CSP ERA-NET has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No. 838311

EuroPaTMoS
European Parabolic Trough with Molten Salt

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"Exchange od Experiences" Webinar – 28 September 2023

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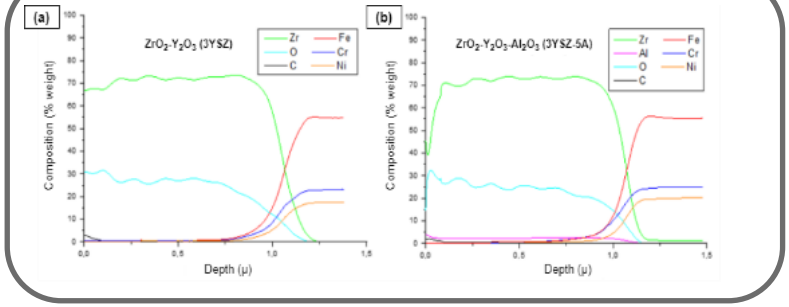
Exchange of experiences Webinar 230928

WP1/2 Corrosion (UCM/Uex/DL)

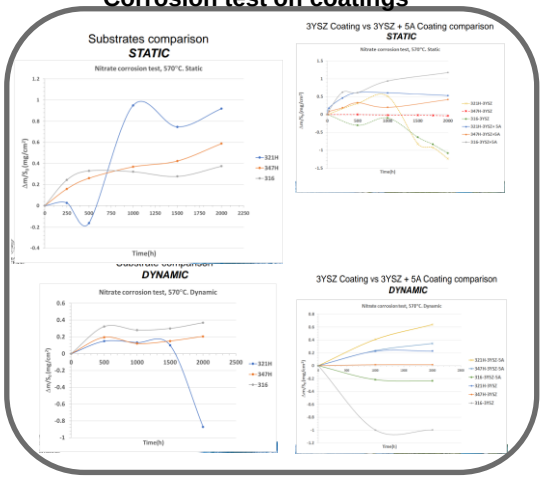
Extensive corrosion tests, including dynamic test methods, were carried out at UCM, along with in-depth characterisation processes by UEX and UCM.

The results, together with a compilation of existing knowledge on molten salt corrosion, were compiled as a best practice guide for component suppliers and plant developers.

Characterisation test on coatings

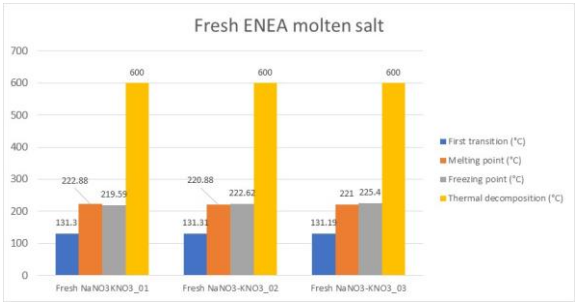


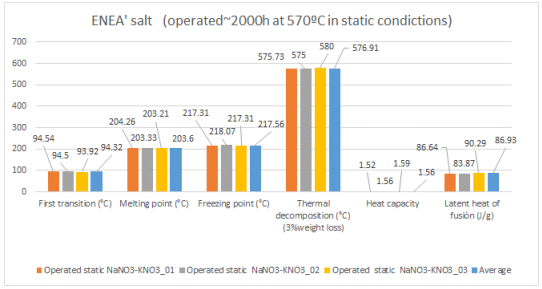
Corrosion test on coatings

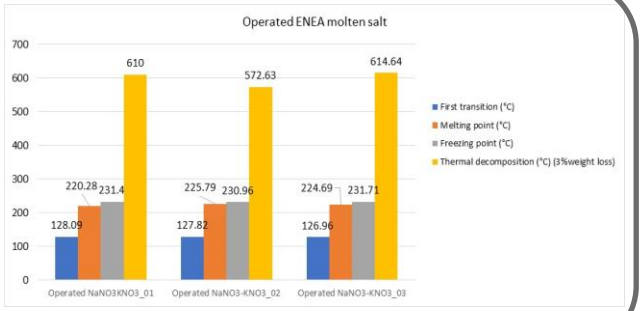


In addition, extensive chemical and thermophysical analyses of the molten salts before and after operation were carried out at UCM in order to assess degradation problems in both composition and thermal properties.

Thermophysical analyses of the molten salts







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CSP CONCENTRATED SOLAR POWER

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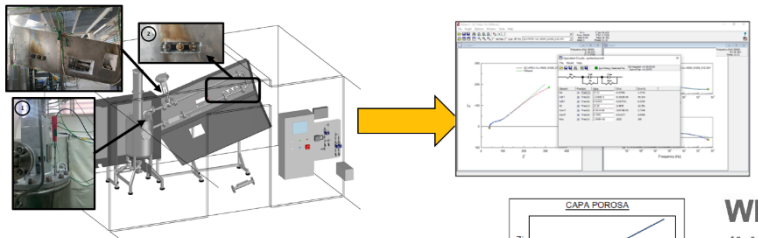
WP1/2 Corrosion (UCM/Uex/DL)

WP 2.4 Plant monitoring system (Ductolux, UCM)

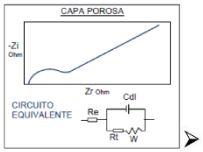
2. Concept test. Corrosion. Lab.

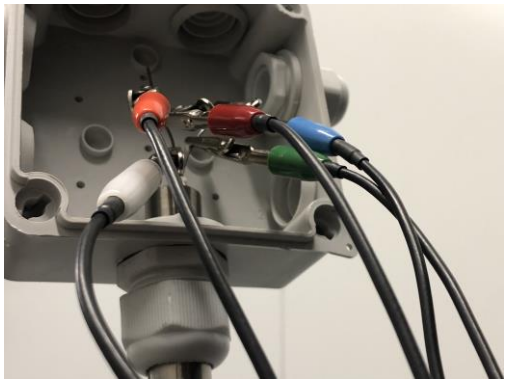
Digital Architecture

Fase	Necesidades
Ingesta	• Sensores en tiempo real
Limpieza	• Procesamiento y preparación de datos para su posterior análisis • Cálculo de datos derivados
Almacenamiento	• Distribuido, tolerante a fallos y elástico • Acceso a históricos con baja latencia
Análisis	• Detección de anomalías
Visualización	• Exploración visual de los datos en un cuadro de mando
Explotación	• Uso de los datos para planificar acciones de mantenimiento



Electrochemical Impedance data collection in the lab.

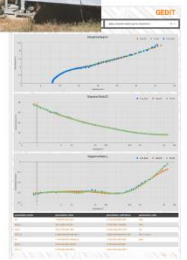




Online corrosión monitoring system onto the molten salt tank

WP 2.5 Real-time long-term tracking of molten salt (UCM, UEvora, Ductolux)

- The static sensor was successfully installed in the drainage tank at EMSP
- The cabling up to the data acquisition equipment is been structuring by Ductolux and UCM during Oct.



DUCTOLUX, UCM, UEX and DLR

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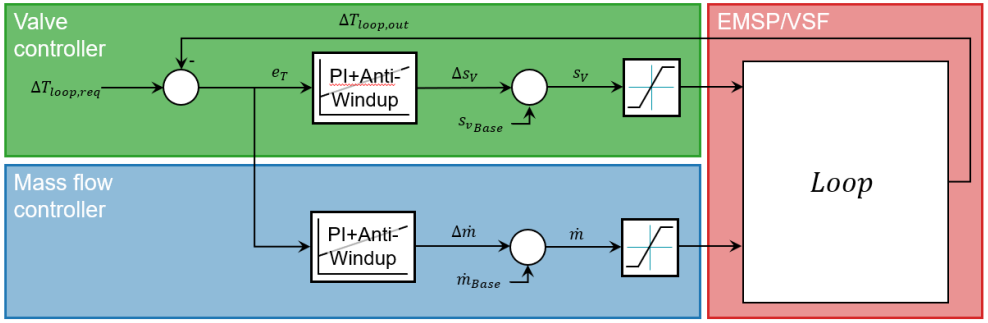
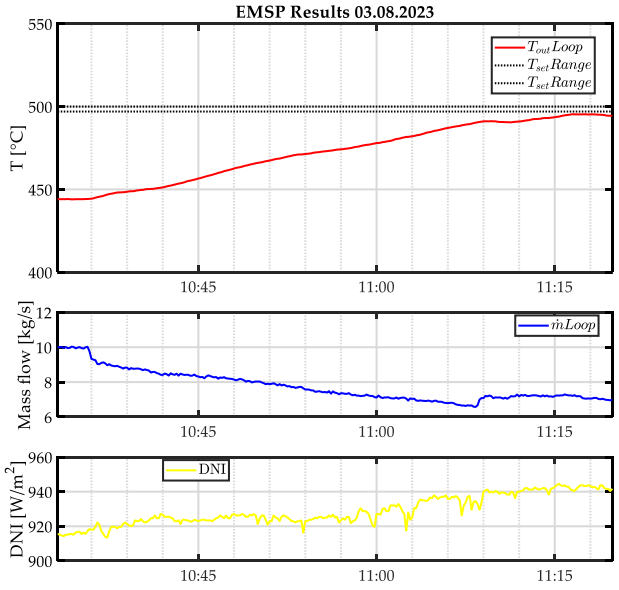
WP2 Control-System for Parabolic Trough with Molten Salt

- Reference solar field with molten salt implemented.
- Spatially resolved irradiation maps generated for simulation of dynamic effects.
- Control concepts for start-up and night mode developed
  - 1st concept: Homogeneous distribution of mass flow in each loop
  - 2nd concept: use of control valves at the inlet of each loop
- Control concepts tested with Virtual Solar Field (VSF) and on Évora Molten Salt Platform (EMSP)

Figure below: Representation of control concept with control valves for a loop.
Figure right: Test of startup from 440°C to 500°C on the EMSP.





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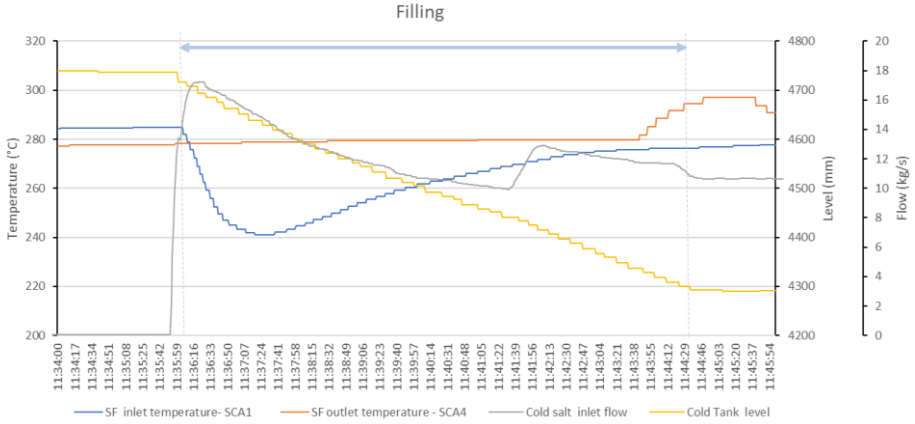
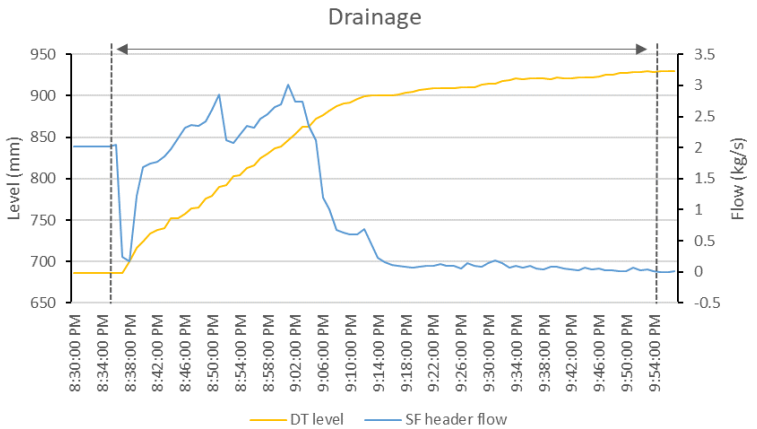
EuroPaTMoS - European Parabolic Trough with Molten Salt

WP1/3 Component tests/O&M processes (FLG/ENEA/UEvora)

Demonstration of molten salt-specific operations at EMSP: Solar Field filling and drainage with Yara Most Molten Salt (Uevora)



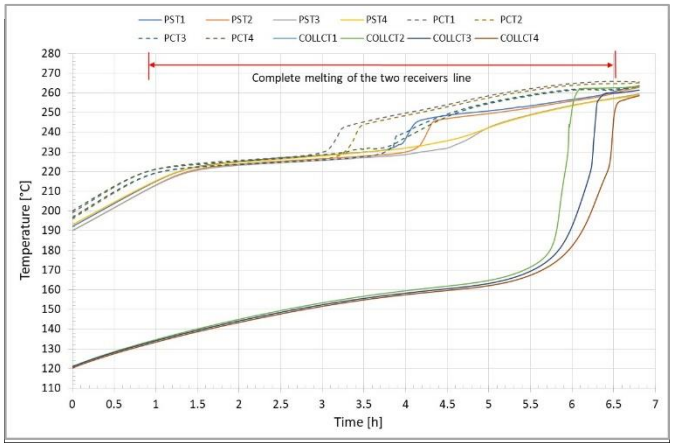
Typical filling graph



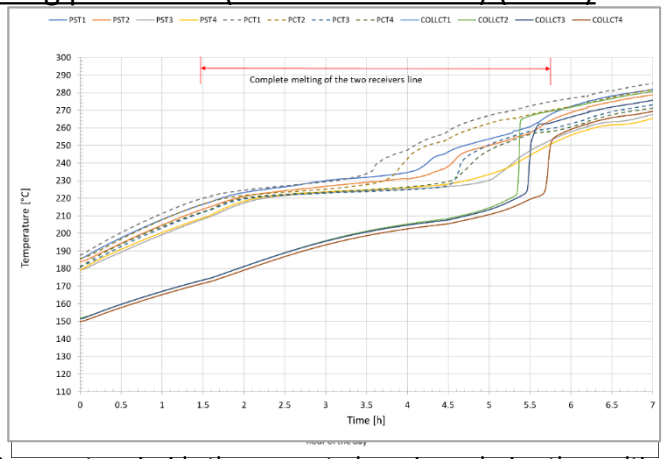
Typical drainage graph

Demonstration of molten salt specific operations ENEA melting procedure inside of receiver tubes (solar salt mixture) (ENEA)

Demonstration of molten salt specific operations ENEA PCS plant preheating procedure (solar salt mixture) (ENEA)



Temperature inside the not - evacuated receivers during the melting process



Temperature inside the evacuated receivers during the melting process

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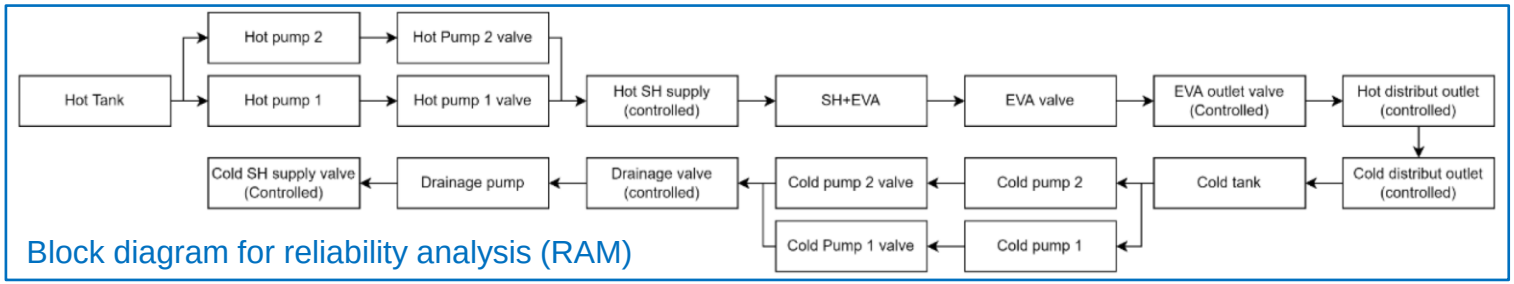
WP4 Systematic risk assessment for molten salt line focusing systems

- Example: Reliability, availability and maintainability analysis of MS plant subsystems



Block diagram for reliability analysis (RAM)

- Example: Failure Mode Effects and Criticality Analysis of MS plants

Structural Analysis (Step 2)			Failure Analysis (Step 4)			Risk Analysis (Step 5)				Optimization (Step 6)				
1. System	2. System Element	3. Component	1. Failure Effects (FE)	2. Failure Mode (FM)	3. Failure Cause (FC)	Severity (S)	Occurrence (O)	Detection (D)	DFMEA AP	Proposed Mitigation Action	Severity (S)	Occurrence (O)	Detection (D)	DFMEA AP
Heat Transfer Fluid	Molten Salt	Salt Mixture	Different chemical composition and properties	Deviations from expected chemical behaviour	Mixing the salt components in a non-predefined mix ratio	5	4	8	M	Countercheck before mixing salt; Taking and analysing control samples after mixing	5	2	3	L
Heat Transfer Fluid	Molten Salt	Ingredients	reduced heat transfer; cavitation risk at pumps	air/water in HTF	leakage from water-steam circuit	4	6	7	M	Regular performance monitoring and check of apparatus, HTF analysis	4	5	4	L
Heat Transfer Fluid	Molten Salt	Temperature	increased HTF degradation, fire	HTF overheating	wrong control of tracking/defocusing	3	8	6	M	Regular performance monitoring and application of correct operation procedure, maintenance of control	3	4	4	L

- Other tasks: -> Life Cycle Analysis of MS plants
  -> Proposal of improved materials and components

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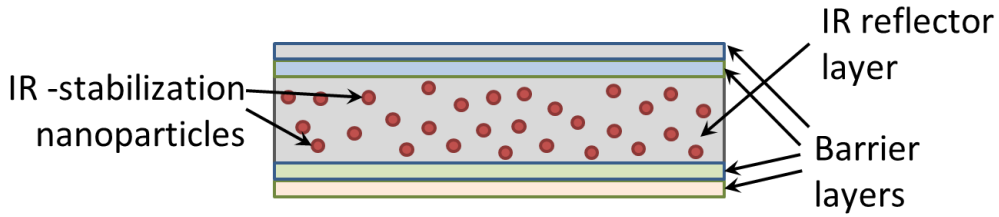
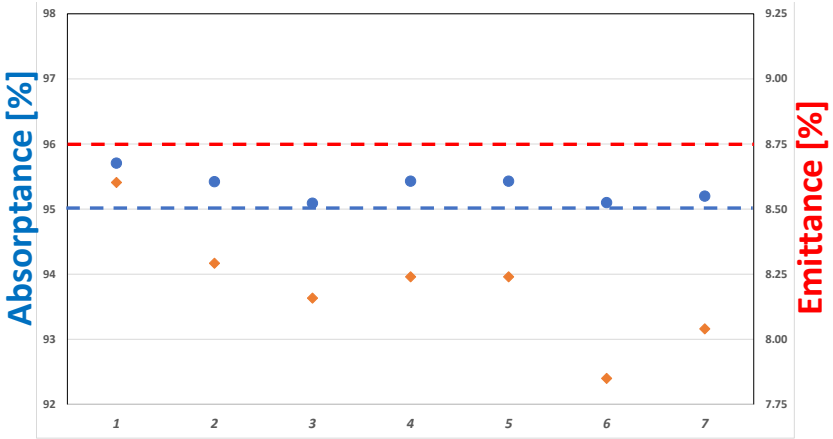
Advanced receiver tube with reduced thermal losses (Rioglass)

Objective:

Develop a receiver suitable for high temperature applications maintaining and even improving performance figures





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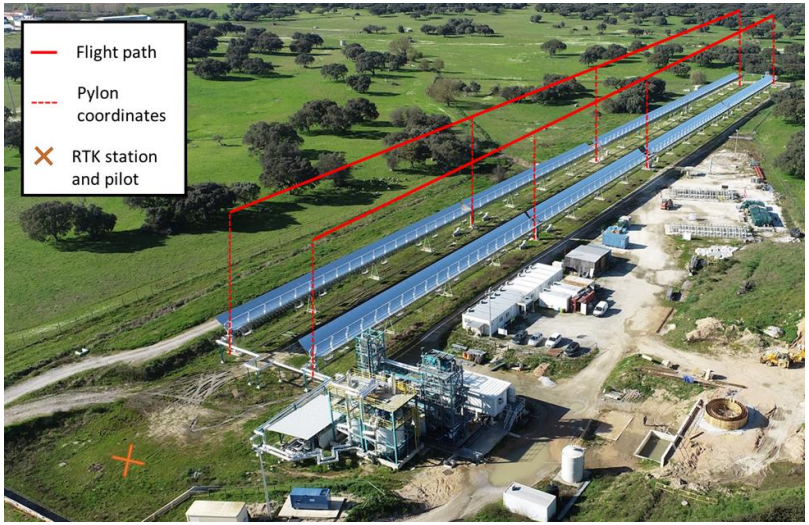
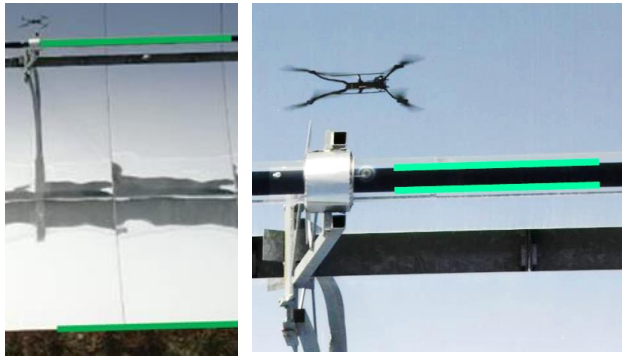
WP5 Development of advanced quality control methods

- Analysis of measurement techniques for solar field installation
- Control of receiver / module alignment accuracy
- Development, test and optimization of MS-specific pre-commissioning services



Flight path above EVORA collector loop

Drone measurement picture



Line fitting to assess module and receicer alignments

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Conclusion(DLR)

Conclusion:

- Evaluated critical plant components regarding reliability (review of consortium joint knowledge, laboratory testing, operation in realistic environment) (WP1)
- Developed a process control concept based on a virtual solar field, to be validated on a full size collector loop enabling hardware-in-the-loop simulation of a full solar field. (WP2)
- Developed and demonstrated O&M procedures for exceptional molten salt operations (e.g. filling, draining, repair of leakages, re-vitalizing frozen parts) (WP3)
- Carried out and document systematic risk assessment including mitigation measures. (WP4)
- Developed high performance receiver tube and validate in relevant environment. (WP5)
- Provided methods and equipment for advanced QA and monitoring during construction and operation of PTC-MS solar fields (WP5)

Thank you!!

Presented by Michael Wittmann (DLR, Germany)

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