

# Modeling of Turbulent Combustion in COMSOL Multiphysics®

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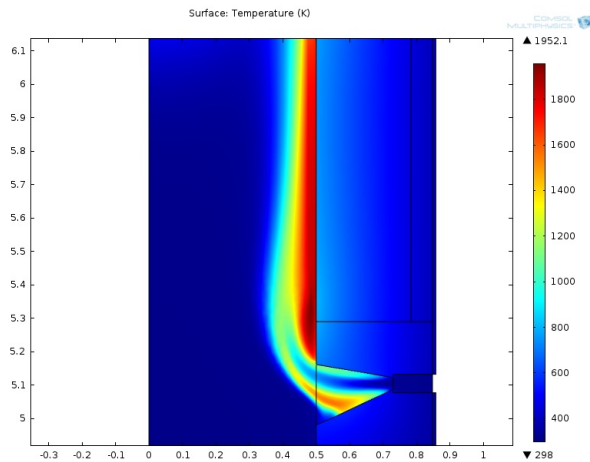
## Abstract

In the production of high quality materials by a heat treatment, it is indispensable to accurately predict the temperature inside the furnaces being employed. Mathematical modelling allows one to optimize the operating conditions of currently existing installations and the design of new ones. In this work we develop a turbulent combustion model for the heat being released by gas burners inside a shaft kiln. Various industries use such kilns to harden clay into objects such as pottery and brick stones. Turbulent combustion is the strongly coupled phenomena of the chemically reacting fuel and oxygen in a turbulent flow. In COMSOL Multiphysics® we model the turbulent flow by a Reynold-Averaged coupled with a k-epsilon turbulence model. The concentration of the chemical species such as methane, oxygen and water are tracked by mass transport equations. The corresponding source terms are represented by the eddy-breakup model. We developed a model for both the empty kiln and the kiln filled with clay-like material being processed. In the latter the material is represented as a porous medium. Numerical results for the empty kiln show a strong temperature gradient near the walls close to the inlet of the kiln. This temperature profile is shown in Figure 1. The presence of the material tends to smooth the temperature gradients as shown in Figure 2. Further work is required to refine the model representing the material inside the oven and its absorption of heat.

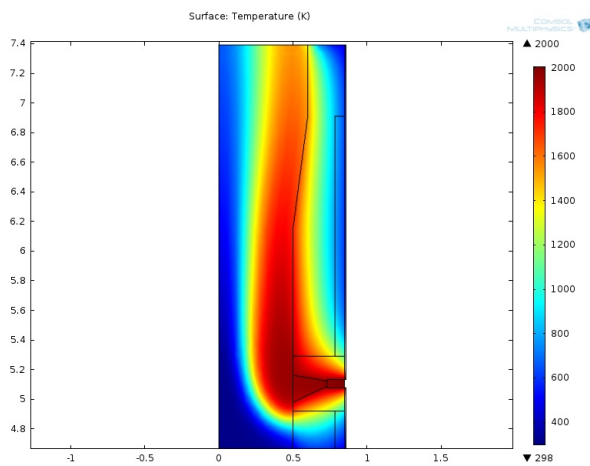
## Reference

J. Warnatz, U. Maas, R. W. Dibble, Combustion, Fourth Edition, Springer, 2006.

## Figures used in the abstract



**Figure 1:** Temperature in empty kiln



**Figure 2:** Temperature in kiln filled with clay-like material