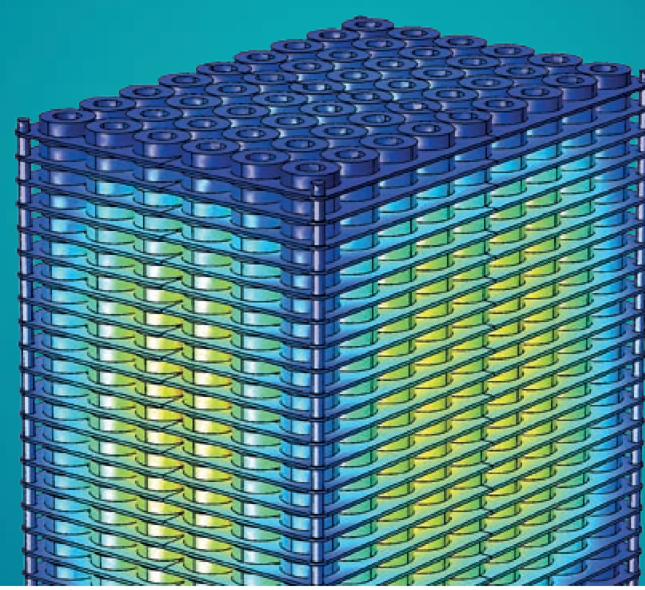
Increasing throughput by design optimization

Lightweight in high temperature applications

Customer benefits

- Increased throughput by 25 %
- Decreased heating energy by 65 % through reduced mass of charging system
- Elimination of creep in the corrosive atmosphere up to 1900 °C
- Fast digital evaluation of the temperature homogeneity

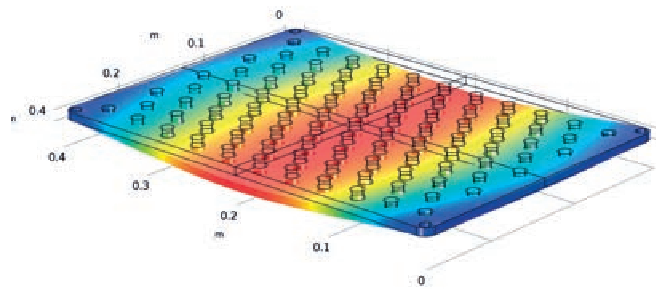


Lightweight construction for the heavy load

At SGL Carbon, we believe that competitive advantage starts with higher production efficiency. High-temperature processes are extremely energy intensive and much of the heat is dissipated to the environment or on undesirable but necessary heating of the auxiliary equipment such as charging carriers. In view of the higher investment costs for the superior lightweight designs, computational methods provide significant opportunities to optimize such designs for the maximum productivity on one side and fast economical payback on the other. Our modeling solutions are inspired by the complexity of the physical systems that require attention to critical details. We are proud to see how our models support customers to achieve their goals in productivity, quality, and environmental targets.

The case

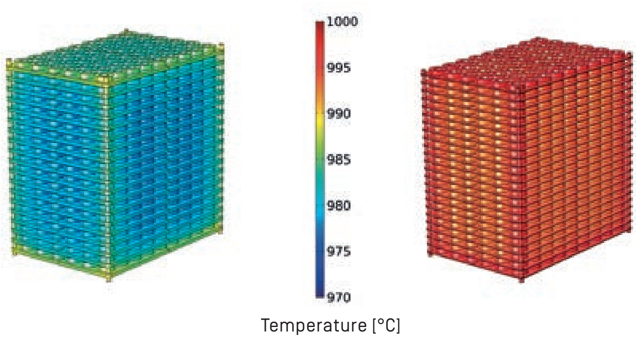
- The sintering of stainless steel is typically done on graphite charging carriers. The graphite has low stiffness and suffers from creep in corrosive high-temperature environments
- The temperature of the charging system and the loaded parts must be homogeneous on each rack to enable efficient sintering
- The total number of parts processed in one furnace run was to be maximized



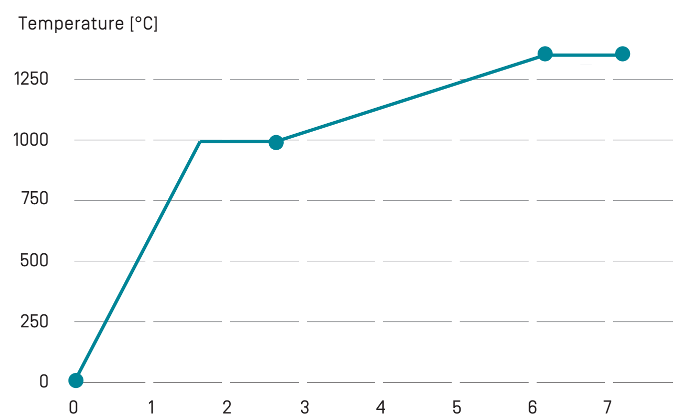
Creep in a graphite carrier plate
in a corrosive environment at 1300 °C

Our Solution

We modeled the heat transfer to verify the temperature homogeneity of the whole charging system. We substituted the benchmark graphite carrier with 19 racks with a carbon fiber reinforced carbon (CFRC) carrier containing 24 racks. This lead to productivity increase of more than 25 %. The mass of the charging carrier and also the energy consumed on heating it in each furnace cycle was decreased by 65 %. The total mass of the CFRC system loaded with 1296 parts is similar to the total mass of the graphite system loaded with only 1026 parts and it has a larger surface area for better heat exchange. As a result of that, the loaded parts follow the set temperature curve of the furnace more closely. The bending of CFRC is less than half of the bending of graphite plates. Due to the superior bending strength, CFRC is not sensitive to plastic deformation through creep.



Temperature distribution in both racks after 100 min.: the CFRC rack has a more homogeneous temperature distribution.



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SGL CARBON GmbH
Central Innovation
Werner-von-Siemens-Straße 18
86405 Meitingen/Germany
simulation@sglcarbon.com
www.sglcarbon.com

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