WACKER

CREATING TOMORROW'S SOLUTIONS

HELISOL®

RENEWABLE ENERGY I SOLAR

HELISOL® – NOVEL SILICONE-BASED HEAT TRANSFER FLUIDS

A NEW LEVEL OF EFFICIENCY FOR PARABOLIC TROUGH CSP

Sunlight is key to sustainable energy production. The new HELISOL® heat transfer fluids from WACKER are key to high-efficiency, concentrated solar-power (CSP) systems. HELISOL® heat transfer fluids are silicone-based fluids intended especially for parabolic trough CSP plants. HELISOL® heat transfer fluids can withstand temperatures up to 425 °C for long periods, and retain their low viscosity even at -40 °C.
When used in combination with parabolic trough collectors, the fluids deliver efficiencies and operational advantages unrivaled by conventional heat transfer media.

Maximum Efficiency, Reliability and Economics

HELISOL® heat transfer fluids deliver maximum efficiency, reliability and economics as they power their way through the 400 °C barrier:

- High thermal stability
- Good heat transfer
- Low pour point
- No critical degradation products
- Higher power-block efficiency
- Fewer environmental and health risks

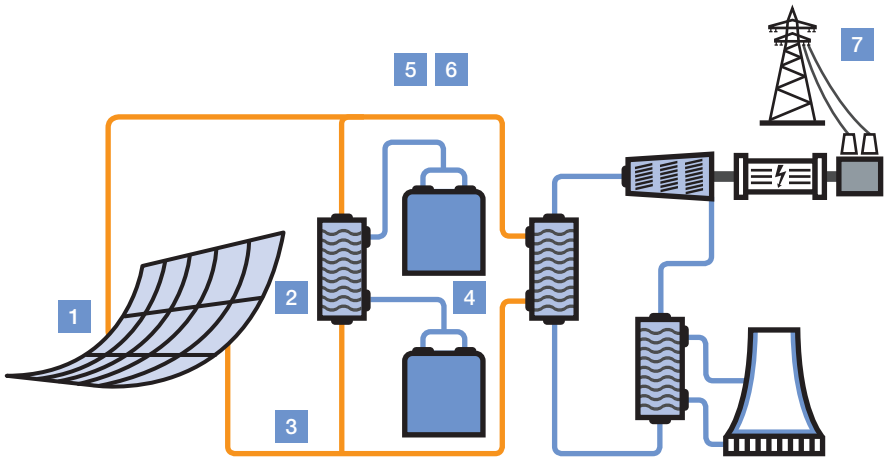
Conclusion

HELISOL® heat transfer fluids offer many advantages, withstanding temperatures of up to 425 °C for long periods and retaining their low viscosity even at -40 °C.

Huge Savings Potential

HELISOL® heat transfer fluids deliver not only higher efficiency levels, but also greater cost effectiveness, while offering superior business benefits in terms of capital (CAPEX) and operating expenses (OPEX) compared to organic BP/DPO (biphenyl/diphenyl oxide):

Schematic Draw of a Parabolic Trough Plant – Advantages of HELISOL®



1. **Operating temperatures up to 425 °C and thus much higher efficiency levels and energy yields**
2. **Longer lifetime of receivers due to less hydrogen generation**
3. **Excellent low-temperature behavior (can be used down to -40 °C); no need for freeze protection**
4. **Higher working temperature allows reduced storage volume**
5. **Cold weather independent maintenance increases the degree of utilization**
6. **Improved economics, reliability and profitability of CSP plants**
7. **Potential 5% LCOE reduction**

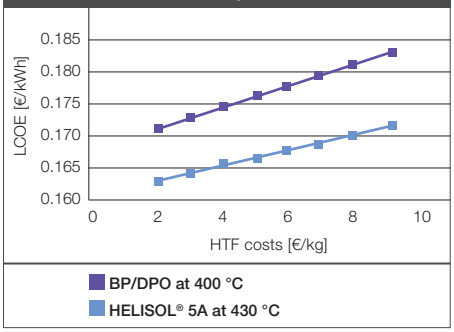
CAPEX

- Lower energy-storage costs
- No freeze protection needed
- Can be filled at any time (irrespective of ambient temperatures)
- No ullage needed for viscosity control

OPEX

- No circulation needed to provide freeze protection
- Maintenance at any time
- Less pumping energy (low viscosities)
- Shorter startup period
- Lower degradation/exchange rate at same temperature
- Less H_2 formation
- No fouling

Lower LCOE with HELISOL® 5A (Simulation Performed at 430 °C by DLR*)



*German Aerospace Center (DLR) Energy Programme Directorate Linder Höhe 51147 Cologne

High-Temperature Stability

HELISOL® heat transfer fluids from WACKER are low-viscosity polydimethylsiloxanes, multi-component mixtures of molecules with various molecular weights. The new heat transfer fluids feature very high heat resistance and durability. Transparent and odorless, they withstand temperatures up to 425 °C in long-term pilot tests conducted in laboratory and demonstration projects (in Inner Mongolia and at the Plataforma Solar de Almería, Spain). Additionally, their pour points are below -40 °C and thus far lower than that of conventional heat transfer fluids.

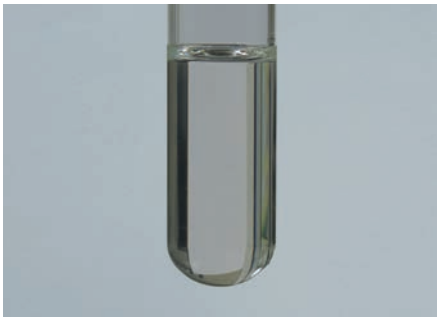
Safety and Reliability

The safety of HELISOL® was tested in laboratory tests and industrial-scale trials which have been performed and assessed by internationally recognized safety experts (e. g. TÜV Nord and Bundesanstalt für Materialforschung und -prüfung (BAM))
The safety and risk assessment of HELISOL® heat transfer fluids include the following trials and experiments:

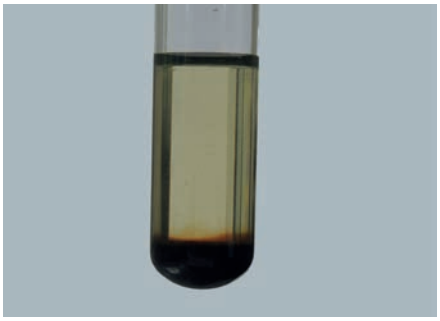
- Analysis of combustion products and burning behavior
- Material compatibility with steel grades
- Critical reactions with water and molten salt
- Detailed analysis of potential hazards in combination with leakages and pipe ruptures: for example, a technical-scale release experiment was performed to simulate a 2" pipe rupture under operating conditions (425 °C, high pressures).

Release test at the Plataforma Solar de Almeria (PSA) performed in May 2018 by CIEMAT (Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas), DLR and TÜV-Nord (TÜV-report) showed no self-ignition of HELISOL® 5A.

HELISOL® Heat Transfer Fluids Compared to Organic Heat Carriers

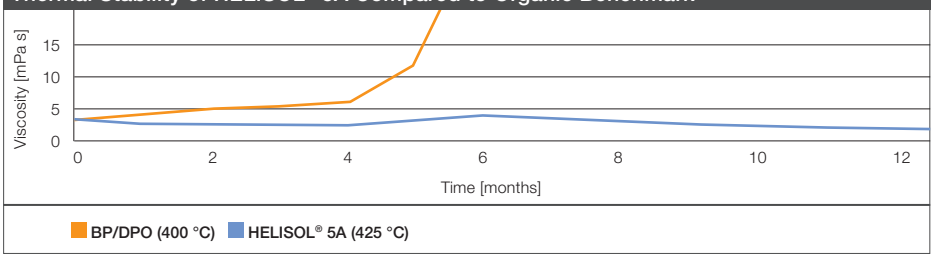


HELISOL® heat transfer fluids operated at 425 °C



Organic heat carrier operated > 400 °C

Thermal Stability of HELISOL® 5A Compared to Organic Benchmark



Conclusion

Under specific test conditions, HELISOL® heat transfer fluids offer greater heat resistance and durability than standard commercial products.

Advantages of HELISOL® Heat Transfer Fluids at a Glance

	BP/DPO	HELISOL® 5A	HELISOL® XLP
Operating temperature (CSP)	400 °C	425 °C	425 °C
Freezing point / pour point	12 °C	< -55 °C	-45 °C
Vapor pressure (400 °C)	11 bar	16 bar	10.3 bar
Viscosity (at 25 °C), in use*	3.71 mPa·s	3.5 mPa·s	12 mPa·s
Cp value	Higher		
H_2 formation		Reduced	Reduced
Environmental risks		Lower	Lower
Fouling	Yes	No	No
Specific cost of thermal energy storage (TES)		Lower	Lower

*** in use = 720 hours at 425 °C**

Conclusion

HELISOL® heat transfer fluids offer outstanding advantages over conventional heat transfer media.

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