Sallaberry. "This is reflected in the growing interest in the new designs of solar collectors, in particular during the last decade, in order to meet the growing heat demands."

According to the new researcher, a solar thermal collector is "a box containing various components in which a fluid circulates and is heated thanks to the greenhouse effect. For a broad range of operating temperatures, solar thermal collectors can use optical concentration systems such as parabolic mirrors to optimize their performance", Fabienne Sallaberry said. "Nevertheless, as optical concentration is based on direct radiation that comes directly from the sun without being dispersed by the atmosphere, it is necessary to use a mechanical device or solar tracker that allows the collector to follow the direction of the sun and thus maximise the amount of solar radiation received by the collector".

Optical losses

In order to achieve optimum performance, it is necessary "to select the appropriate tracking system. Otherwise," added Sallaberry, "the collector would sustain significant optical losses due to the inadequate focusing of the solar radiation, irrespective of the quality of the device components and its manufacturing process."

That is why Sallaberry has focused her research on calculating errors due to the solar trackers. To do this, she initially conducted some of her own tests to evaluate these mechanical devices. Then she used computer-based simulation techniques and experimental observations to produce an optical characterisation of various solar collectors that use optical concentration. "It is about determining how far their performance depends on the errors of their solar trackers," she said. "It should be highlighted that a high degree of agreement was observed between the theoretical results provided by the simulation program and the experimental ones".

In a third phase, she calculated the long-term optical losses caused by the solar tracking system. "The impact of the maximum tracking error on the optical performance has been determined for various collectors and different tracking systems," she said.

Finally, her thesis indicates the sections included in the international standards (in particular the ISO 9806 standard for testing and certifying solar thermal collectors) that need revision in order to determine the influence of solar tracking on the overall performance of the collectors. In this respect, Fabienne Sallaberry has put forward improvements for inclusion in a future procedure on the standardized testing of solar trackers for solar thermal collectors.

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