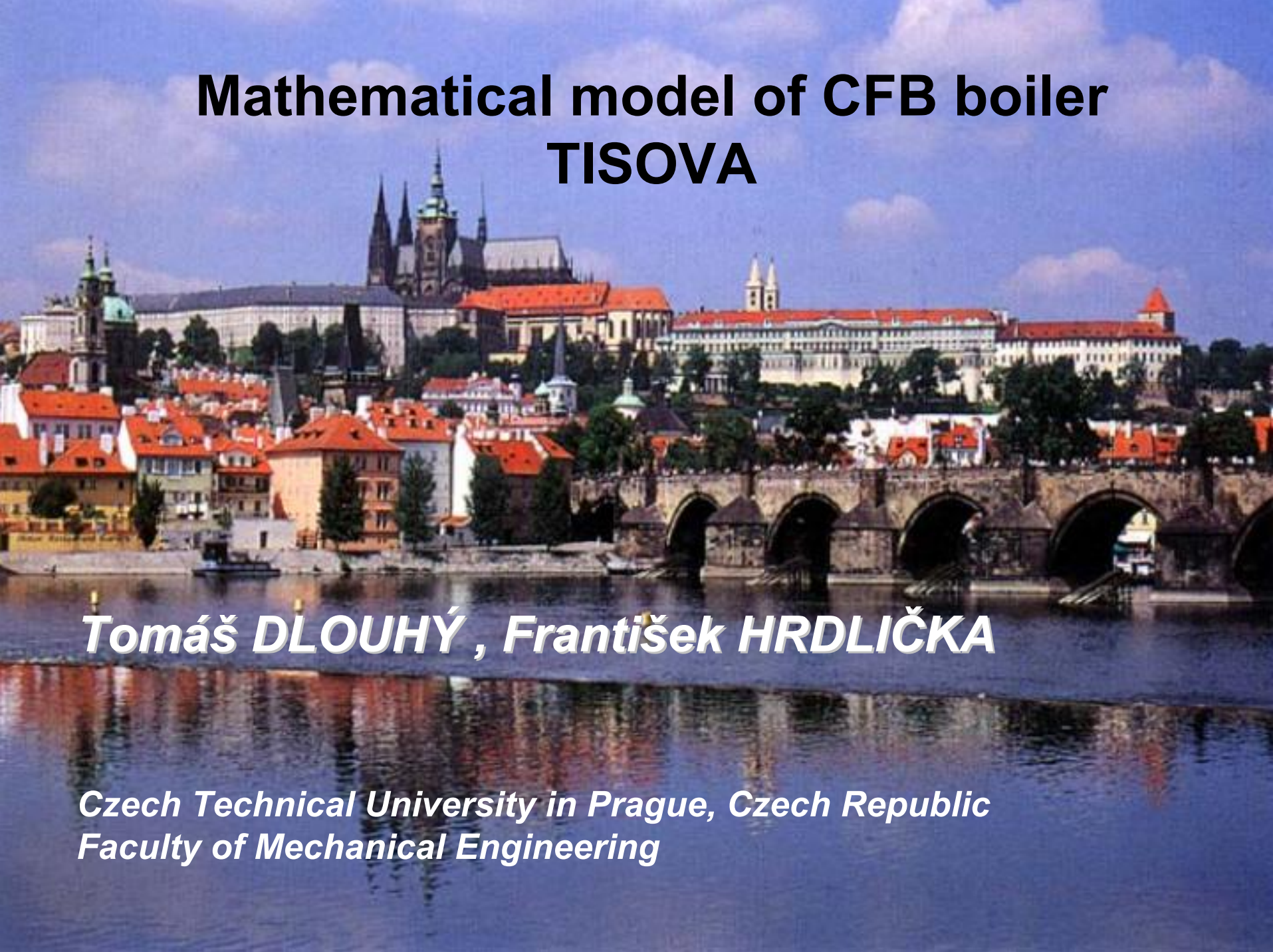
Mathematical model of CFB boiler TISOVA



Tomáš DLOUHÝ , František HRDLIČKA

Czech Technical University in Prague, Czech Republic
Faculty of Mechanical Engineering

Mathematical model of CFB boiler

Model is able to simulate

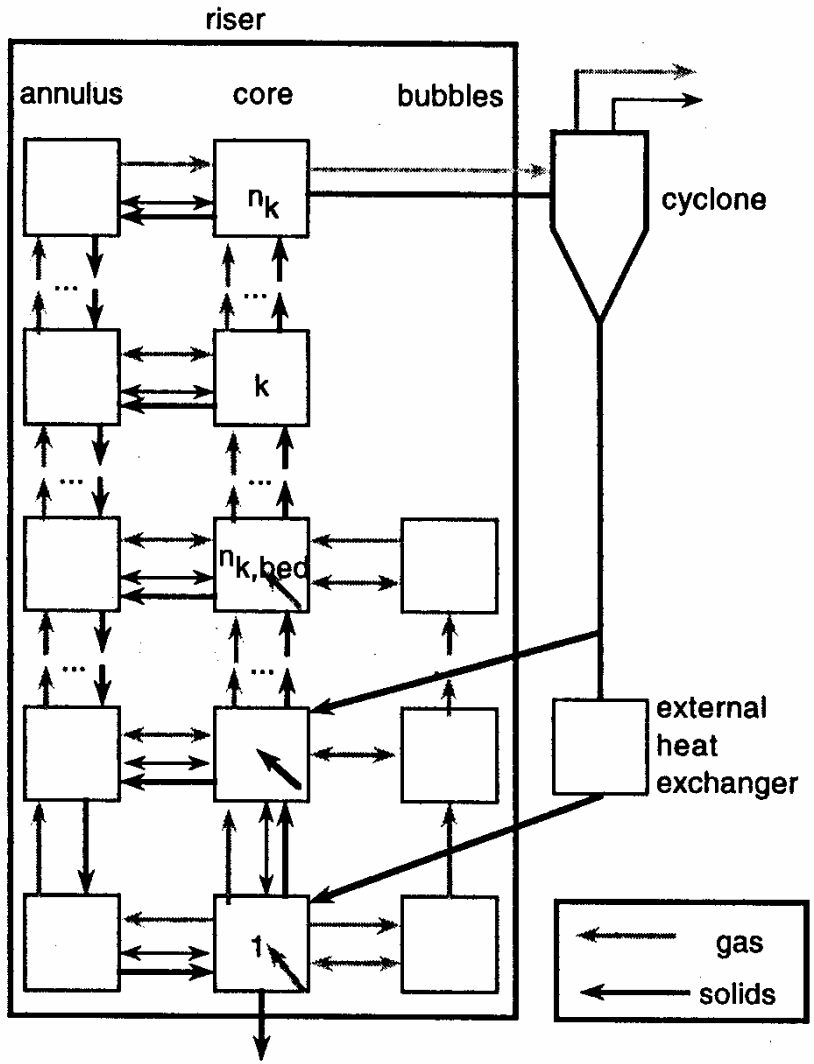
- change of fuel properties
  - composition and heating value
  - size distribution
- conditions of additive desulfurization
  - limestone excess
  - limestone size distribution
- mass and heat transfer
  - definition of mass and heat flows in furnace
  - fluidization
  - mass and heat transfer in convective heating surfaces

Model architecture

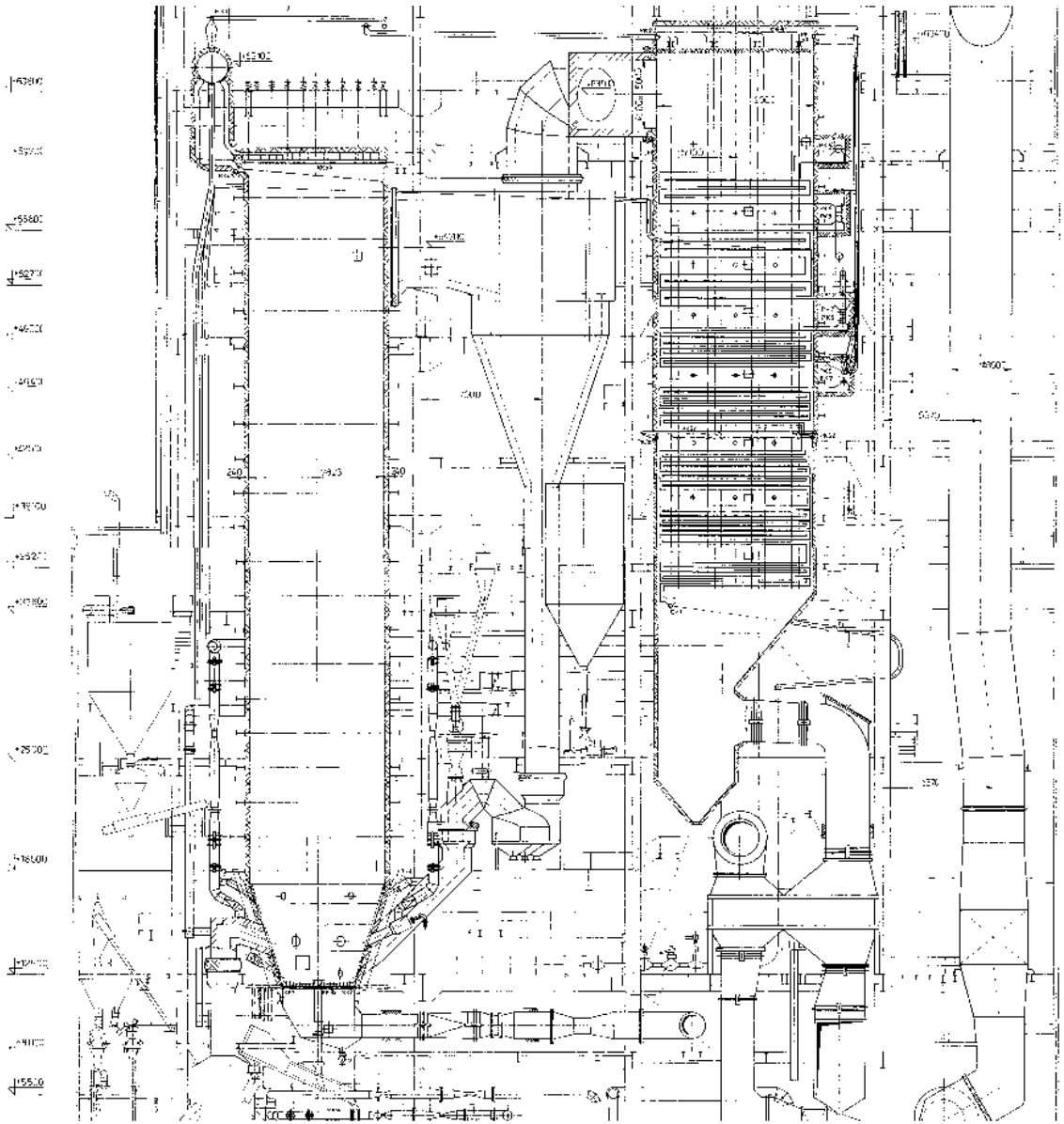
- Model of CFB boiler was created by connection of two independent models
  - model of CFB furnace created by TU Delft
  - model of pulverized coal fired boiler created by CTU Prague
    - calculation of pulverized coal fired furnace in this model was substituted by the model of CFB furnace
    - calculation of heat transfer in heating surfaces and general heat balance of the boiler was utilized

Cell structure of CFB furnace

- riser is divided into vertical cells
- core and annulus cells in radial direction are established
- core cells are divided into bubble and emulsion phase in dense (lower) bed region



Validation of the model

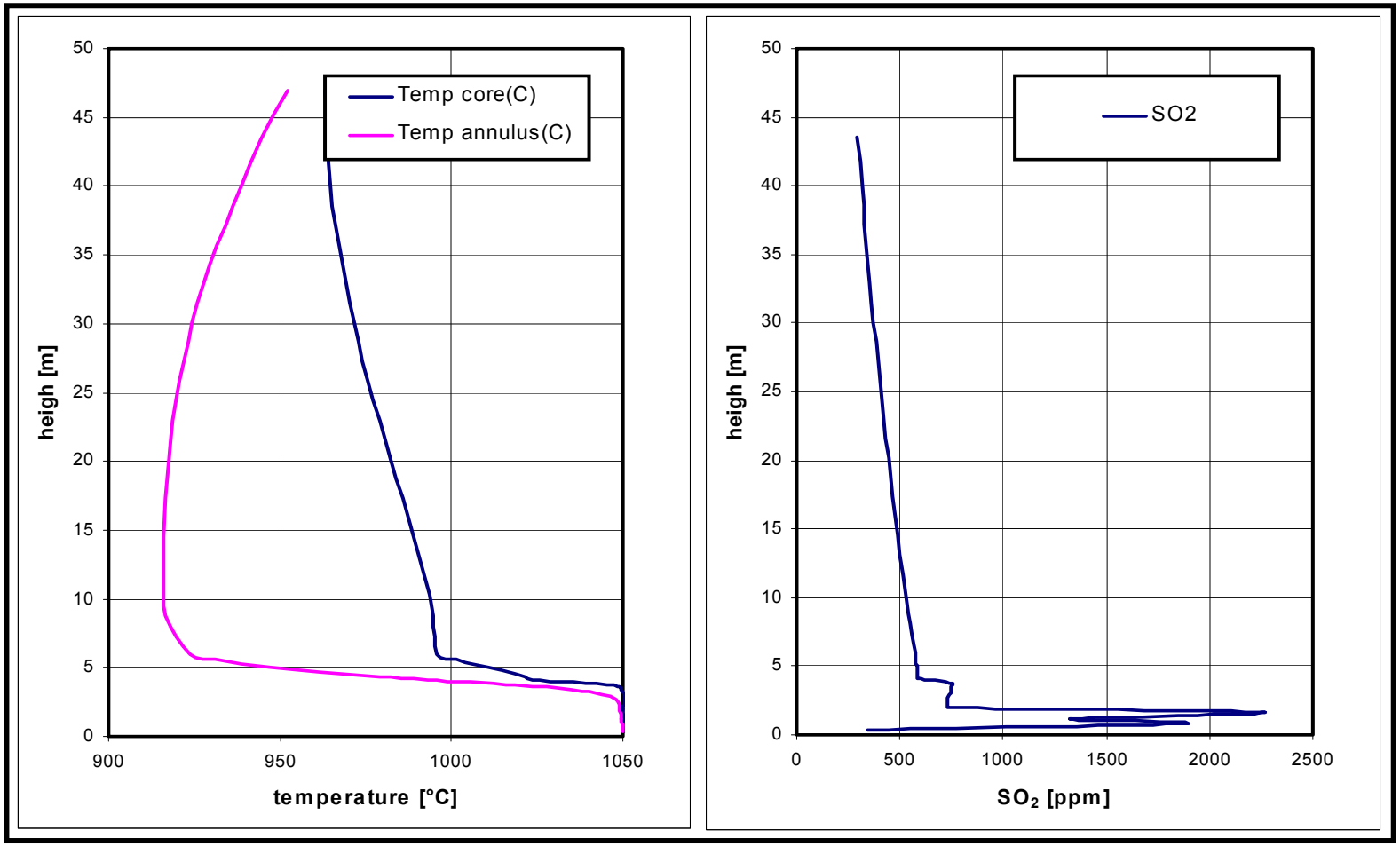


CFB boiler

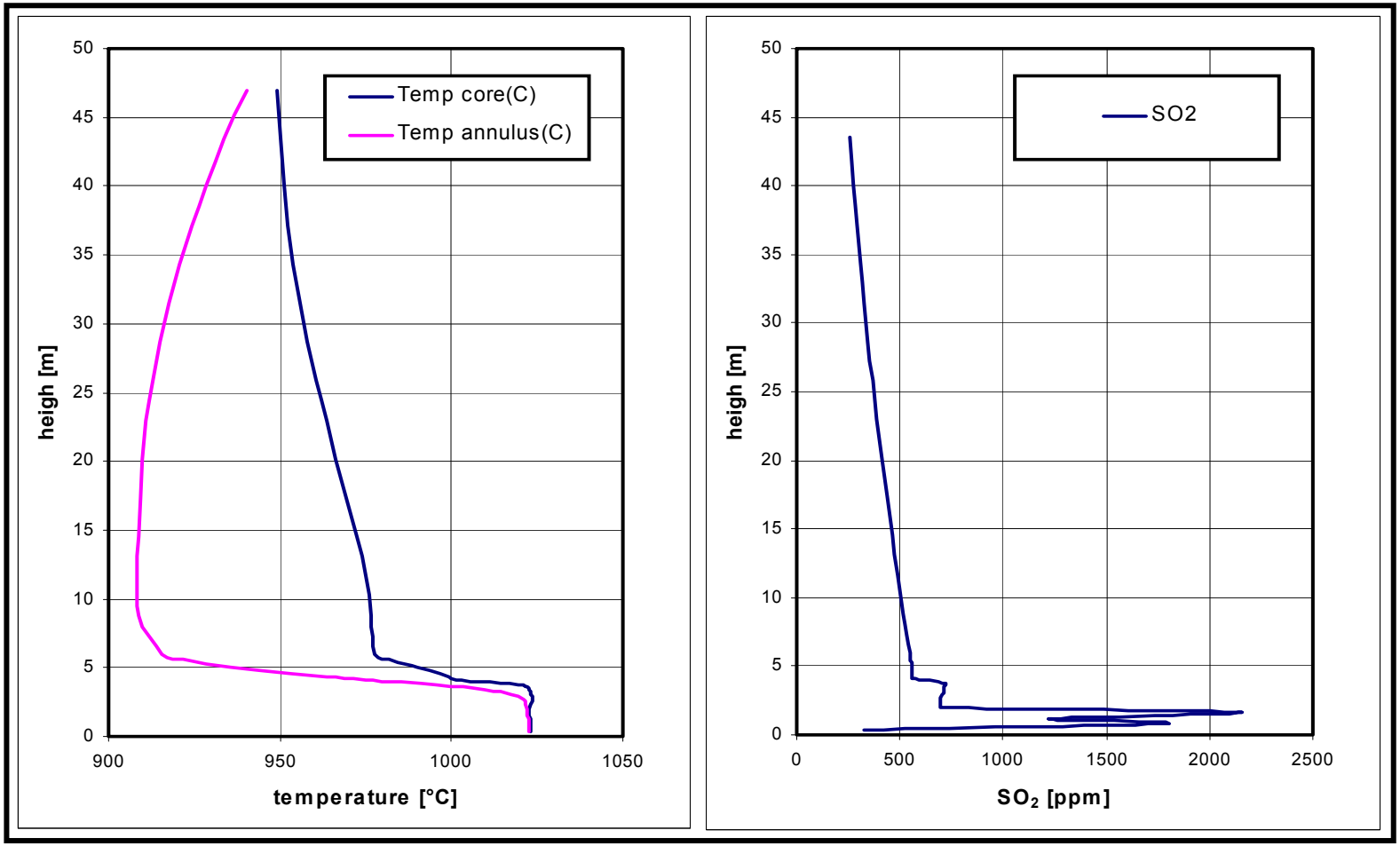
Tisova Power Plant

steam rate	350 t.h-1
steam pressure	9,42 MPa
steam temperature	505 ± 5 °C
FW temperature	165 °C

Reference conditions



+10% of recirculated flue gas



THANK YOU FOR YOUR ATTENTION

PRINCIPLE LAYOUT

FURNACE divided among 3 type cell : core cell, annulus cell and bubbles

Gas and solid feed flows are added only into core cells.

The in and outflows, as well feeds are introduced by the user in the model input file. The in and outflows, as well as mixing between the cells is calculated using the submodels for elutriation, dense bed solid fraction, minimum fluidization, separetion efficiencies, mixing parametr etc.

The temperature is calculated by means of a temperature balance in each cell, considering the in- and out going heat and the diferences in formation enthalpy due to gas reactions. Each cell is assumed to be completely homogeneous in concentration and temperature.