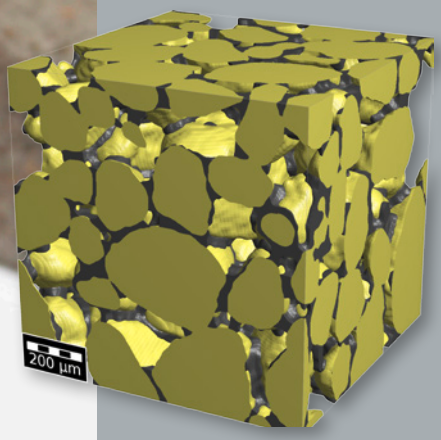


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# µ-KERN: MICROSTRUCTURE-BASED CALCULATION METHOD FOR CORE SAND

1 *The sand core was produced by a core shooting process at the UTG. The grains of sand are bound to a mould by a binder.*

2 *Sand grains in beige and binder in grey can be seen in the virtually created microstructure.*

Casting technology uses core sand to map the cooling channels in a cylinder head. Core sand consists of the granular material quartz sand formed to a porous composite by a binder. This is placed in the outer mold before the metal is poured and destroyed after the casting process to produce a sand-free casting. We are developing micromechanical simulation models for core sand in cooperation with the Chair of Metal Forming and Casting (UTG) at Technical University of Munich (TUM).

**Calculating the properties of inorganically bound core sands**

An innovative, inorganic silicate-based binder complies with strict environmental laws and enables sustainable, low-emission production. However, changing the components used changes the physical behavior of the core sand and the result is only visible after passing through the entire process chain. We are able to accelerate development by modeling and simulating the process.

Based on input parameters such as the manufacturing process and the materials used, we effectively calculate physical properties such as strength, gas permeability, and thermal conductivity. In the first phase of the project, we create a representative microstructure for the sand-binder composite and prepare high resolution images of existing composite structures using micro-computer tomography.

**Validating the structures produced**

The UTG partners measure the elastic properties of the sand and the binder. Then, we create virtual microstructures with stochastic methods and validate them by comparing them with structural images. The properties of the sand (such as grain shape, size, and size distribution) and of the binder (such as volume content and chemical composition) influence the physical properties of the composites. We investigate the dependence of the elastic stresses in the composite on the elastic properties of the materials used i. e., the quartz sand and water glass.

In the second part of the project, we use the Stokes/Navier-Stokes model to calculate the gas permeability and the thermal conductivity. Furthermore, we generalize the elastic model to nonlinear damage effects.