

SLAGSTOCK

Low-Cost Sustainable Thermal Energy Storage Systems Made of Recycled Steel Industry Waste

Project Duration: 05.2015 to 04.2018

Final report submitted: 06.2018

Summary

One of the major challenges of the Concentrated Solar Power (CSP) industry is the development of cost effective high temperature thermal energy storage (TES) systems. Currently, the most applied storage strategy in commercial CSP plants consists in a double-tank configuration based on molten salt as storage material. This arrangement presents several limitations such as the reduced operation temperature range, the worldwide availability of salts and their high cost.

SLAGSTOCK project aimed to develop an innovative thermal storage concept to overcome these drawbacks. The investigated approach makes use of slag, a by-product from the iron and steel manufacturing, as heat storage material for packed bed TES systems. Even if this material is currently recycled in several applications such as aggregates for construction or road materials, about 2,8 Mt of slag are landfilled per year. In this regard, the valorization of the slag as thermal storage material could represent a successful approach to obtain a low-cost and environmentally friendly TES solution. Furthermore, it was found that the slag presents energy density ($0.9 \text{ kWh/m}^3 \cdot \text{K}$) comparable to other materials proposed for packed bed TES systems, and that its operation temperature range can be extended up to $1100 \text{ }^\circ\text{C}$.

The 400 kWh_t experimental set-up constructed and tested within the SLAGSTOCK project has permitted the validation of the steel slag as TES material for packed bed system up to $800 \text{ }^\circ\text{C}$ using air as heat transfer fluid. Furthermore, the experimental results obtained in this lab-scale plant were used to validate a theoretical model that was applied for scaling-up the proposed TES technology to a real CSP plant. The results obtained with this model were used to perform a complete Life Cycle Assessment (LCA) and Techno-Economical Assessment (TEA) to evaluate the viability of the proposed solution in new generation CSP plants.

Project consortium

Coordinator and contact details:

Full name of organisation:	Centro de Investigacion COOP de Energias Alternativas CIC Energigune
First and family name of coordinator:	Iñigo Ortega
Full address:	Parque Tecnológico de Álava C/Albert Einstein, 48 01510 Vitoria, Spain
E-mail:	iortega@cicenergigune.com

Participating countries and financing:

Country	Number of organisations involved	Project costs in EUR	Public funding in EUR
Spain	3	628'789	242'000
Switzerland	1	153'450*	115'353
Germany	1	96'888	80'740
France	1	96'636	50'707
<i>Total</i>	<i>6</i>	<i>975'772</i>	<i>488'800</i>

* The contract of PSI is in CHF. The average exchange rate over the project duration was applied: 1 EUR = 1,0975 CHF. Cost numbers shown are assuming approval of PSI's final financial report.

Funding agencies involved and contracts

Funding Agency	Contract N° and Title
Ministerio de Economía y Competitividad (MINECO)	PCIN-2013-122-C03-01 - Sistemas sostenibles de almacenamiento de energía térmica a partir de residuos de la industria del acero
Swiss Federal Office of Energy	SI/501231-01 - SLAGSTOCK: Low-cost Sustainable Thermal Energy Storage Systems Made of Recycled Steel Industry Waste
Ministerio de Economía y Competitividad (MINECO)	PCIN-2013-122-C03-01 - Sistemas sostenibles de almacenamiento de energía térmica a partir de residuos de la industria del acero
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Federal Ministry for Economic Affairs and Energy (BMWi)	FKZ 0325806 - SLAGSTOCK-Kostengünstige umweltverträgliche Wärme-Energie-Speicher Systeme aus aufgearbeiteten Fabrikationsabfällen der Stahlindustrie-(Schlacken)
ADEME - Environment and Energy Management Agency	SRER-14-186/RC/YD/GM -SLAGSTOCK: Low-cost Sustainable Thermal Energy Storage Systems Made of Recycled Steel Industry Waste