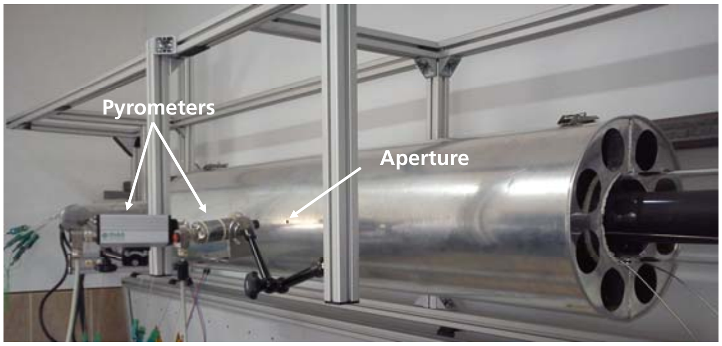

Figure 1: Receiver with radiation shield. Two infrared pyrometers (2.0…2.6 µm, 8…14 µm) measure the temperature of the absorber tube and the glass envelope through an aperture in the radiation shield.

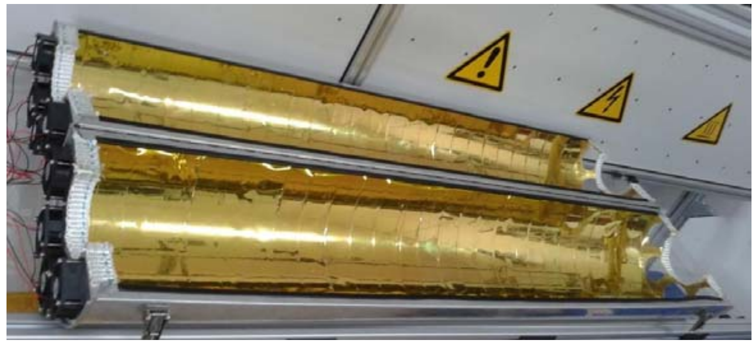

Figure 2: Inside of radiation shield with infrared reflection foil and ventilation fans. The foil reflects the infrared radiation emitted by the glass envelope.

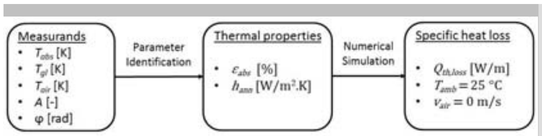

Figure 3: Transient measurement analysis workflow.

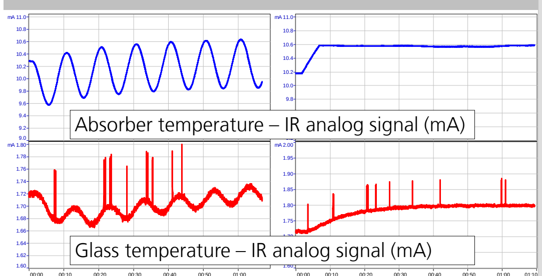

Figure 4: Experimental data excerpts for transient measurements. Left: Sinusoidal absorber temperature excitation profile. Right: Ramp-and-hold excitation.

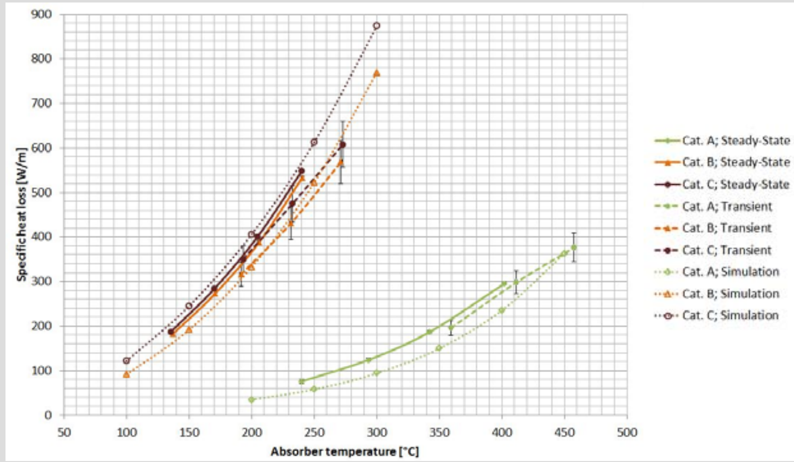

Figure 5: Comparison between steady-state specific heat loss measurements (DLR ThermoRec), specific heat losses derived from transient infrared thermography measurements and specific heat losses derived from simulation based on material data.

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Transient Infrared Thermography Heat Loss Measurements on Parabolic Trough Receivers Under Laboratory Conditions

A method based on transient infrared thermography has been developed for the measurement of parabolic trough receiver heat losses in the field and first laboratory tests have been conducted.

A receiver is excited with transient heating power (sine or ramp). Absorber and glass temperatures (Fig. 4) are measured with infrared pyrometers (Fig.1) through a radiation shield covering the receiver (Fig. 2). Five measurands are derived from temperature measurements (Fig.3): mean absorber temperature T_{abs}, mean glass temperature T_{gl}, mean air temperature inside the shield T_{air}, amplitude ratio A and phase shift ϕ.

These measurands are used to derive the absorber emittance ε_{abs} and the annulus heat transfer coefficient h_{ann} with a numerical receiver heat transfer model. These thermal properties are then used to simulate the specific heat loss $Q_{th,loss}$ of a receiver under standard laboratory conditions (T_{amb} = 25°C, v_{air} = 0 m/s).

Specific heat losses obtained from transient experiments deviate from steady-state heat loss measurements by less than 10% for standard receivers (Fig. 5). The transient measurement method is currently investigated in the solar field.

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