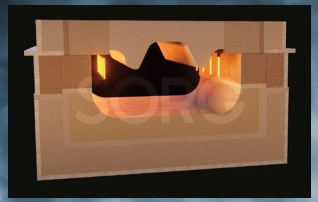
Sorgs all-electric Forehearth “VIKING” - the logical next step towards sustainability

86TH GLASS PROBLEMS CONFERENCE - DIRK SCHNURPFEIL / R&D

SORG | GMIC 86th Glass Problems Conference and Symposium
October 6-9, 2025, Toledo, Ohio, USA

sorg.de

AGENDA



- Company SORG - Innovation & Tradition
- Sustainability in glass production
- Forehearth Basics
- State-of-the-art in electric forehearths
- Modelling exercise
- Target definition
- Sorgs all-electric “VIKING”-forehearth

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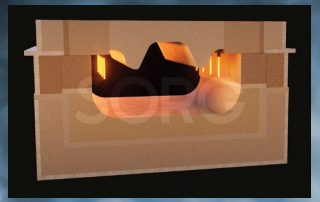

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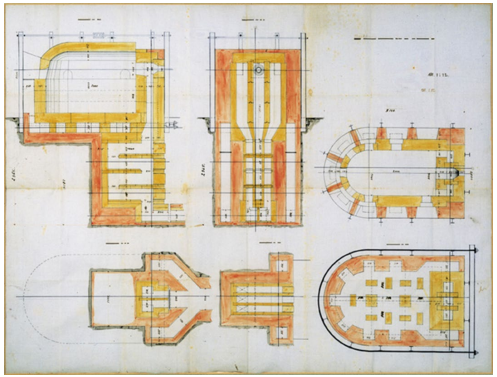
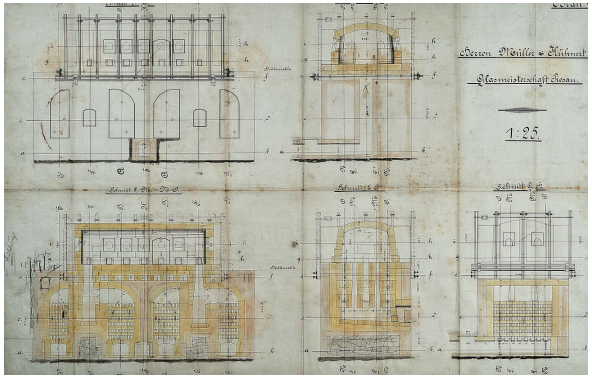
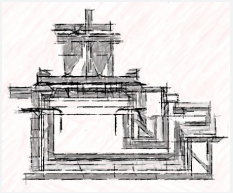
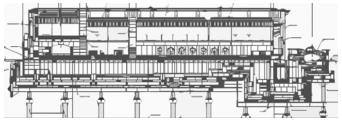
Innovation and Tradition



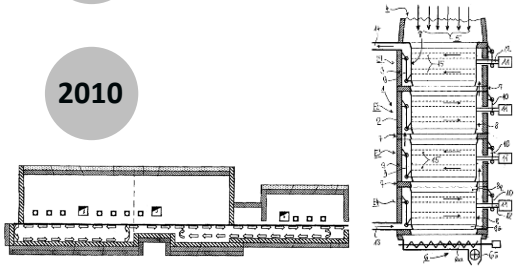




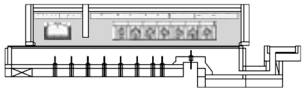
1971 first all-electric VSM®



1985 first LoNOx-Melter®



2010 Solar bench & Batch pre-heater



2023 first „CLEAN-Melter®“

Innovation and Tradition

- SORG is continiously developing & supplying conditioning systems since almost 50 years
- More than:
  - 439 working ends - 1507 forehearths
  - 316 Conti-Drain Syst. - 41 colouring forehearths
  - 170 side wall boosting systems in FH & WE
  - **175 electric heated FH & WE in soda-lime glass**
    - **55 with Moly-electrodes (pull rates from 5-200 tpd)**
    - **35 with SiC heating elements (pull rates from 2-43 tpd)**

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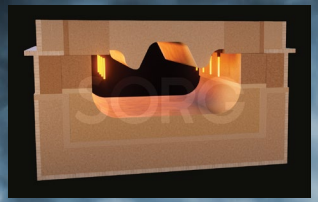

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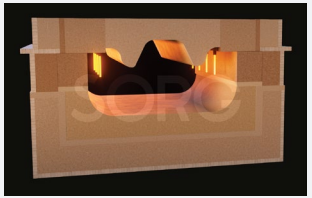
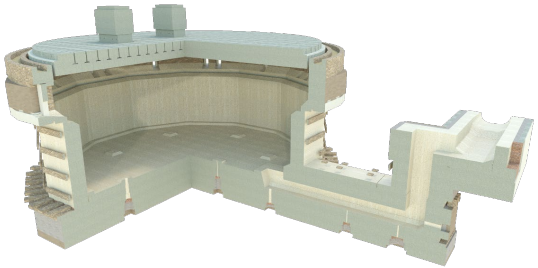
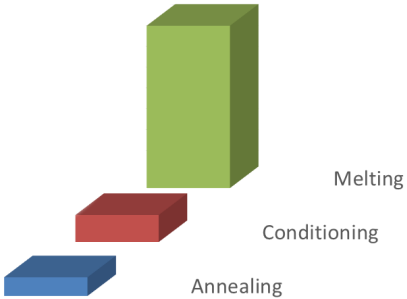
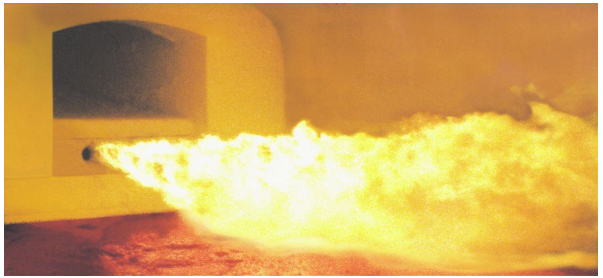
Innovation & Tradition
Sustainability

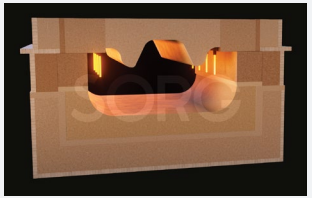


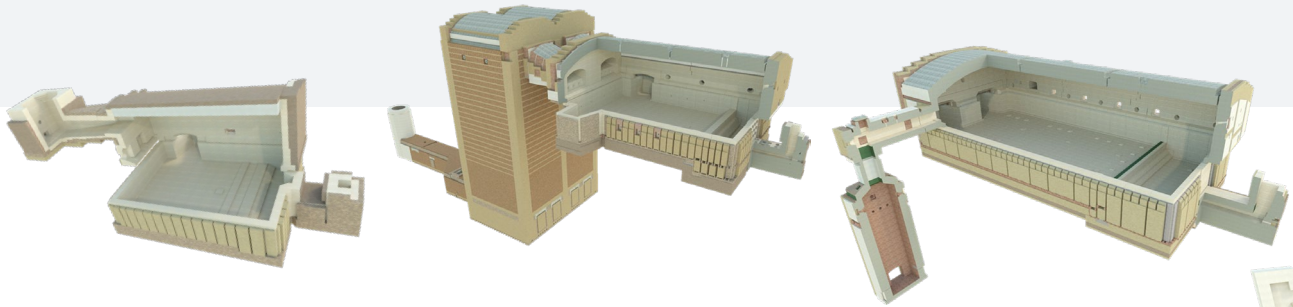


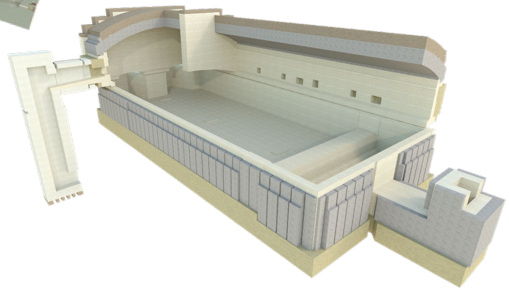


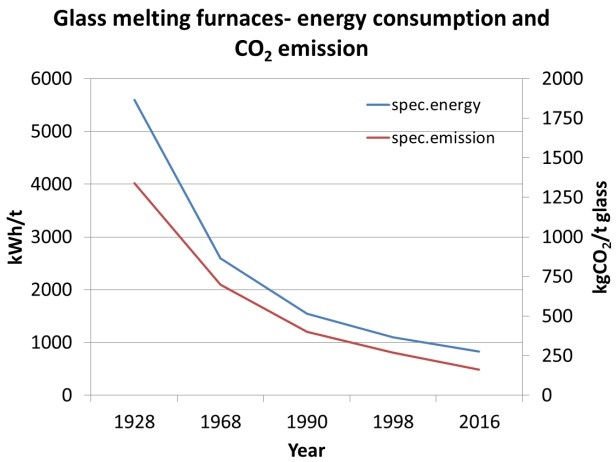


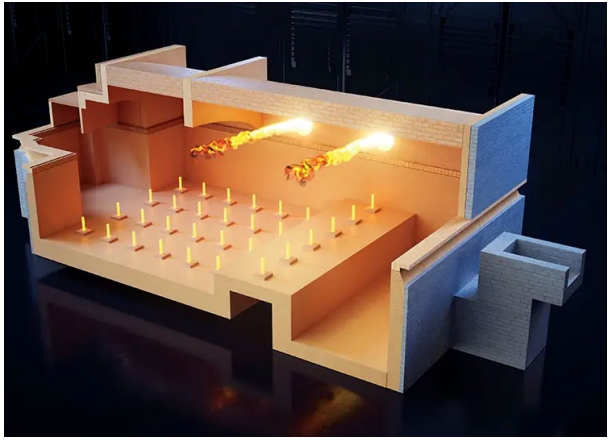
Innovation and Tradition

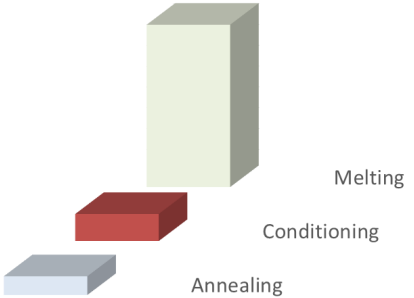












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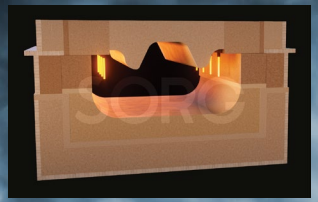

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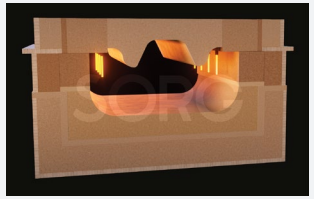
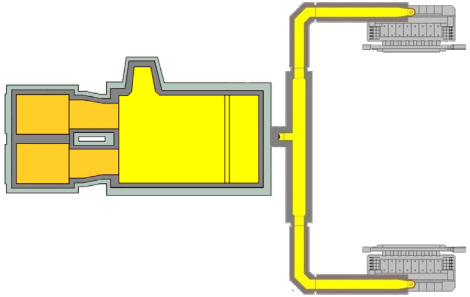
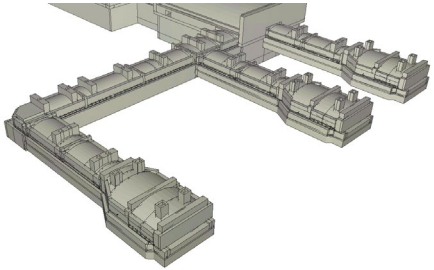
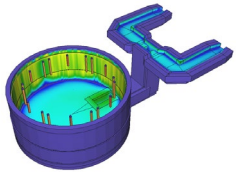
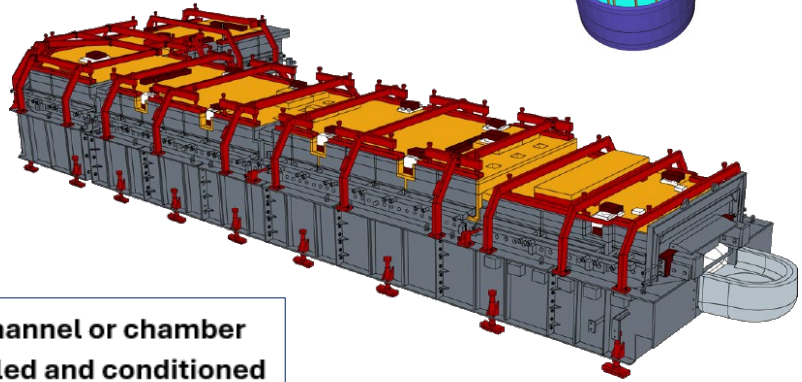
FOREHEARTH - BASICS

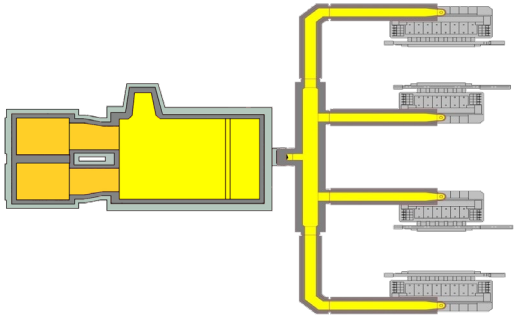






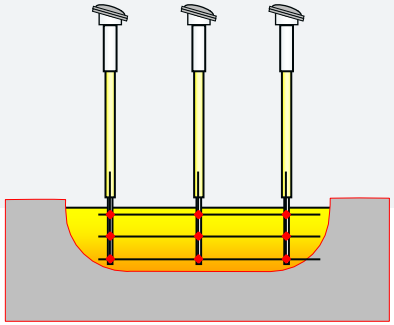


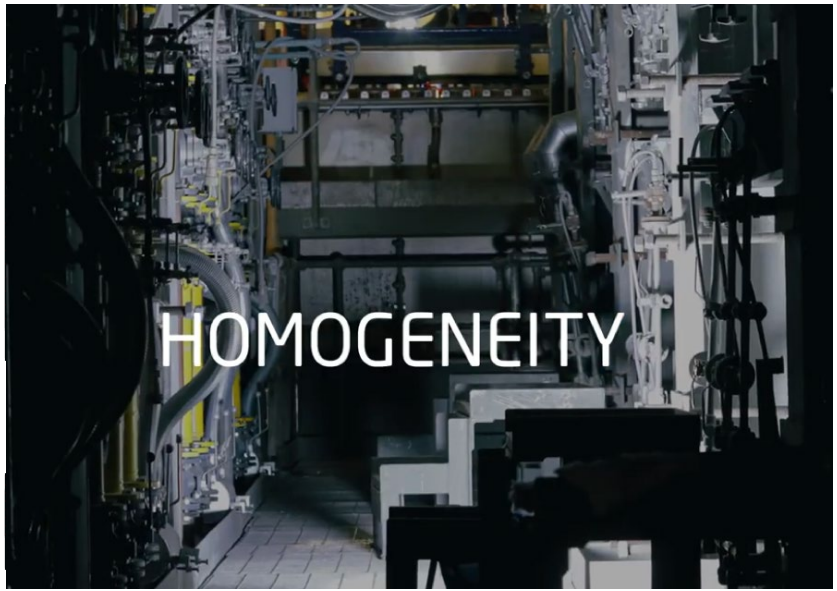


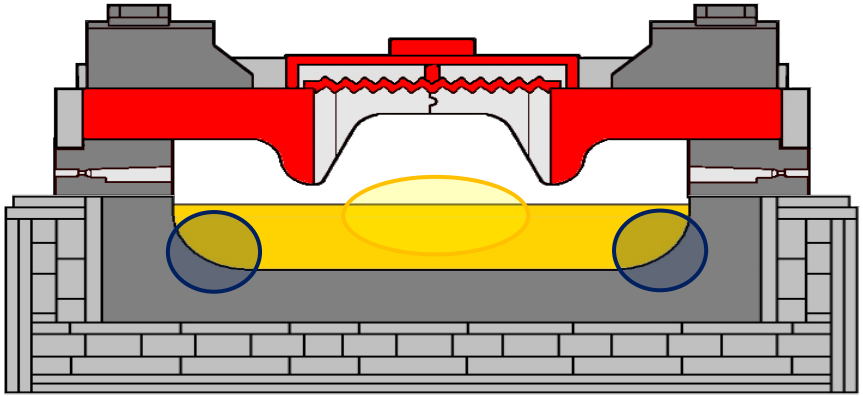


A forehearth is a heated channel or chamber where molten glass is cooled and conditioned from the high temperatures of a furnace to a temperature suitable for forming into products like bottles, jars, or fiberglass

FOREHEARTH - CHALLENGE







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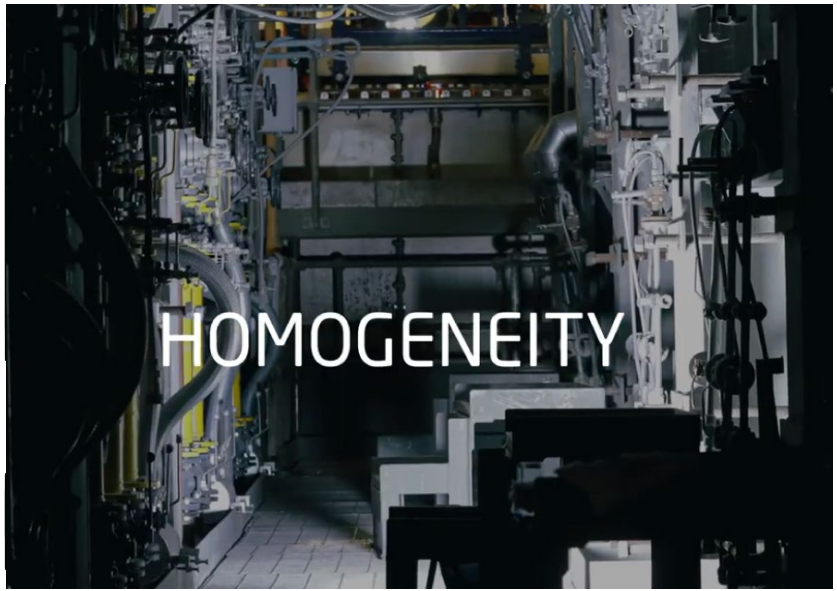
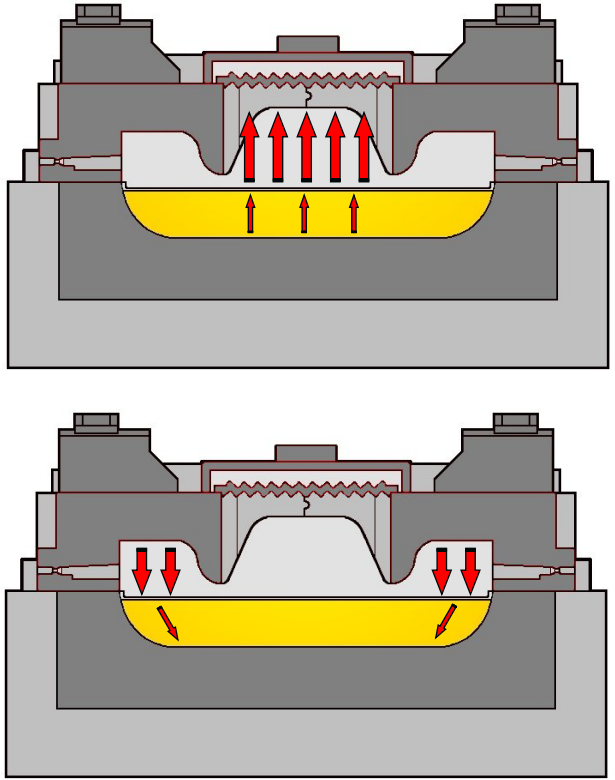
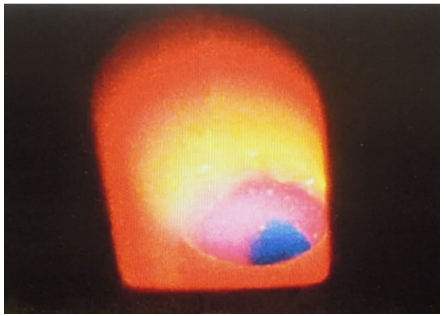
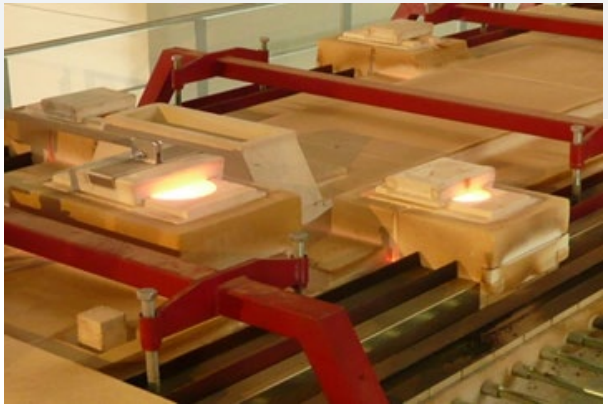
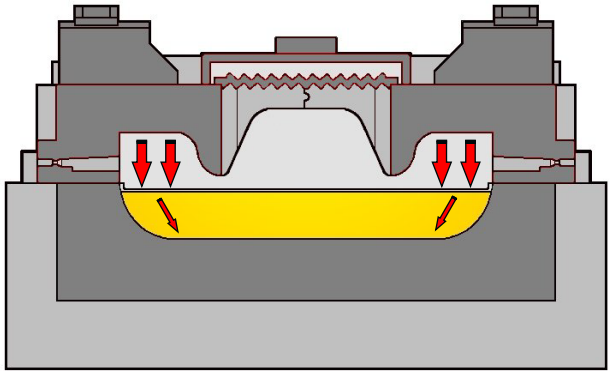




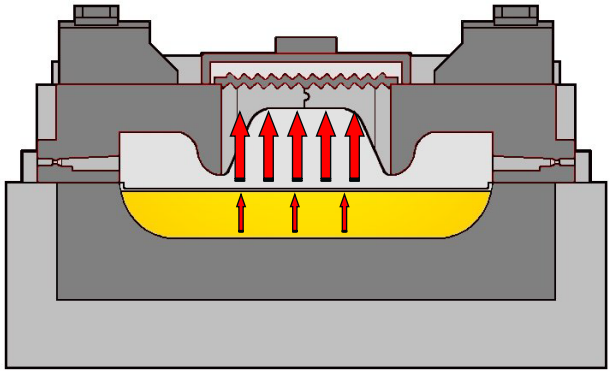
FOREHEARTH - HEATING



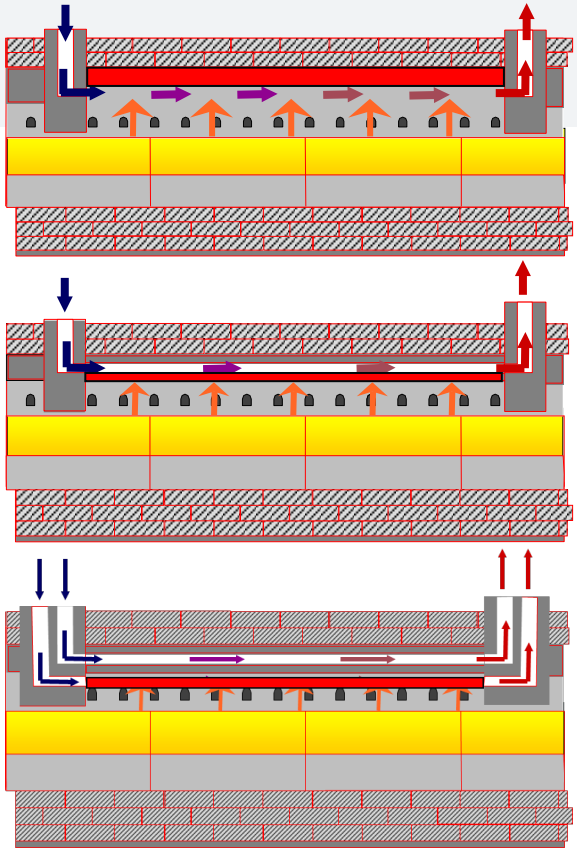




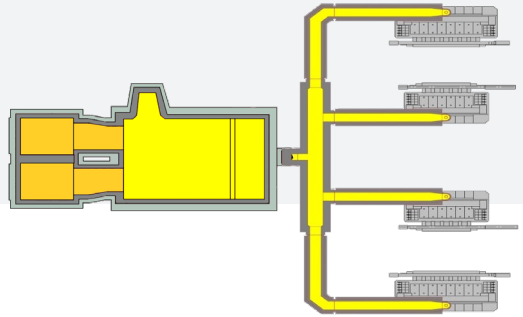
FOREHEARTH - COOLING



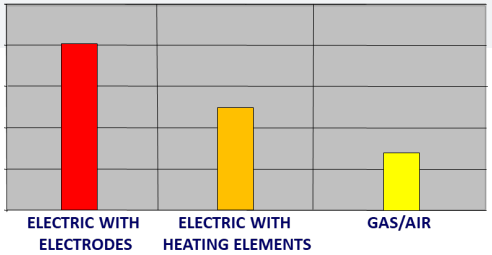
- Direct
- Indirect
- Combi

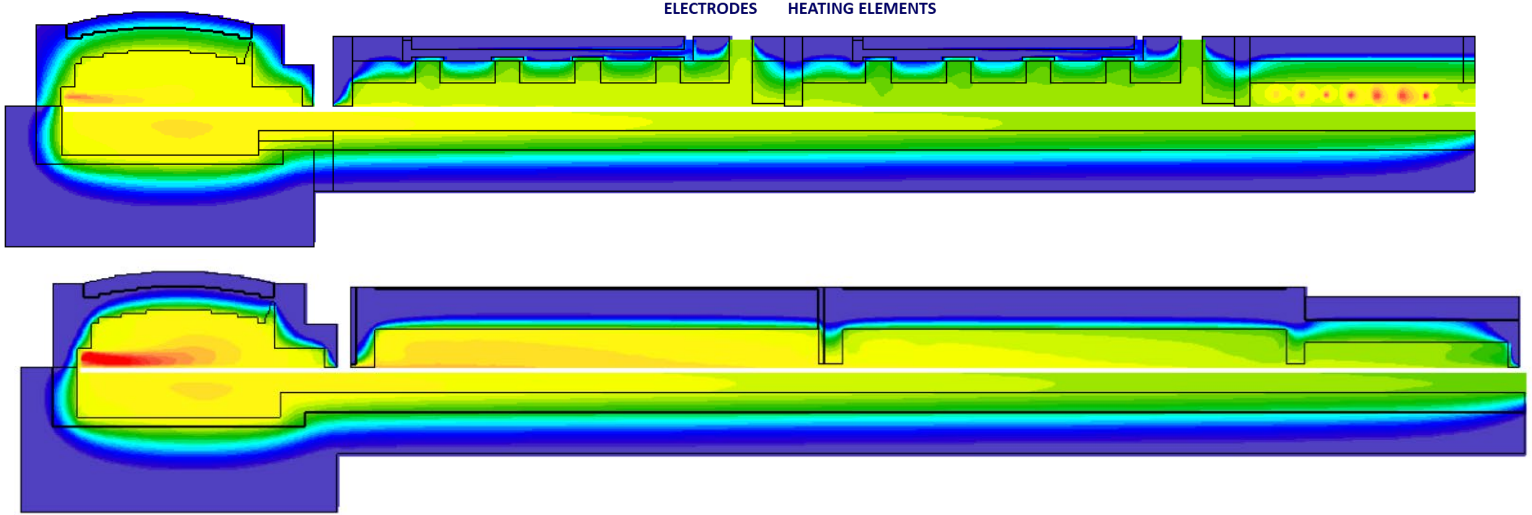


FOREHEARTH - ELECTRIFICATION



- Hybrid vs. all-electric





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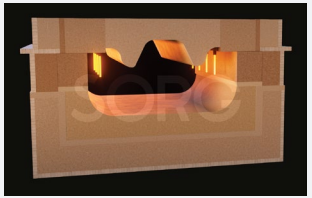
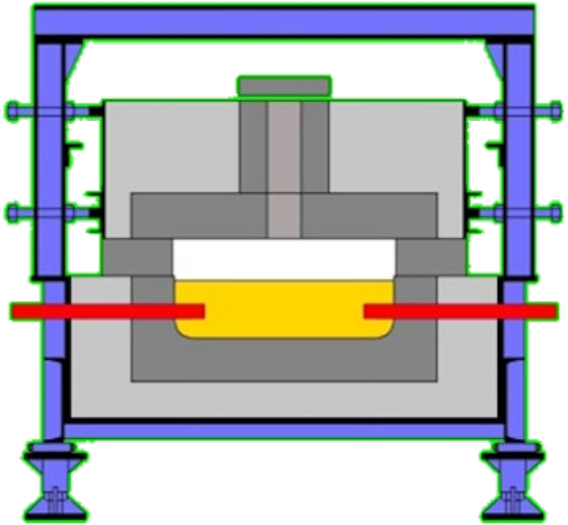
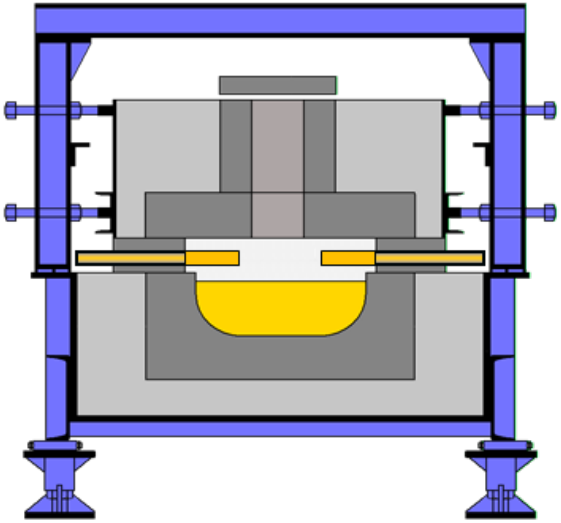




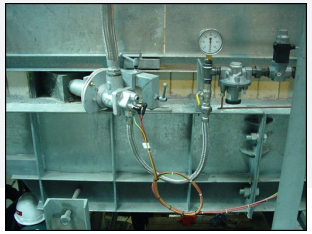
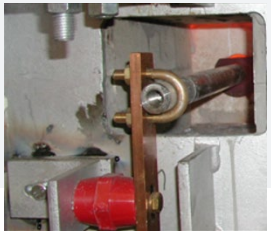
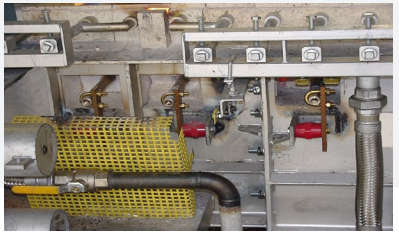
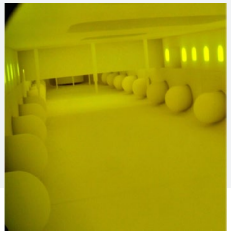
vs

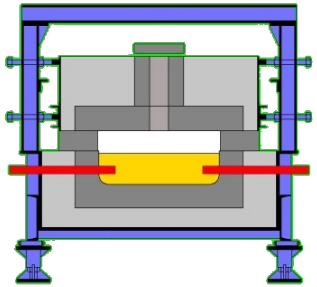


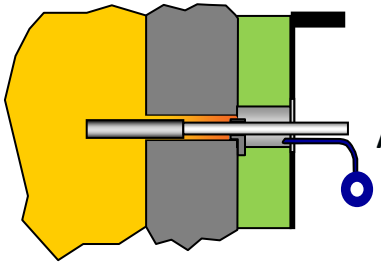
(direct) Joule heating

(indirect) Resisitive (Ohmic) heating

DIRECT HEATING

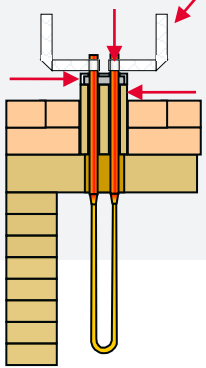





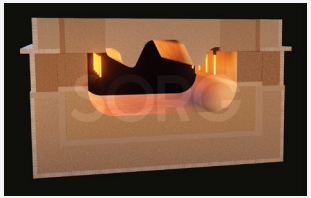


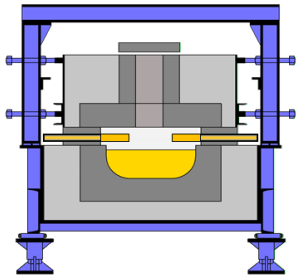


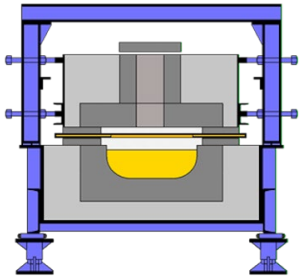
	Molybdenum	Tin Oxid	Platinum
Max. specific Load:	1 - 3 A/cm²	0,2 - 0,7 A/cm²	2 A/cm²
Disadvantage:	oxidises in air >450 °C Molybdenum streaks possible at oxidized soda lime glass blister formation is possible	Bad thermal shock resistance electrode connection wear of electrodes possible Blister formation is possible	High Price, According literature 50 Hz not possible
Advantage:	reasonably price easy Installation pushing	suitable for oxidising flint glass and Lead crystal glass	for optical Glass Preferred

INDIRECT HEATING



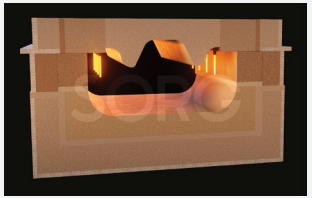




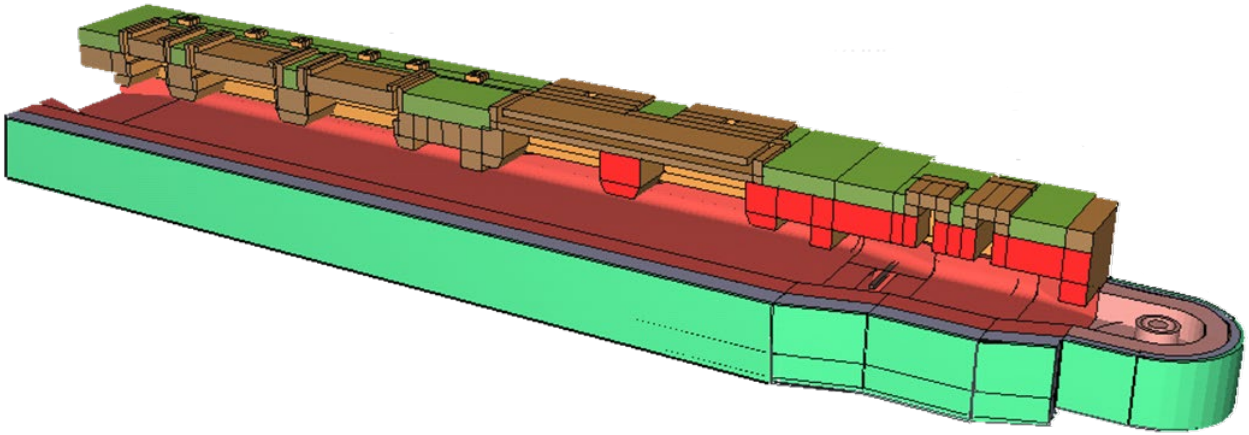


	SiC	MoSi2
Max. specific Load:	1-3 kW/elem.	1-6 kW/elem.
Max. work. Temp.	1400°C	1700°C
Disadvantage:	limited lifetime due to element wear, Pieces can fall into the melt	Fallen pieces into the glass may contaminate the melt for longer time
Advantage:	reasonably price easy Installation	suitable for all glasses longer lifetime than SiC

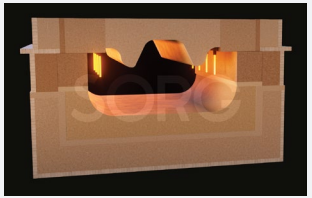
FOREHEARTH - ELECTRIFICATION

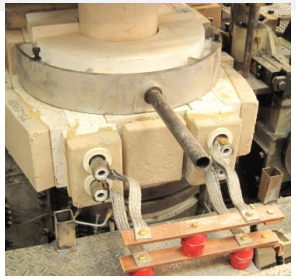


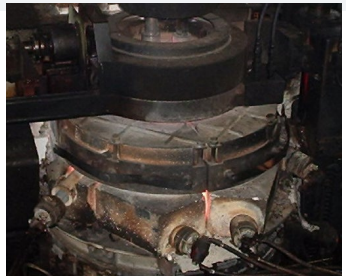
- Forehearth is divided into several zones:
- each of them requires different approach in electrification



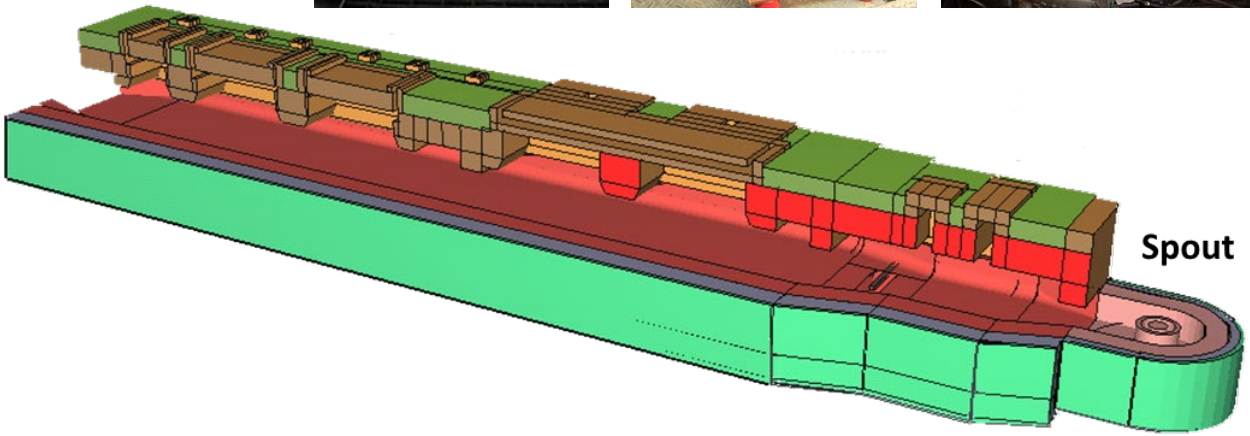
FOREHEARTH - ELECTRIFICATION



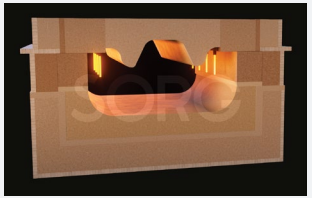


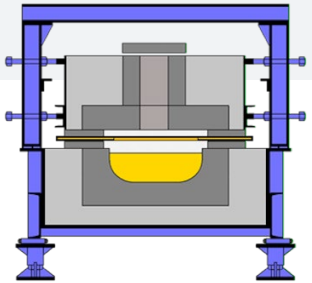


- Forehearth is divided into several zones:
- each of them requires different approach in electrification
- Spout
  - special alignment
    - Not enough space for direct electrodes
    - Electric heating prob. possible only with heating elements (although quite tight)

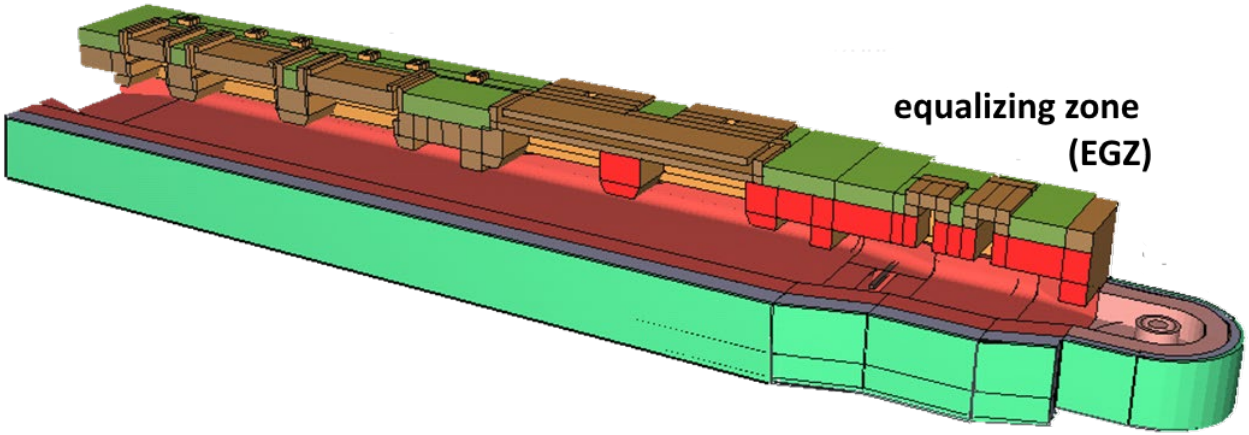


FOREHEARTH - ELECTRIFICATION

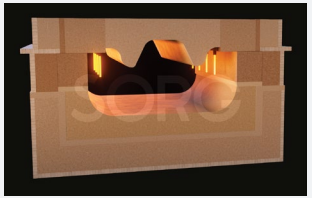


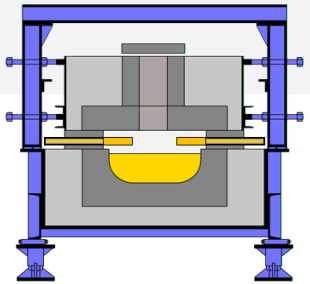


- Forehearth is divided into several zones:
- each of them requires different approach in electrification
- Spout
  - special alignment
- Equalizing zone
  - full width top heating

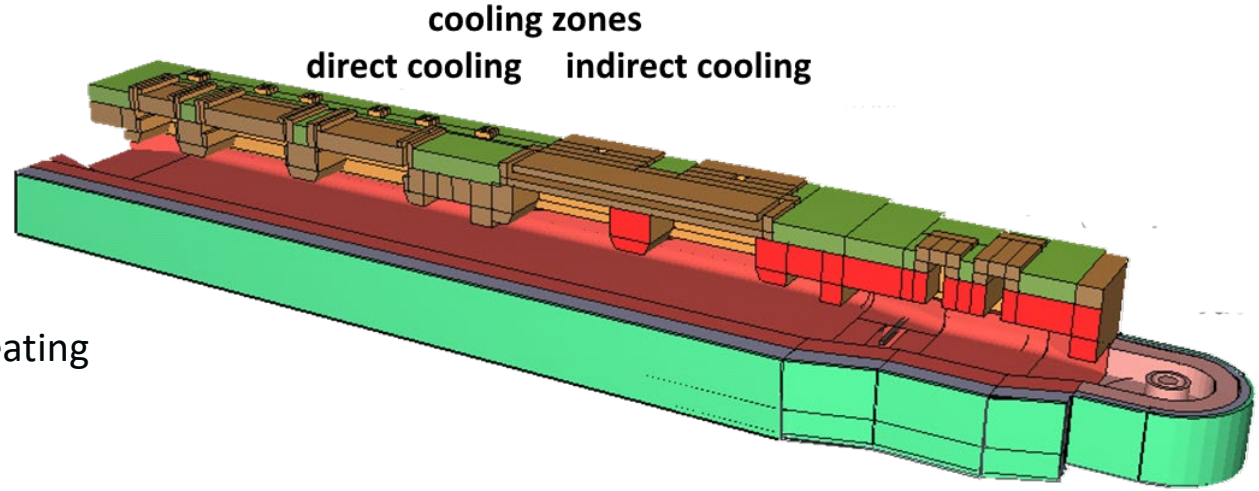


FOREHEARTH - ELECTRIFICATION

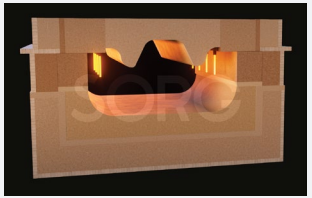


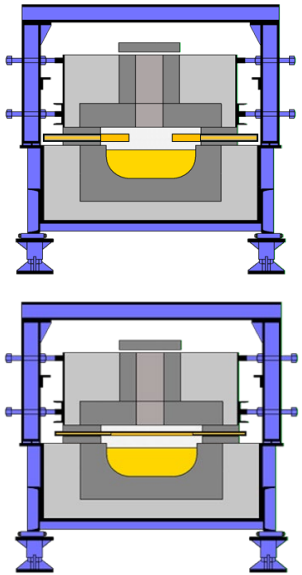


- Forehearth is divided into several zones:
- each of them requires different approach in electrification
- Spout
  - special alignment
- Equalizing zone
  - full width top heating
- Cooling zones
  - preferably side top heating

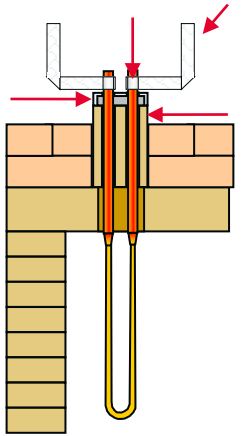


CHALLENGE IN INDIRECTLY HEATED ALL-ELECTRIC FH'S

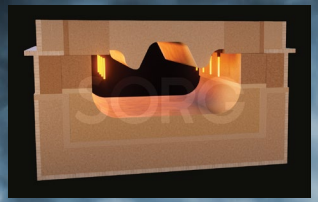




- Heating elements are deteriorating and may contaminate the melt
- Heating elements may break and require time-consuming interruptions for cleaning



AGENDA



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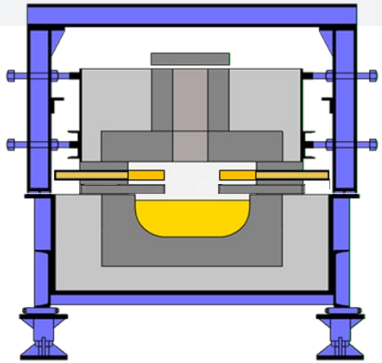
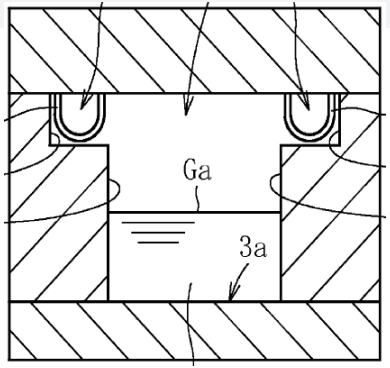
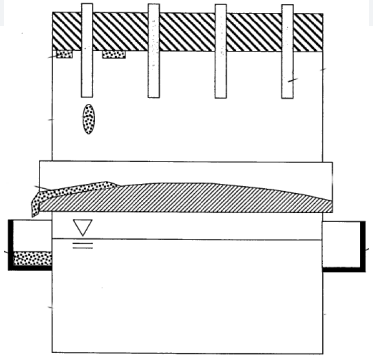
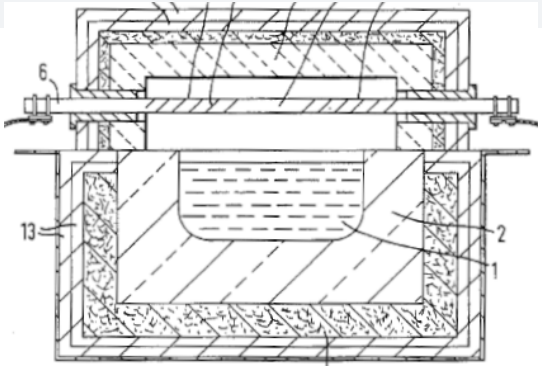
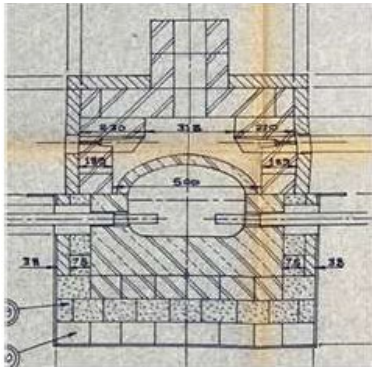
STATE-OF-THE-ART

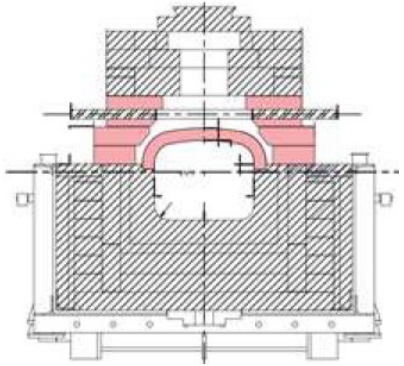


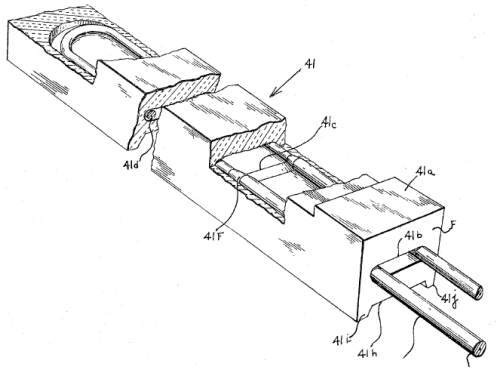




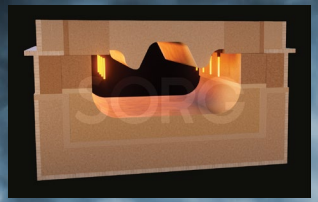








AGENDA



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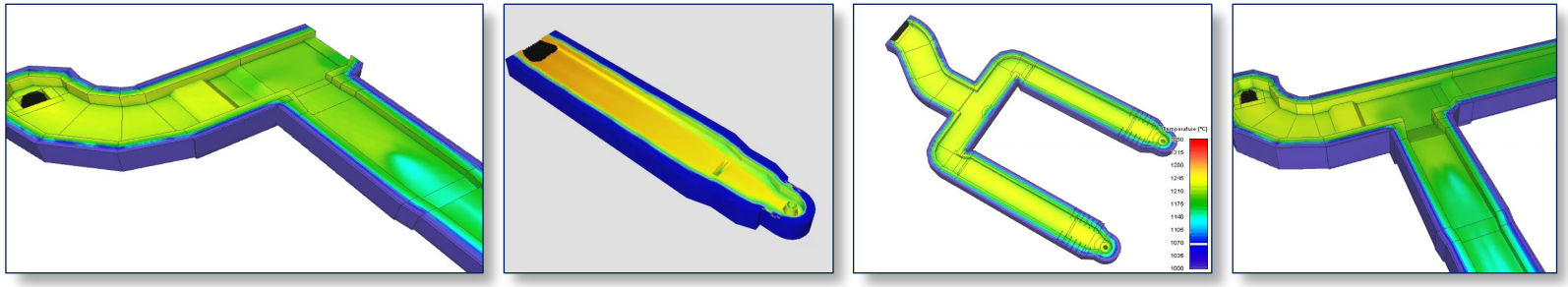
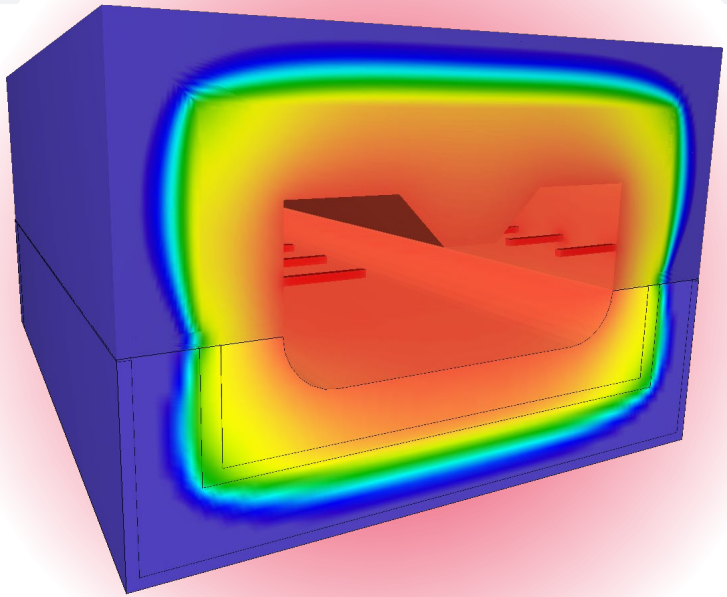
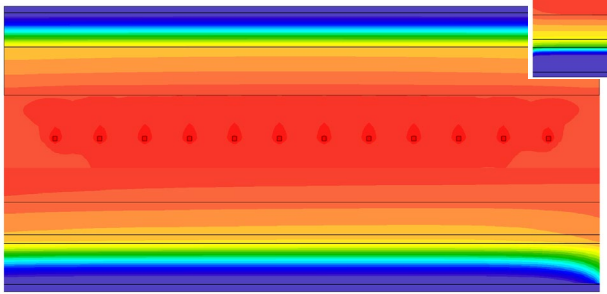
Modelling

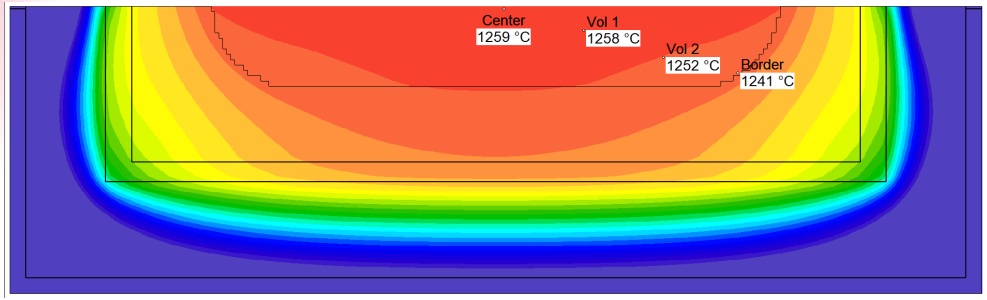


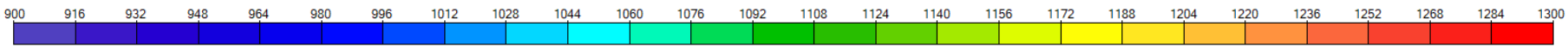
Modelling excercise - base case



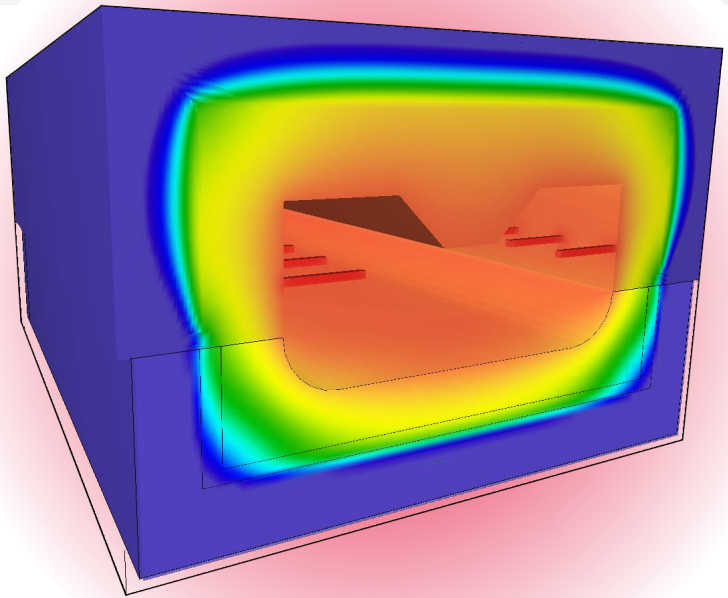


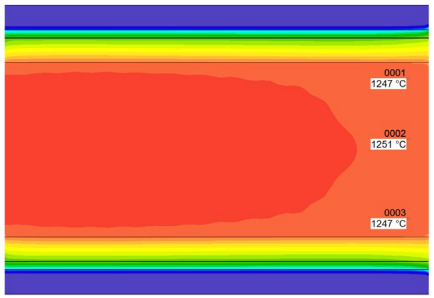
ΔT = 18°

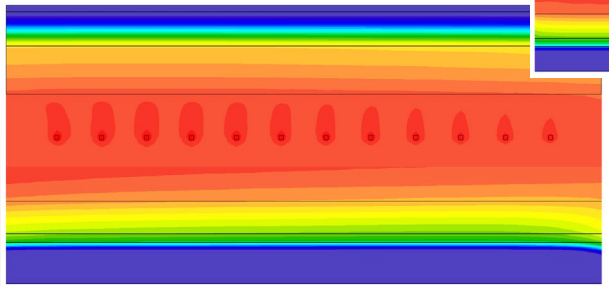




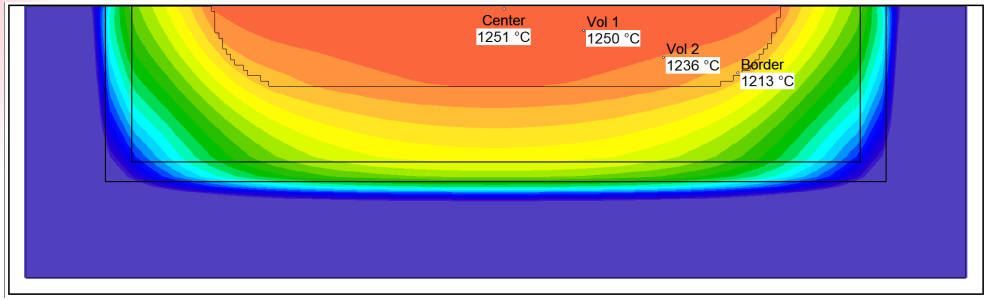
Modelling excercise - base case

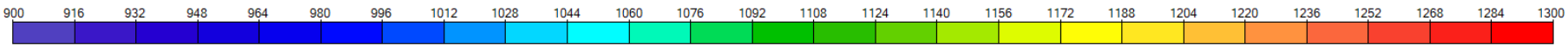




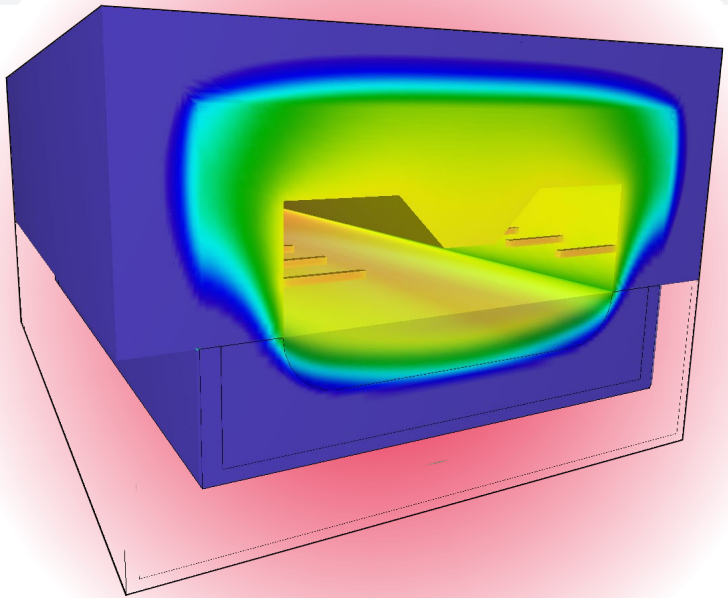


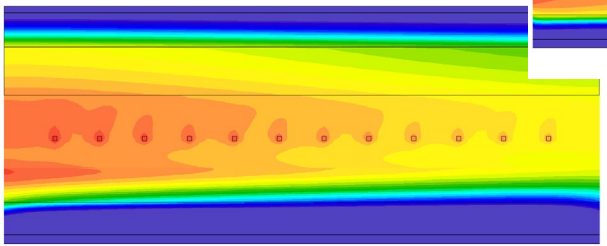
ΔT = 38°

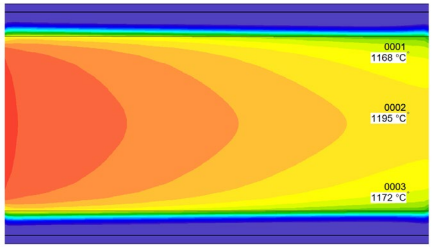




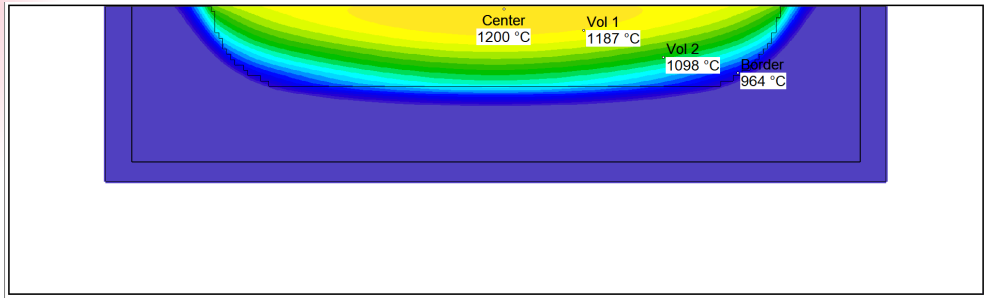
Modelling excercise - base case

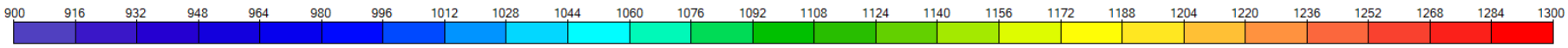




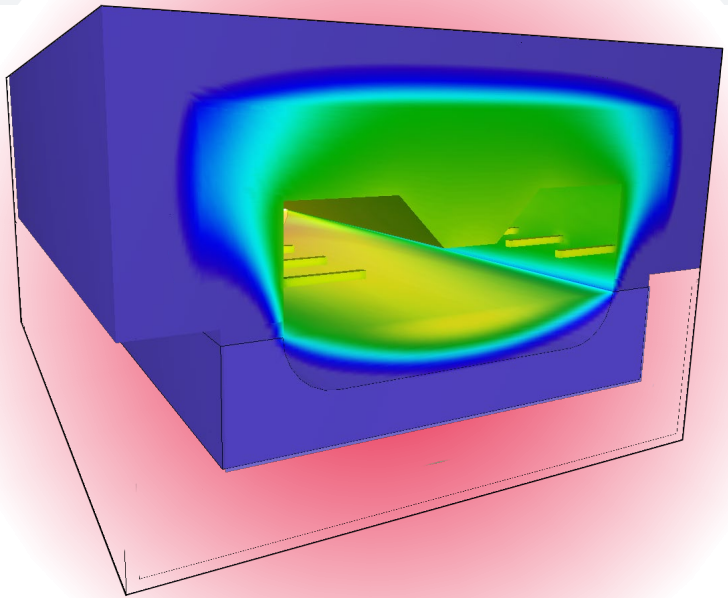


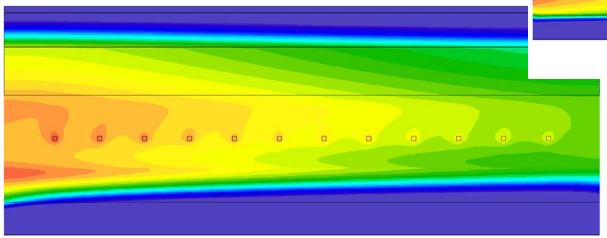
$\Delta T = 236°$

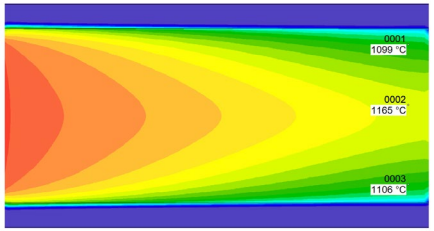




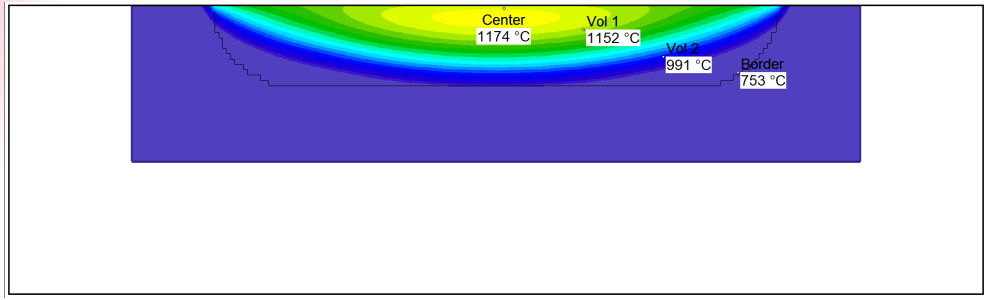
Modelling excercise - base case

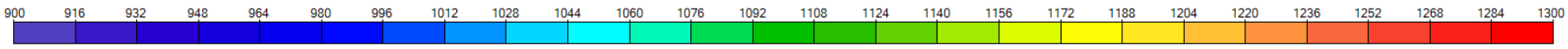




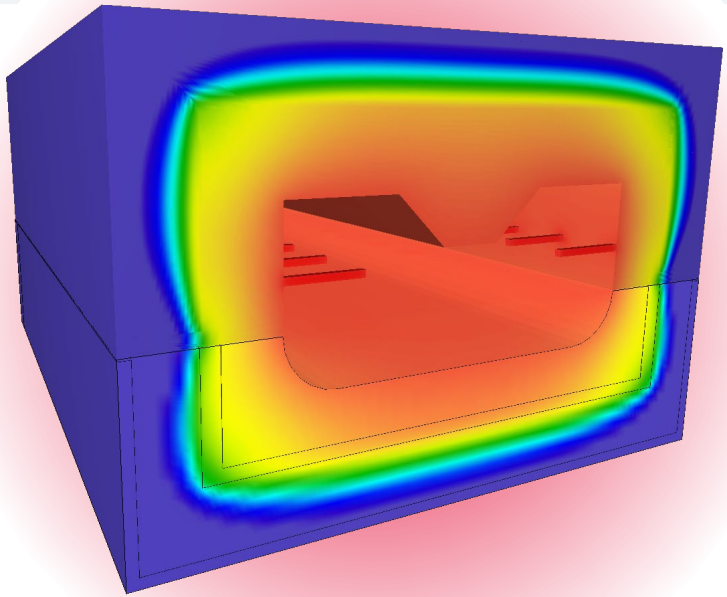


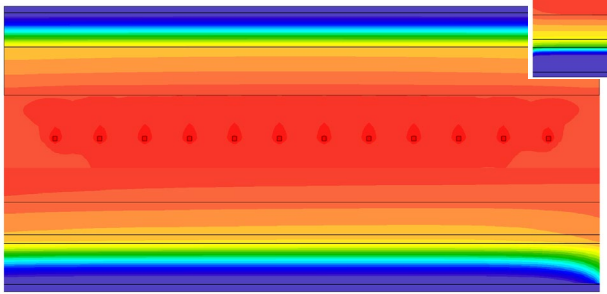
ΔT = 421°



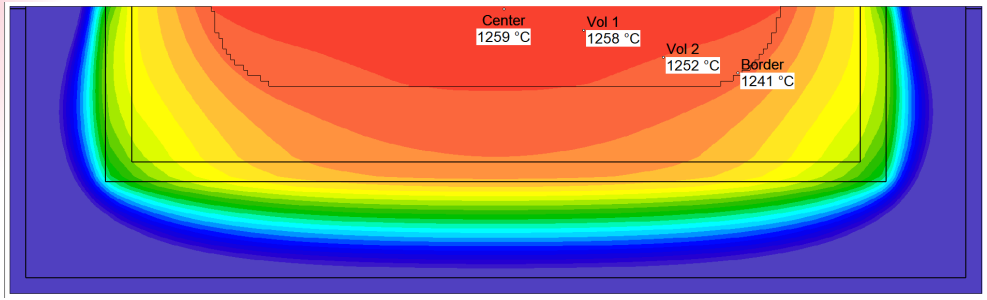


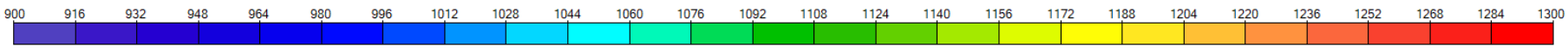
Modelling excercise - base case



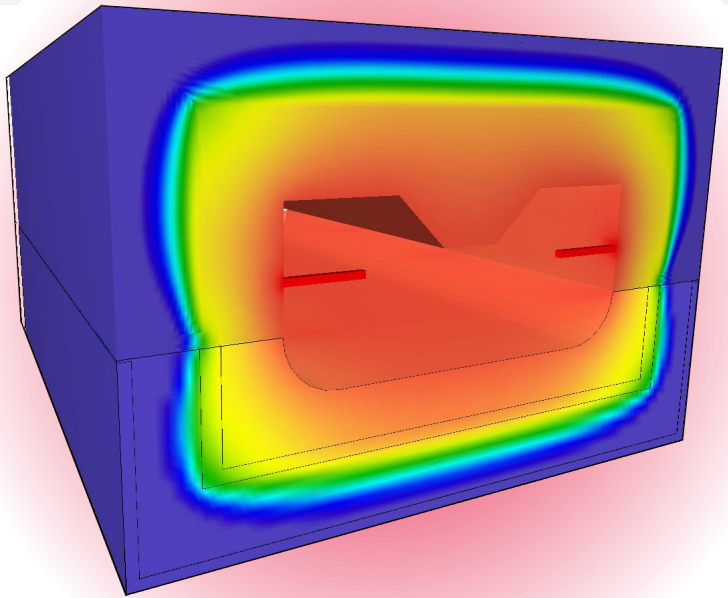


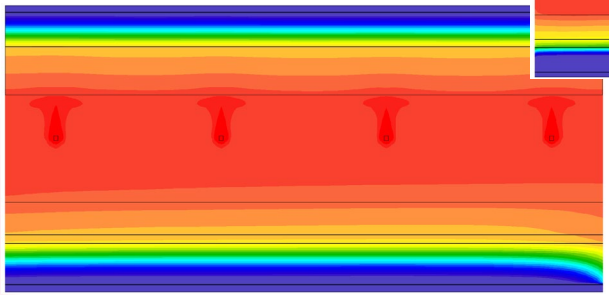
ΔT = 18°



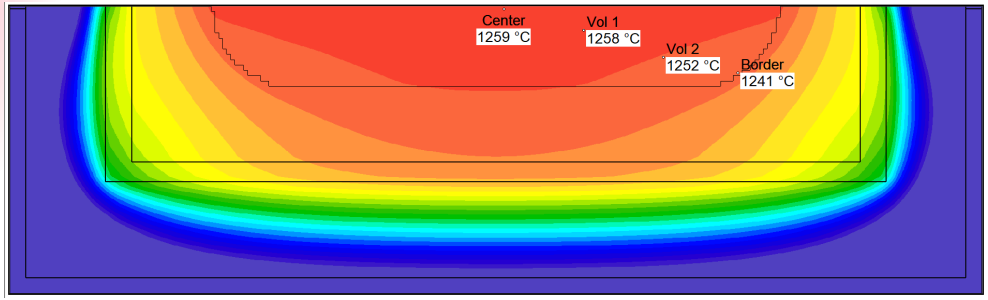


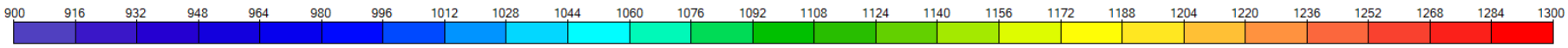
Modelling excercise - base case



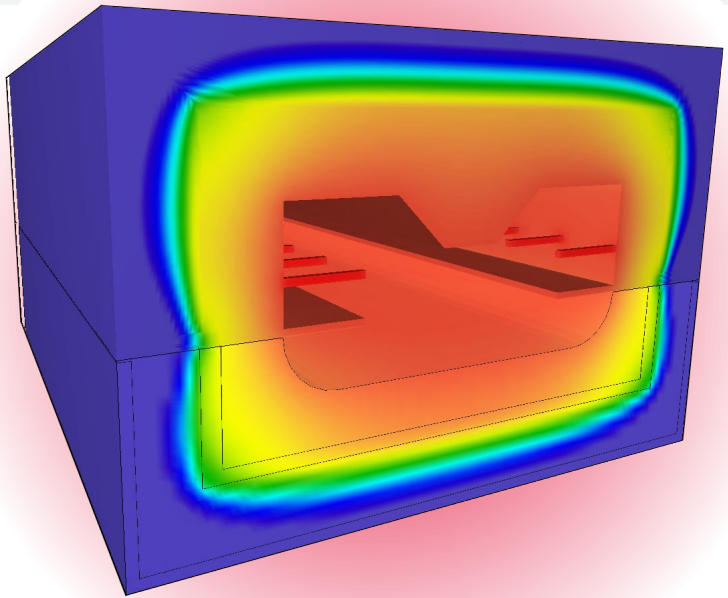


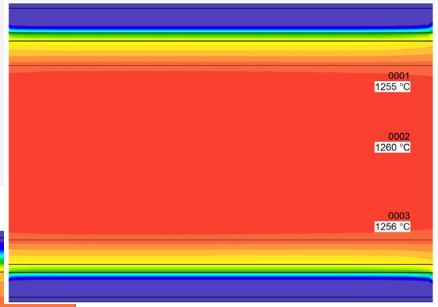
ΔT = 18°

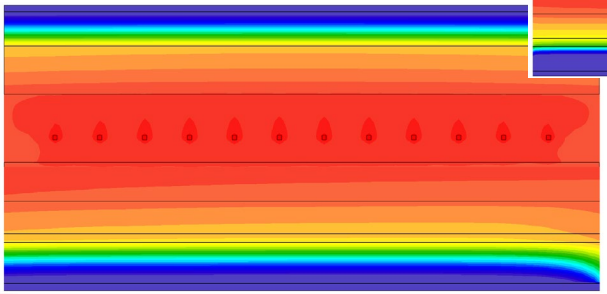




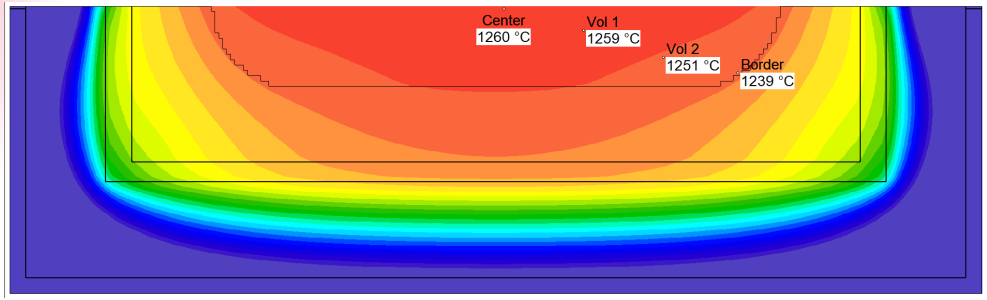
Modelling excercise - base case

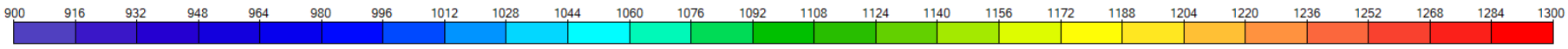




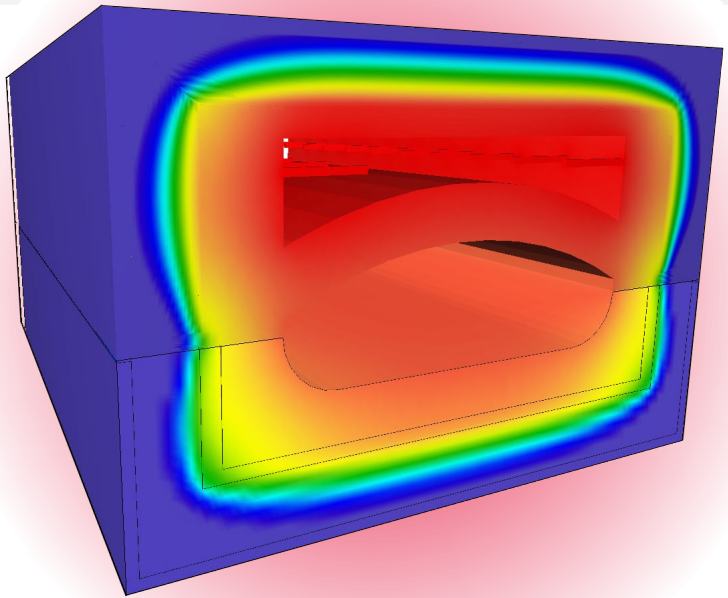


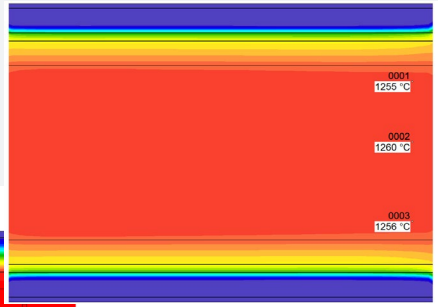
ΔT = 21°

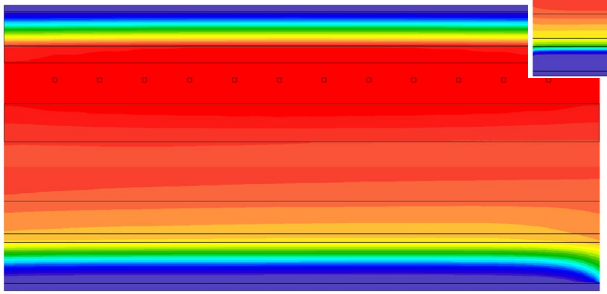




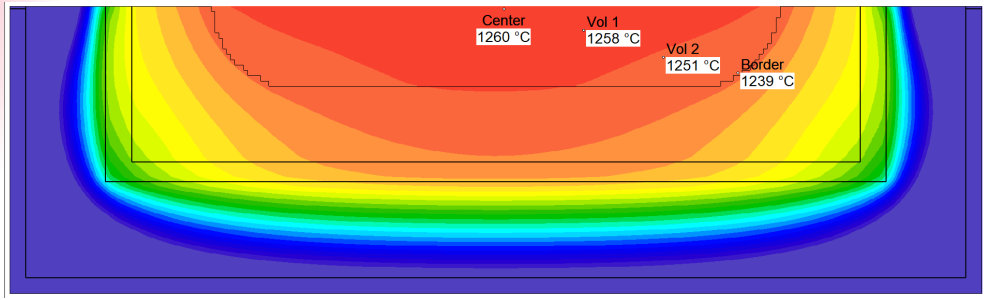
Modelling excercise - base case

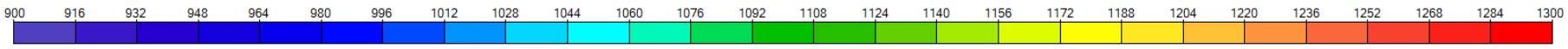




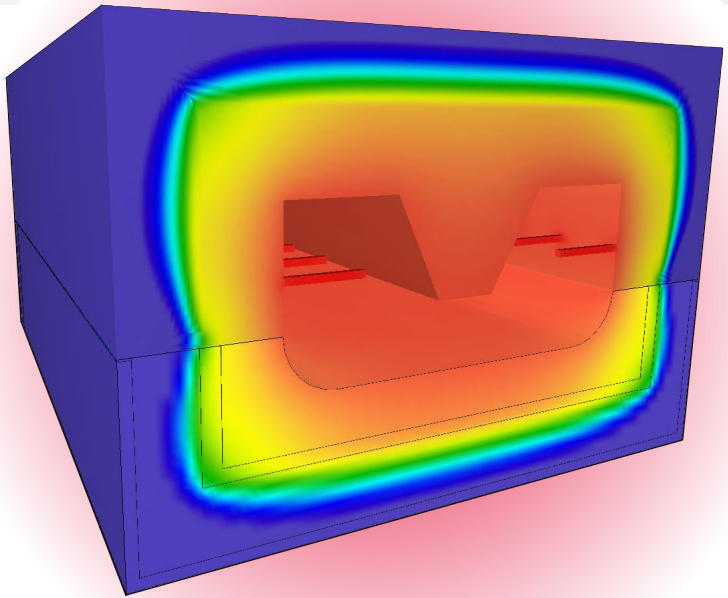


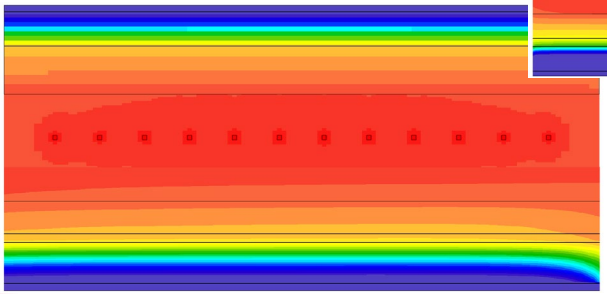
ΔT = 21°



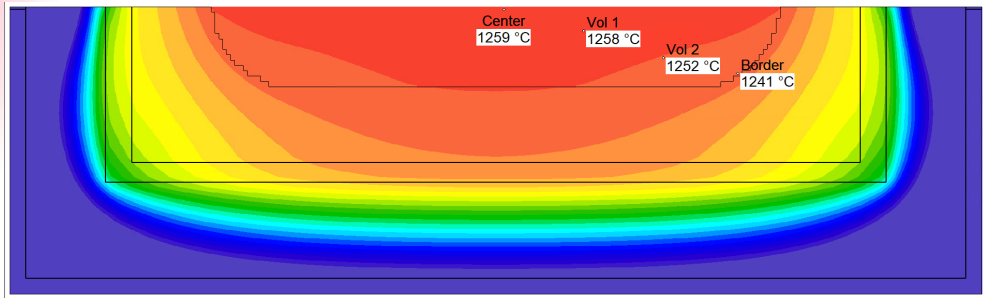


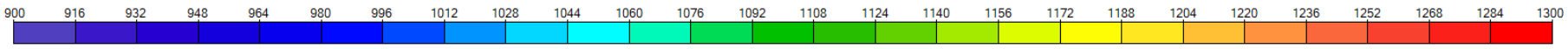
Modelling excercise - base case



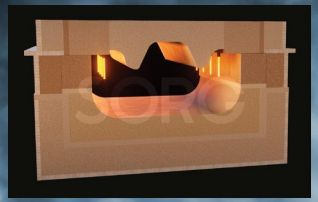


ΔT = 18°





AGENDA

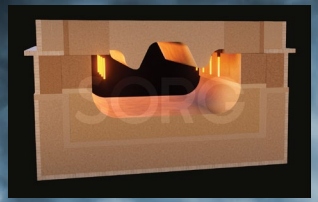


- Company SORG - Innovation & Tradition
- Sustainability in glass production
- Forehearth Basics
- State-of-the-art in electric forehearths
- Modelling exercise
- Target definition
- Sorgs all-electric “VIKING”-forehearth

TARGET DEFINITION

- The target of the new development was to create a forehearth system, which was:
  - electrically heated for increased sustainability
  - heating preferreably at the feeder sides and not in the center
  - avoiding local overheating of the glass
  - avoiding blockage of the center cooling path
  - avoiding contamination of the product by deteriorated heating elements
  - offering sufficient lifetime
  - not requiring separate gas heating system for heating-up

AGENDA



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SORGS ALL-ELECTRIC 340S+ “VIKING” FOREHEARTH

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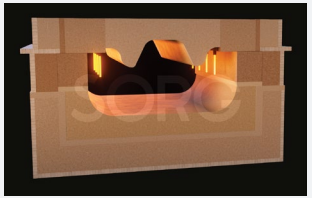
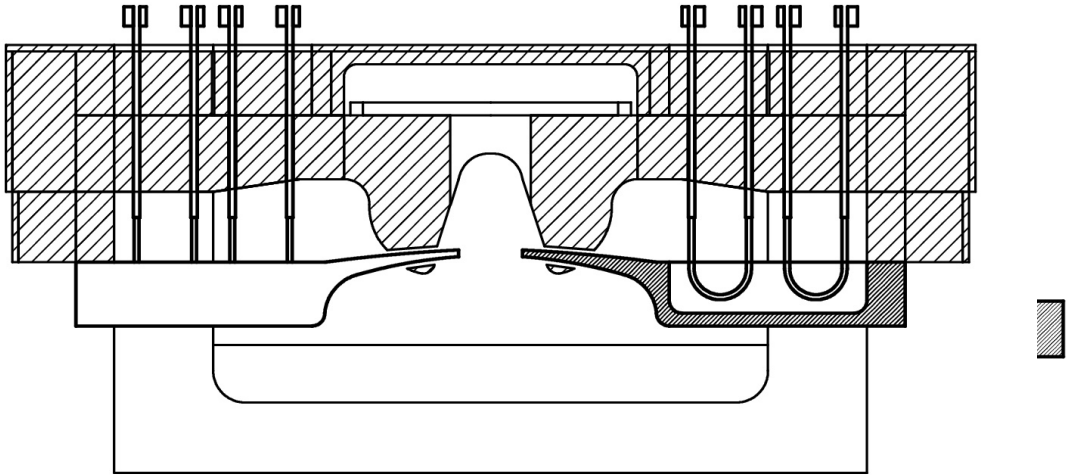
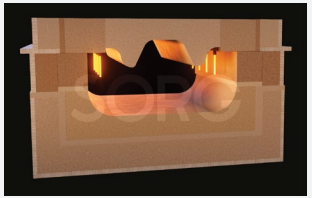
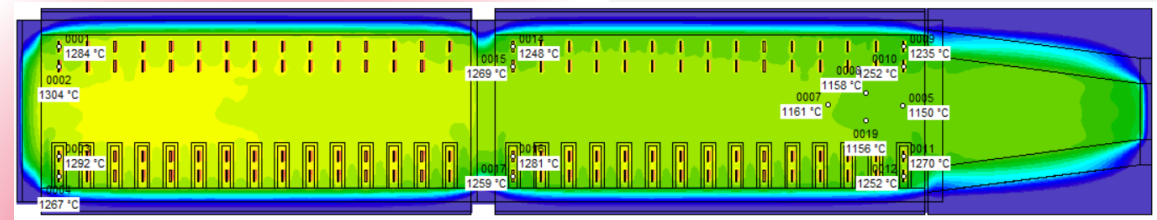
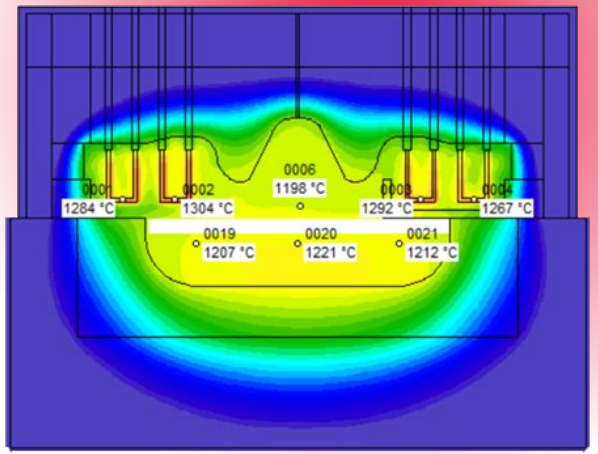


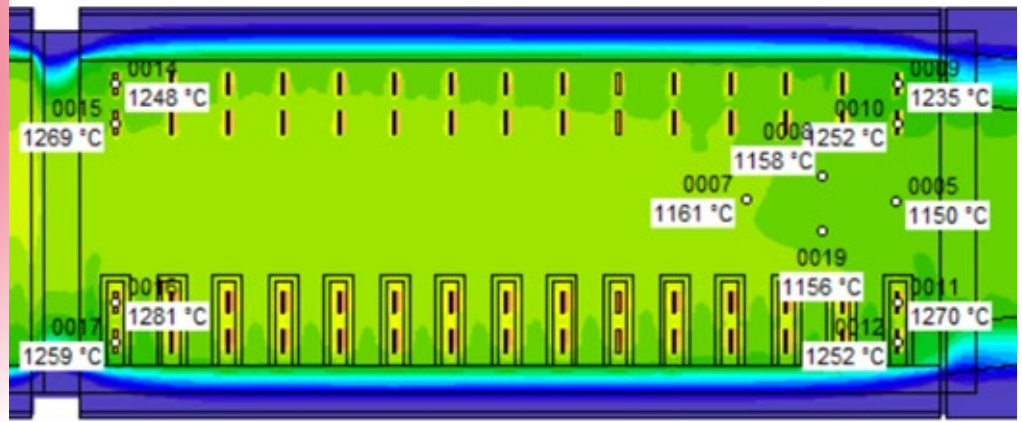


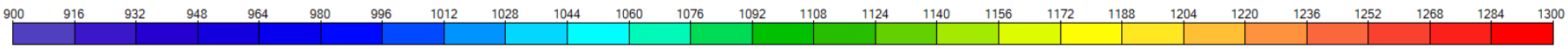
SORGS ALL-ELECTRIC 340S+ “VIKING” FOREHEARTH



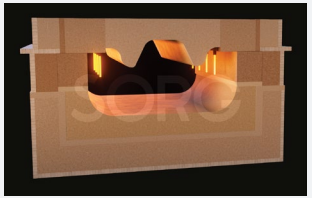


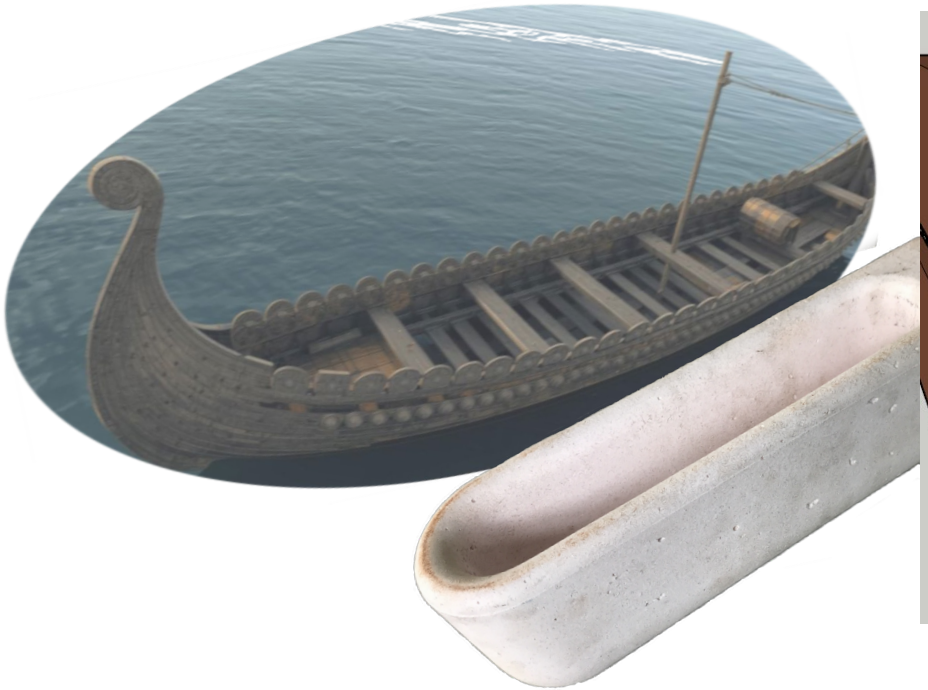


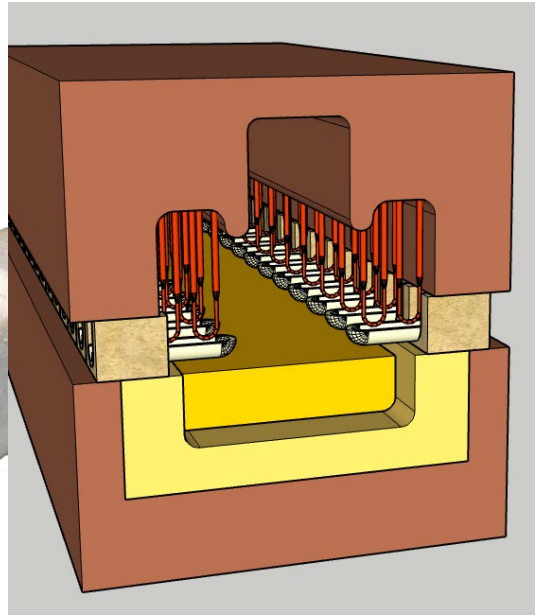




SORGS ALL-ELECTRIC 340S+ “VIKING” FOREHEARTH







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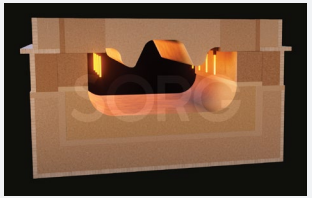

- Best and most reliable solution remains the traditional gas heating or at least an hybrid solution (gas and electric)
- If renewable energy is available and sustainability is key - Sorg offers a viable solution with its 340S+ Viking forehearth
- Several direct and indirect heating systems are available - secured MoSi2-heating elements fit to most of the requirements
- Energy savings of up to 65-75 % could be expected

- → 1st installation in 2nd half of 2025 - extra flint - 40…110 tpd

Nikolaus SORG GmbH & Co. KG
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97816 Lohr am Main

Thank you very much for your attention

SORG | GMIC 86th Glass Problems Conference and Symposium
October 6-9, 2025, Toledo, Ohio, USA