

SITEF Silicon Fluid Test Facility

Project Duration: 01.2016 to 12.2017

Final report submitted: 08.2018

Publishable Summary

The SITEF (Silicone fluid Test Facility) project demonstrates the loop scale functionality and applicability of a new Wacker Chemie AG silicone heat transfer fluid (SHTF) named HELISOL[®] and associated parabolic trough collector (PTC) components at temperatures up to 450°C. Such operation temperatures are beyond state of the art in PTC power plants and increase the overall power plant efficiency. This innovative project has been performed in a German-Spanish cooperation making use of the so called PROMETEO test facility at Plataforma Solar de Almería (PSA).

Silicone fluids (e.g. DOW, SYLTHERM 800[®]) have been used in the past as heat transfer fluids (HTF) in medium scale installations such as PTC test loops e.g. at PSA, NREL (National Renewable Energy Laboratory) and elsewhere. SHTFs are pumpable at temperatures below 0°C, environmentally friendly (unused fluid), low in hydrogen formation, almost odourless and very low in acute toxicity. Until now, such fluids are not used in large-scale commercial CSP power plants because currently available SHTFs are far more expensive than the widely used eutectic mixture of diphenyl oxide and biphenyl (DPO/BP). According to laboratory test results HELISOL[®] may tolerate operation temperatures up to 450°C and will be available at a price similar to DPO/BP fluids (current price level).

During the preceding project called “Si-HTF”, HELISOL[®] has been investigated experimentally and economically in comparison to DPO/BP revealing promising results such as a considerably higher operating temperature and a low tendency to hydrogen formation. Based on and motivated by these results the “development” of HELISOL[®] shall be completed within SITEF by demonstrating its utilizability under actual power plant operation conditions on a loop-scale.

In addition to the heat transfer fluid demonstration, this project comprises the development and demonstration of adapted/appropriate receiver tubes from SCHOTT / RIOGLASS and rotation and expansion performing assemblies (REPAs), so called RotationFlex[®] Systems from Senior Flexonics to be used with HELISOL[®] at 450°C. These components are integrated into the PROMETEO test facility; an existing test loop consisting of two east-west aligned parabolic trough collectors with 8 trough modules each. Further technical modifications to its piping system implementing the necessary temperature upgrade enable the said loop outlet temperature of 450°C.

Intensive solar operation of the PROMETEO test loop, representing relevant power plant conditions, forms the core activity of SITEF. Its operational loop outlet temperature is increased in reasonable steps according to the results of accompanying thermos-physical and chemical laboratory analyses. These examinations are performed to monitor the degradation of the HTF and also to determine its long-term behaviour heading for a 25 year lifetime.

The economic benefit of the tested HELISOL[®] incorporating technical investments derived from the

higher HTF temperature / different HTF and the greater energy output is studied at full power plant scale. This task combines practical test experience, facility requirements and detailed component costs with theoretical analysis carried out during Si-HTF preceding project. A safety review identifies potential Si-HTF specific operation risks and points out technical measures.

Silicone fluid technology can contribute largely to the next step towards highly efficient and environmental-friendly parabolic trough plants. Unlike other alternative heat transfer fluids, HELISOL® may be used without major modifications to the solar field design and with components already in use in many other existing CSP plants.

Project consortium

Coordinator and contact details:

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Participating countries and financing:

Country	Number of organisations involved	Project costs in EUR	Public funding in EUR ¹
Germany	5	1'222'144	946'574
Spain	1	172'901	74'999
<i>Total</i>	6	1'395'045	1'021'573

¹ Funding according to grant agreement

Funding agencies involved and contracts

Funding Agency	Contract N° and Title
PTJ	Verbundvorhaben: SITEF- Silicone Fluid Test Facility; Teilvorhaben: Begleitende Laboruntersuchungen und Kollektorqualifizierung" Förderkennzeichen: 0325846A
MINECO	PCIN-2014-083. Instalación de ensayo de fluido de silicona (SITEF)
PTJ	Verbundvorhaben: SITEF- Silicone Fluid Test Facility Teilvorhaben: Befüllung der Anlage und Testbetrieb
ETN	Silicone Fluid Test Facility (SITEF) Förderkennzeichen: W040
PTJ	"Verbundvorhaben: SITEF - Silicone Fluid Test Facility; Teilvorhaben: Entwicklung und Einsatz einer flexiblen Rohrverbindung" Förderkennzeichen: 0325846C
PTJ	Verbundvorhaben: SITEF - Silicone Fluid Test Facility; Teilvorhaben: „Erhöhung der Betriebssicherheit und Beurteilung des Gefährdungspotentials“ Förderkennzeichen: 0325846E