sgl carbon

Heat treatment process simulation

Optimizing temperature control for heat treatment processes

Customer benefits

- Reduction of investment risk for new machinery
- Reduction in downtime for costly trial and error runs
- Improved product quality

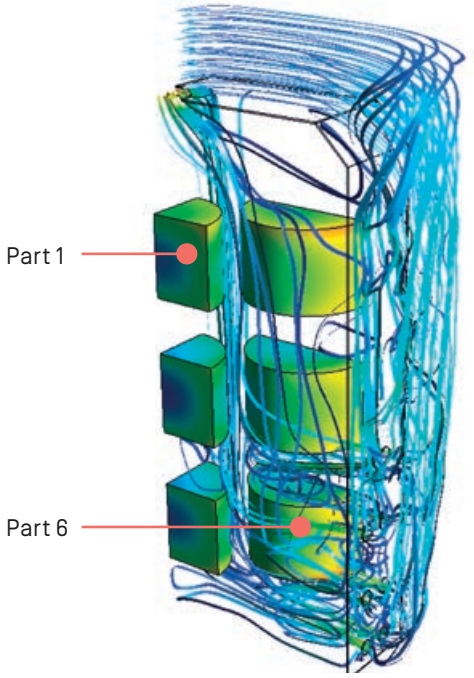
Know your process before investing

Industrial heat treatment processes for metals, ceramic materials, and glasses involve a fine balance: processing times have to be short to assure economic feasibility, while heating rates are limited to prevent defects.

With these technological constraints, all process parameters have to be specified such that the entire volume of the treated parts undergoes the exact temperature profile required for the heat treatment process to be effective.

The case

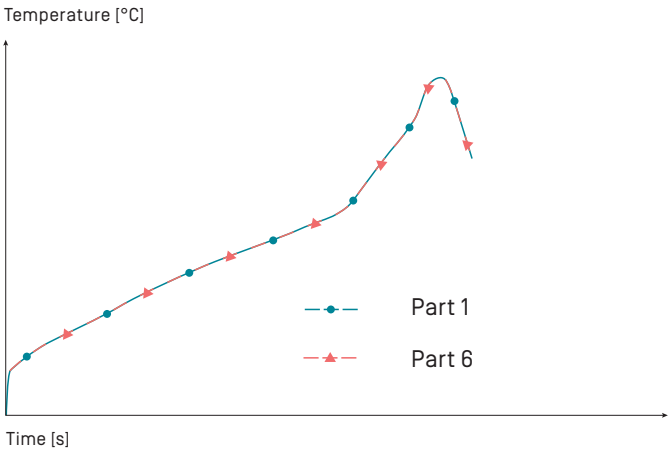
- A new furnace design for a baking process was to be developed with a “first time right” approach
- The process parameter settings required to achieve an optimal temperature profile were to be identified for different arrangements of the parts in the furnace chamber
- The baking process takes over 100 hours, making trial runs extremely expensive and time consuming



Heat treatment process: visualization of temperature distribution in individual parts (here shown as simplified blocks) makes it possible to identify hot spots during specific firing cycle.

Our Solution

We used a non-linear, transient, computational fluid dynamics (CFD) model of the furnace atmosphere to predict the temperature profile of individual parts for different firing cycles and various arrangements of the parts. The model enabled a full visualization of the temperature distributions during the firing cycle. This information is otherwise inaccessible. Based on the model, an optimized firing cycle was specified for the new furnace design. It was ensured that this firing cycle prevents hot spots during the heat treatment process that may lead to defects like cracks and chipped features. The digital assessment in the design stage of the furnace significantly reduced investment risk. The concept was validated early on in the design phase and costly modifications and downtime was avoided. The test effort in the commissioning phase of the new equipment was reduced significantly such that the new equipment reached full productivity shortly after installation.



Temperature curve of different parts subject to optimized firing program: the dashed and dash-dotted lines show the temperature curve of parts 1 and 6, respectively. The overlapping temperature curves indicate a homogeneous temperature distribution throughout the entire firing cycle. This is achieved through the new furnace design combined with an optimized firing program.

Need to reduce testing effort with new heat treatment equipment? Need to test your concept early in the design phase?
Get in touch with our experts.

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