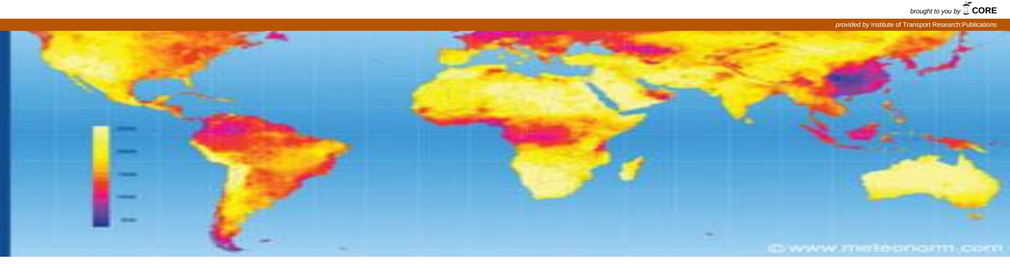
September 28 - October 2, 2020
Online Event
26th SolarPACES Conference
SolarPACES
Solar Power & Chemical Energy Systems



UV degradation of primary mirrors in outdoor exposure and accelerated aging

Francisco Buendía-Martínez[1,*], Aránzazu Fernández-García[1], Johannes Wette[2], Florian Sutter[2] and Loreto Valenzuela[1]

[1]CIEMAT-Plataforma Solar de Almería, Solar Concentrating Systems Unit, Ctra. Senés, km 4, E-04200, Tabernas-Almería (Spain)
[2]DLR, German Aerospace Center, Institute of Solar Research, Paseo de Almería 73, 2°, 04001 Almería, (Spain)
**Correspondence: Tel. +34 950 38 78 00; e-mail: francisco.buendia@psa.es*

Introduction

- CSP plants are located in zones where the **solar irradiance** is extremely high. UV radiation might significantly affect the **durability** of solar reflector materials.
- UV radiation modifies the transmittance of the solar glass mirror [1-2]. The severity of this modification strongly depends on the **iron content** of the glass.
- **Objectives**: To **quantify** the **degradation** originated by UV radiation and temperature in **silvered-glass reflectors** exposed in three locations with high solar irradiance and to **replicate** the degradation mechanisms observed in outdoors through accelerated aging tests.
- To achieve this goal, a study was conducted in order to quantify the **weathering** provoked by the **UV radiation** and **temperature** in solar reflectors. The **degradation phenomenon** observed by means of the outdoor exposure of several types of reflectors was properly reproduced by **accelerated aging tests**.

Methodology

- **Materials:** seven different silvered-glass reflectors with low-iron glass provided for an experienced manufacturer.
- **Outdoor exposure**: of the solar reflectors in three different locations over 3 years (Table 1, Fig. 1).
- **Accelerated aging:** UV testing with a fluorescent lamp which emits radiation from 290 to 400 nm, with the intensity set to 0.9 W/m²/nm and 37 ºC of temperature.
- **Analysis method:** quantification of the solar hemispherical reflectance drop between 320 and 750 nm in function of the UV dose received.

Table 1. Description of the outdoor locations.

Location	Yearly GHI (kW·h/m²)	Average temperature (ºC)
Chajnantor (Chile)	2609	-2.7
Tabernas (Spain)	1901	18
Missour (Morocco)	2023	22

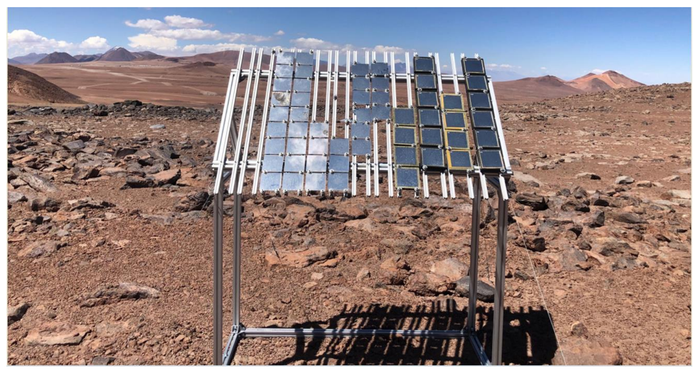


Fig. 1. Outdoor exposure of the reflectors in Chajnantor (Chile).

Results

- UV chamber, with a fluorescent lamp, perfectly reproduces the same degradation observed outdoors (Fig. 2).
- **UV test accelerates approximately 9 times compared to** Tabernas (Fig. 2).

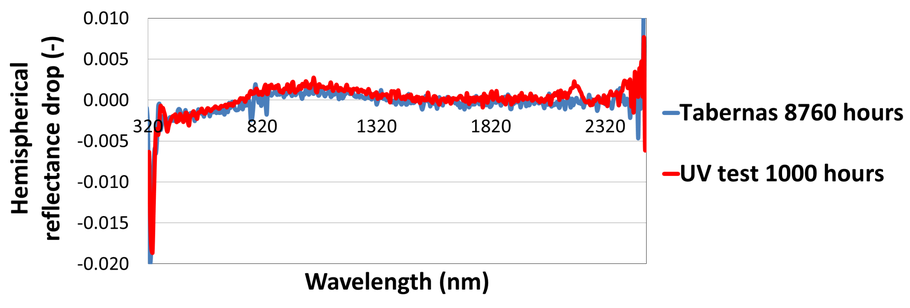


Fig. 2. Solar hemispherical reflectance drop after 8760 h of outdoor exposure in Tabernas (Spain) and 1000 h of UV test.

- Missour showed the highest degradation, followed by Tabernas and Chajnantor (Fig. 3).
- It possibly exists **synergism** between **UV radiation** and **temperature**, but in-depth investigations are needed to verify it.
- Temperature influence is more critical than UV radiation.

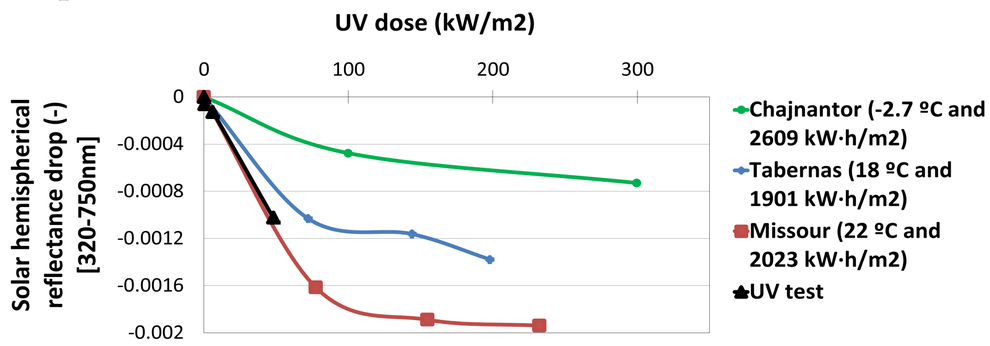


Fig. 3. Solar hemispherical reflectance drop [320-750 nm] depending on the outdoor site or UV test.

Conclusions

- **UV test** with a fluorescent lamp **reproduces** the **same degradation mechanisms** observed in Tabernas (Spain) approximately **9 times faster**.
- It probably exists **synergistic effects** between **UV radiation** and **temperature**.
- Up to now, this degradation mechanism **does not** significantly **affect** to the **reflector durability**.

References

[1] Kennedy CE, Terwilliger K, Jorgensen GJ. Further Analysis of Accelerated Exposure Testing of Thin-Glass Mirror Matrix. ASME 2007 Energy Sustain Conf. 2007;1055–64.

[2] White JF, Silverman WB. Some Studies on the Solarization of Glass. Journal of the American Ceramic Society. 2006;33: 252 - 257.

SOLTERMIN

This work is part of the Spanish Project SOLTERMIN (Ref. ENE2017-83973-R) supported by the Programa Estatal de Investigación, Desarrollo e Innovación orientada a los Retos de la Sociedad (National Program of Research, Development and Innovation oriented to Society's Challenges) of the Ministerio de Economía y Competitividad (Spanish Ministry of Economy and Competitiveness)

GOBIERNO DE ESPAÑA
MINISTERIO DE CIENCIA, INNOVACIÓN Y UNIVERSIDADES
Ciemat
Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas
PSA
PAC