ThermoOptical Measuring System TOM_air

Service Offering

Fraunhofer Center HTL offers different services for debinding (binder burnout, pyrolysis) in all industrially relevant furnace atmospheres:

- Optimization of temperature-time cycles for small components by means of in-situ measurements and kinetic field technique
- Optimization of temperature-time cycles for large components by means of experimental investigations and FE-simulation
- Transfer of debinding cycles to industrial furnaces
- Optimization of setting plans and gas flows
- Evaluation of commercially available binders
- Evaluation of green sample quality

If required, further heat treatment steps can also be investigated and optimized at the HTL. These include the drying of green bodies, the dehydration of silicate ceramics or the sintering and infiltration of ceramics and powder metals.

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Fraunhofer Center HTL
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Fraunhofer ISC

Center for High Temperature Materials and Design HTL

Optimization of Debinding Processes

High Temperatures – Efficient Solutions

Optimization of Debinding Processes

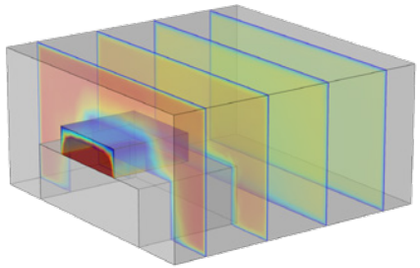
The debinding of green bodies is accompanied by desirable or undesirable physical and chemical processes. Associated with this are process-related problems that must be avoided:

- Structural damage
- Incomplete debinding
- Structural changes
- Long process time

To counteract these problems, precise knowledge of the debinding process and the material under investigation is necessary. With methods specially developed at Fraunhofer Center HTL, debinding processes can be characterized and precisely optimized. The procedure is divided into the following steps:

- In-situ characterization
- FE simulation
- Optimization of debinding parameters

With the aid of these methods, debinding processes can be optimized in terms of their cost and energy efficiency as well as their product quality.



Simulation of the debinding of a refractory brick

ThermoOptical Measuring System TOM_I

In-situ Characterization

With conventional thermal analysis methods and special ThermoOptic Measurement (TOM) systems, green bodies are characterized during debinding. This enables the calculation of temperature cycles with constant debinding rates. The just safe maximum debinding rate is then determined experimentally. For this purpose the damage to samples or small components during debinding is detected by means of acoustic or gas emission. For larger components, a finite element (FE) simulation of the debinding is required.

FE Simulation

Fraunhofer Center HTL has a coupled FE model with which thermal effects, reaction kinetics, gas flow and diffusion as well as mechanical stresses during debinding are calculated. In addition to the in-situ measurement data, the simulation requires further experimental data on the composition of the organic binder, permeability of the pore channels, thermal conductivity and green strength. This allows debinding to be calculated for larger components and optimize debinding cycles.

Technical Processes

Measurement methods for the optimization of debinding

- Mass loss (thermogravimetry)
- Heat of reaction (differential scanning calorimetry)
- Gas analysis (mass spectrometry / CO_2 detection)
- Optical monitoring (optical dilatometry)
- Acoustic monitoring (acoustic emission analysis)
- Thermal diffusivity (laser flash analysis)
- Binder composition (elemental analysis)
- Green strength (e.g. ball on ring method)
- Binder wetting (optical contact angle analysis)
- Gas permeability (permeation measurement)

Coupled FE simulation

- Thermal calculations (COMSOL, ANSYS)
- Kinetic models (COMSOL)
- Fluid mechanical calculations (COMSOL)
- Structural mechanics calculations (COMSOL, ANSYS)