

Development of a Solar Water Heating Efficiency Test Facility in Uruguay under ISO Standards

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Introduction

The purpose of this facility is to measure the efficiency of solar thermal collectors and solar water heaters according to ISO standards. This capacity allows the country to perform quality control of national and imported equipment. This project was funded by Uruguay's National Energy Office (DNE) of the Ministry of Industry, Energy and Mining (MIEM).



Fig. 1

Design

The design was locally done by the Solar Energy Laboratory and Faculty of Engineering of the University of the Republic. To take advantage of the international experience an agreement was done with the National Center of Renewable Energies of Spain (CENER). The final design have two test stations for solar thermal collectors and two for solar water heaters (solar systems). The key issue of controlling the temperature is performed using heat-exchangers and automatic valves. The heating water is taken from an electric heater and the cooling water is taken from a chiller. The automatic valves and the electric heater are controlled by a central PLC.

Solar thermal collectors

Thermal performance tests are done according with ISO 9806:2017 standard under steady state conditions (SST). In this facility it is possible to test collectors from 1 m² to 5 m² with an inlet temperatura up to 85°C. Each test station has a tracking system to control the angle of incidence and ventilation units to impose wind velocity over the collectors.



Fig. 2

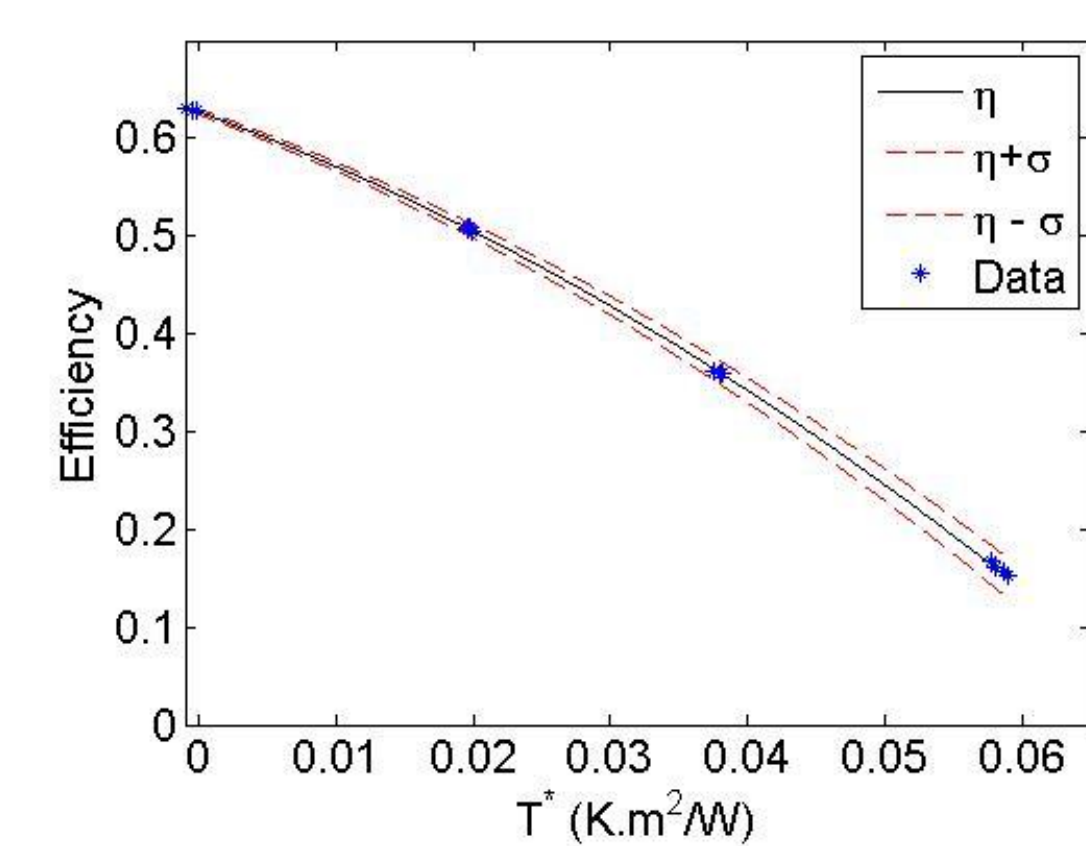


Fig. 3



Fig. 4

This test is done according with ISO 9459-2:1997 standard. Equipment up to 600 liters tank capacity can be tested in this facility. To determine the storage tank heat losses and mixing degree a gas heater is used. The test station has a several open/close valves that are commanded by a PLC, with a high degree of automation. We want to implement the ISO 9459-5:2007 standard to reduce testing time. The only action that is needed for this step is to develop the PLC programming for the test, as the rest of the facility met the technical requirement for its implementation.

Solar water heaters

Quasi dynamic testing of solar thermal collectors

In the ISO 9806:2017 standard another test method is presented; quasi dynamic testing (QDT). We have made a preliminary analysis of the applicability of this method in our climate based on the typical meteorological year of Uruguay. Figure 5 shows the number of test hours for each month of the year for two different cases. In the first case, we follow the SST method and track the sun in azimuth and altitude. In the second case, we follow the QDT method with the collector faced to the equator and a fixed inclination of 45°. The number of test hours in the second case are considerably higher and, for this reason, we want implement the QDT method in the future to take more advantage our facility.

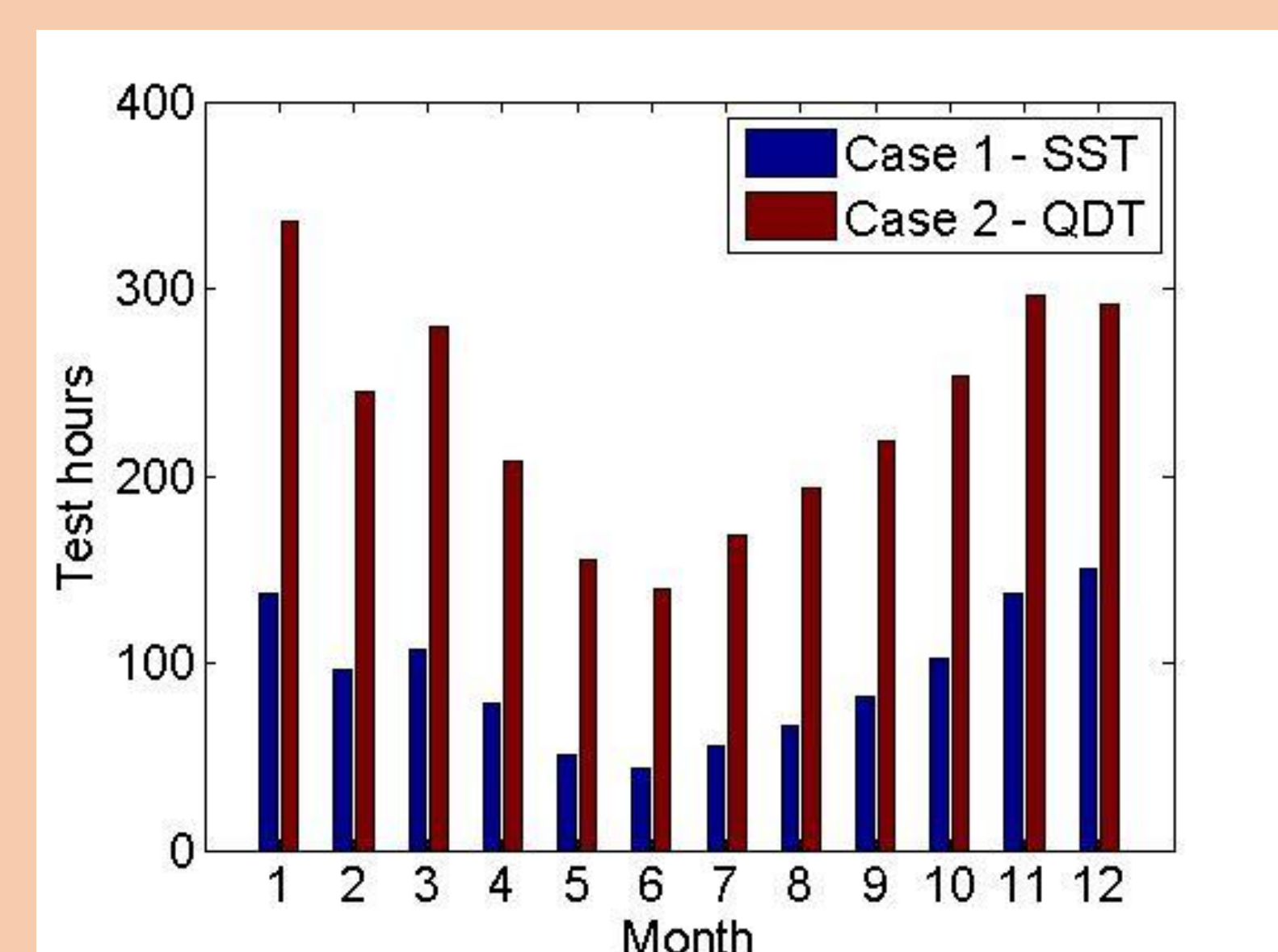


Fig. 5