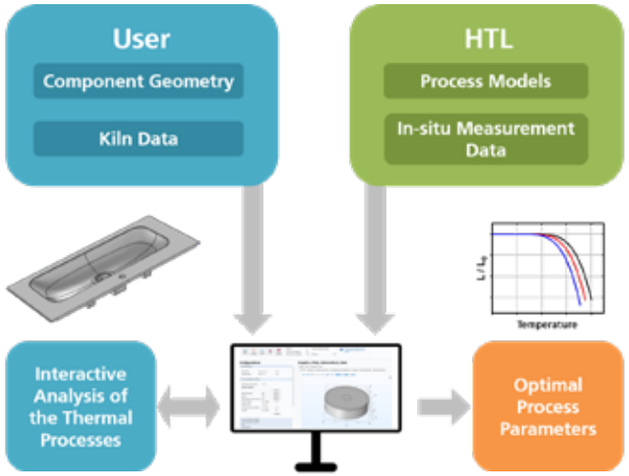

Service Offering

Fraunhofer-Center HTL creates apps on behalf of customers that can be used to independently optimise thermal processes for ceramic or powder metal products. To do this, the problem and optimisation goals are first formulated together with the customer. Then the required material data are measured and implemented in the software. Various expansion stages can be realised:

- Purely material-specific simulation – suitable for small objects
- Simulation for variable component geometries
- Consideration of furnace-specific heat transfer
- Consideration of stresses in the component
- Prediction of component distortion, e. g. by gravity

The scope of delivery of each app includes documentation and training for effective use. Later updates, for example to implement other material data or to expand the range of functions, are possible at any time.

Fraunhofer-Center HTL
is certified acc. to ISO 9001:2015

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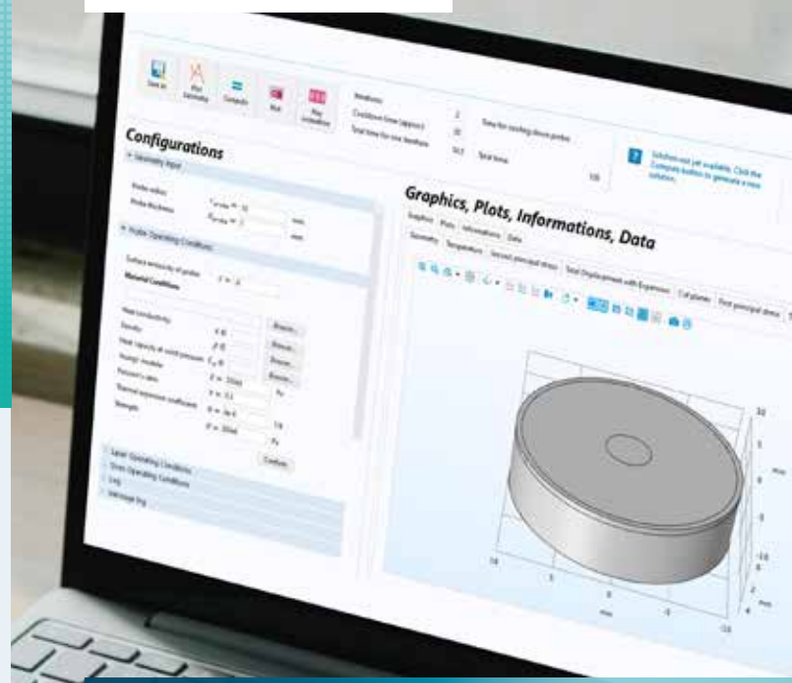
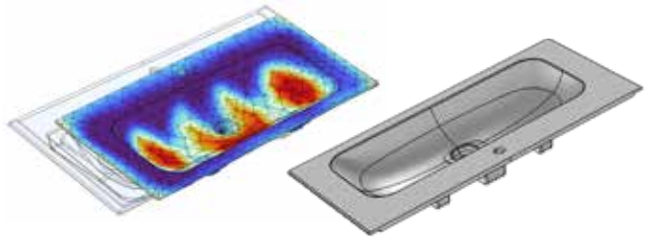


Center for High Temperature Materials and Design HTL

Development of Customised Apps



Customised Software for the Optimisation of Thermal Processes

In the powder-metallurgical production of ceramic and metallic products, success almost always depends significantly on the correct thermal treatment of the components. This applies to classic shaping such as cold pressing as well as to additively manufactured components. Fraunhofer-Center HTL develops user-specific apps that allow you to optimise thermal processes independently.

Technical Concept

Behind the optimisation software is a methodology that has been tried and tested over many years and is constantly being further developed: First, the material behaviour in the thermal process under consideration is determined specifically for the problem by means of precise in-situ measurements. Based on the measurement data, a finite element model is created that can predict the material behaviour, such as the pressure build-up due to pyrolysis products or local stresses due to sintering shrinkage in the component. Based on the validated models, the processes can be optimised on the computer.

Possible Processes

- Dehydration
- Binder burnout / pyrolysis
- Sintering

Benefits

- Minimising energy consumption
- Maximisation of throughput
- Near-net-shape production
- Minimisation of scrap
- Protection of critical know-how

Material and Furnace Characterisation

Precise measurement data on the material to be heated and (optionally) the specific oven situation are recorded as the basis for digital optimisation:

- Measurement of thermophysical material properties
- In-situ characterisation of material properties via ThermoOptic Measuring systems (TOM)
- On request, recording of additional parameters in the industrial oven
  – Temperature distribution
  – Type and flow rate of process gases

Simulation Process

The proven FE software COMSOL is used for the simulations. The models are based on the kinetic field method and continuum mechanics, among other things.

Options for Implementation in the Apps

With our technology, we create individual software products that enable the optimisation of thermal processes for your specific materials and different component geometries. The apps are generated from the FE models, but function as standalone programs; a separate COMSOL licence is not necessary. The in-situ measurement data specific to a product material are implemented in the respective app.

As a basic functionality, the fastest or most energy-saving temperature-time curve for reaching the desired final state (e.g. sinter density) can be determined in each app. Depending on the process and quality requirements, the functionality can be extended by:

- Readability of variable sample geometries
- Calculation and evaluation of mechanical stresses in the component due to pyrolysis or combustion gases or temperature gradients in the component
- Prediction of component distortion
- Consideration of the product position in the firing stack
- Consideration of hot gas flow in the kiln