

# A CFD study of the performance of horizontal dilution tubes

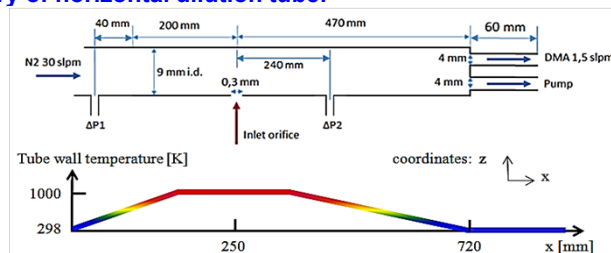
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## Objectives

- Investigate the flow conditions in horizontal dilution tubes by CFD:
  - nature of the orifice flow
  - turbulence
  - mixing and cooling quality
  - dilution ratio
- Flame studied: CH<sub>4</sub> oxy-fuel,  $\Phi = 2.4$

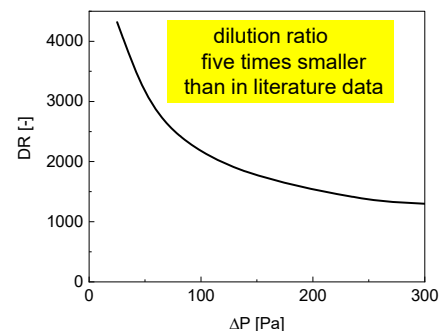
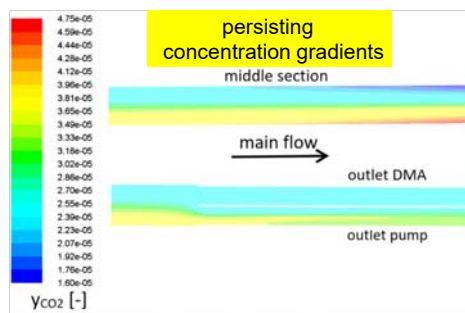
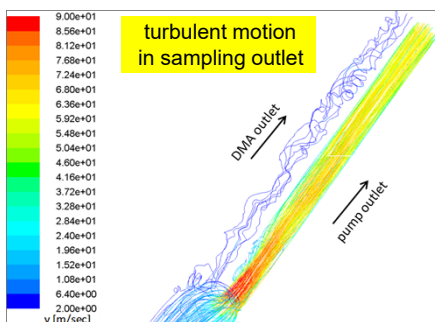
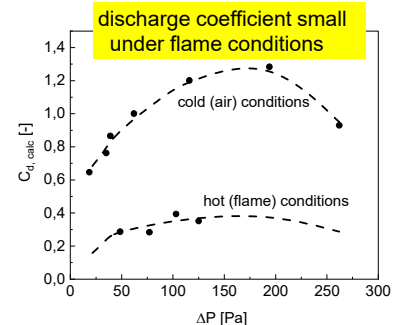
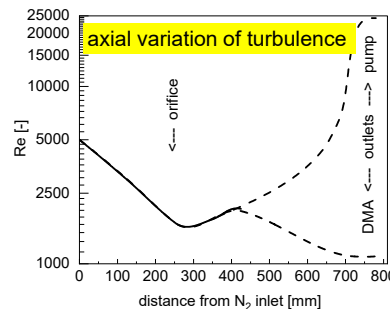
## Numerical Approach

- Gas sampling by orifice is jet in crossflow configuration
- Calculate orifice flow rate without particular physical assumptions
- Flame conditions approximated by proper boundary conditions at tube
- High resolution grids used for **RANS and LES**
- Geometry of horizontal dilution tube:**



## Results

- Rapid decrease of turbulence along tube axis due to heating of diluent gas
- Sampled gas remains close to pipe wall due to low jet to crossflow momentum flux ratio
- High turbulence revives in tube outlets due to small cross sections
- Residence time is too small for efficient mixing, concentration gradients persist



## Conclusions

- The mixing and cooling efficiency in current experimental set-ups is insufficient.
- Concentration gradients persist.
- The dilution ratio is significantly smaller than estimated previously.
- The horizontal dilution tubes need to be optimized with respect to flow conditions.

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