

## Our Services

The examination of industrial furnaces and drying chambers is provided at different levels of detail: from a simple thermographic examination of the furnace to a complete simulation and quantitative evaluation of efficiency potentials.

We offer the following measurements and simulations:

- Qualitative 3D thermography
- Local heat flow measuring
- Flow measurement for cooling water
- Measurement of electrical power consumption
- Measurement of the temperature distribution in the combustion chamber and in the kiln
- Measurement of the furnace atmosphere
- Measurement of gas flow in the furnace
- Analysis of furnace exhaust gases
- Simulation of furnace, stack, or charge
- Measurements with autonomous sensor boxes

## Please feel free to contact us:

**Fraunhofer-Center for  
High Temperature Materials and Design HTL**

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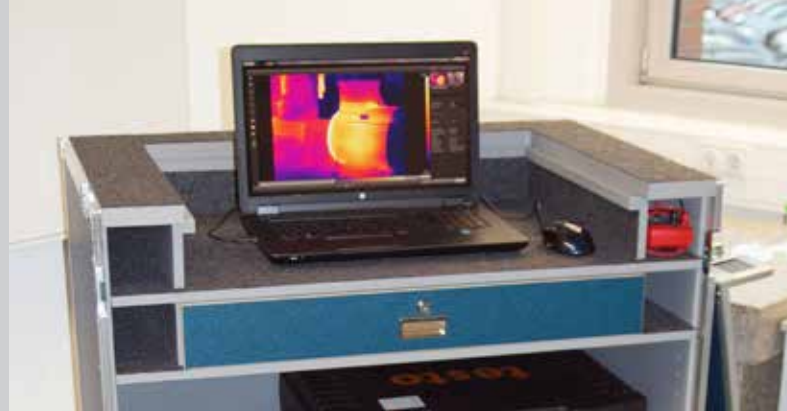
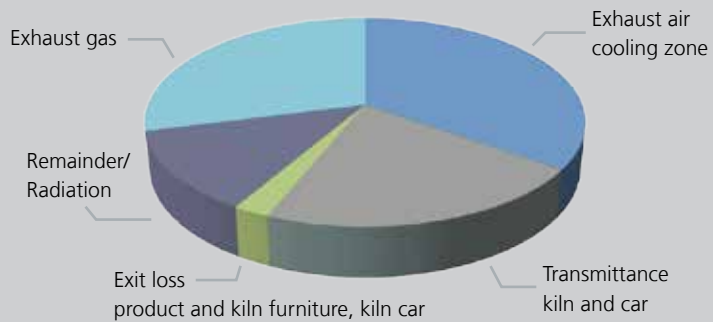
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## Analysis of Industrial Thermal Processing Systems





## Usage

Industrial furnaces often provide large potential for optimization in terms of cost and energy efficiency as well as the product quality achieved. Optimization approaches affect the furnace insulation, setting plans, the kiln furniture used, as well as the temperature cycles and furnace atmospheres – the latter in terms of composition and gas flow. Optimization can be improved if the furnace is not used as a black box in an input-output analysis, but has detailed data especially on thermal management.

Therefore, a mobile furnace measuring rig has been developed at Fraunhofer-Center HTL, which can be used on-site on industrial furnaces without having to interrupt the furnace operation.

## Measuring Methods

3D thermography and the measurement of heat flows are used to identify heat leaks and to evaluate resulting heat losses. Measurements of cooling water and electrical loads are used to establish energy balances. Moreover, oven atmosphere and temperature distribution measurements are usually needed to assess the quality of the heating process.

Fraunhofer-Center HTL has electrochemical and optical sensors with which critical gas types (for example  $\text{CO}$ ,  $\text{O}_2$ ,  $\text{CO}_2$ ,  $\text{SO}_2$ ,  $\text{NO}_2$ ,  $\text{C}_x\text{H}_y$ ) are analyzed in the furnace exhaust or – at temperatures of up to  $1200\text{ °C}$  – using a gas sampling lance. Gas flows are measured with a differential pressure lance or with an impeller anemometer. The temperature distribution inside the furnace is recorded with specially conditioned and calibrated temperature measuring rings.

Several properties in industrial furnaces are obtained using autonomous sensor boxes which accompany the charge during the heat treatment.

## Implementation

Fraunhofer-Center HTL carries out analyses of industrial furnaces with the mobile furnace measuring rig. These analyses alone can already indicate optimization potentials.

Depending on the detail level of the analysis, a simplified finite element (FE) model of the kiln plant can be created from the measured values (heat flow, exhaust temperatures, atmospheric flows, cooling water temperatures, etc.). Using this model, changes in insulation, flows or heating parameters can be visualized and their effects on furnace operation and the product can be investigated.

The heat management in furnaces can also be optimized using FE simulation. An overall optimization can be achieved for many heat treatment processes with regard to product quality and energy efficiency by combining the furnace simulation with the simulation of process kinetics in the charge (drying, debinding, sintering, melt infiltration).