Joined comparative study of the CORIA Rouen Spray Burner Simulation instructions

7th Workshop on Measurement and Computation of Turbulent Spray Combustion (TCS7)

Benoit Fiorina*[2] and Constantin Nguyen Van†[2,3]

[1]*CORIA, CNRS, 76801 Saint-Etienne-du-Rouvray, France*
[2]*Laboratoire EM2C, CNRS, CentraleSupélec, 91192 Gif-sur-Yvette, France*
[3]*Safran Tech, 78772 Magny-les-Hameaux, France*

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Operating condition

- Non confined configuration
- Non-swirled air coflow
- Atmospheric conditions : $T = 298 \pm 2K$, $P = 1\ atm$
- Fuel mass flow rate : $\dot{m}_{C_7H_{16}} = 0.28\ g.s^{-1}$
- Air mass flow rate : $\dot{m}_{air} = 6.00\ g.s^{-1}$

Simulation cases

1. Non reactive configuration with spray
2. Reactive configuration with spray

Recommended minimum domain width

Due to the non confinement of the burner, we suggest to simulate a domain of, at least, 300 mm width.

*Email: benoit.fiorina@centralesupelec.fr
†Email: constantin.nguyen-van@centralesupelec.fr

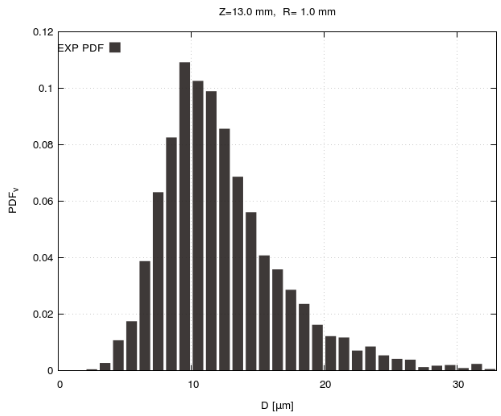
Boundary conditions

Dispersed phase

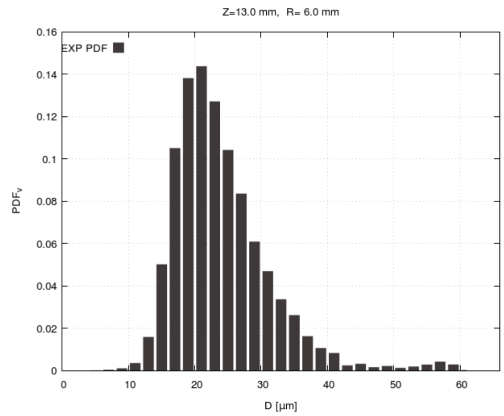
We suggest that each group adjust their own boundary conditions (including atomization modelling, droplet size distribution...) in order to retrieve target experimental profiles from the non reactive configuration.
As radial experimental profiles exhibit slight asymmetries, it is also suggested to target the average of positive and negatives sides.
The identified target quantities are

- Droplet size distribution at $z = 13\ mm$ based on droplet's volume (Figure 1) for:
  - $r = 1\ mm$ [1]. Figure 1 (a)
  - $r = 6\ mm$. Figure 1 (b)
  - $r = 10\ mm$. Figure 1 (c)
- Mean droplet diameter in terms of r (Figure 2 (a)) : $d_{10\ (r,z=13mm)}$
- Mean axial spray velocity in terms of r (Figure 2 (b)) : $u^{MEAN}_{p,axial\ (r,z=13mm)}$

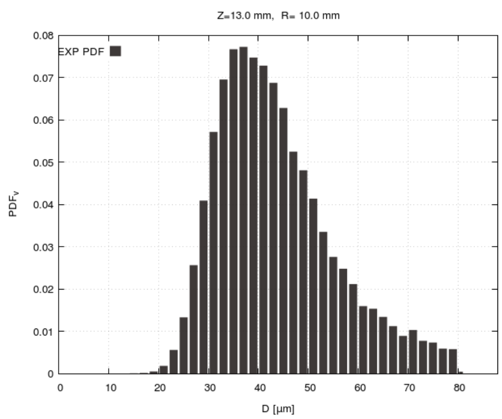
[1]Where r denotes the radius.



(a)

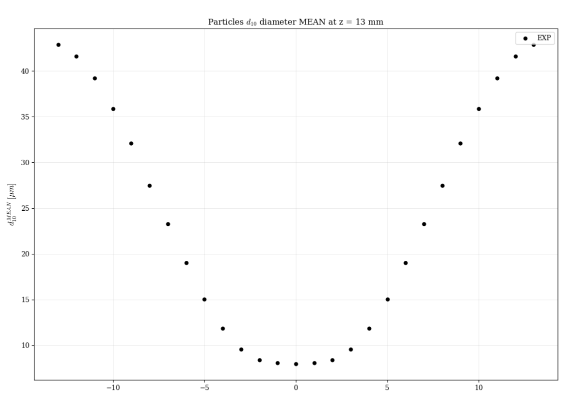


(b)

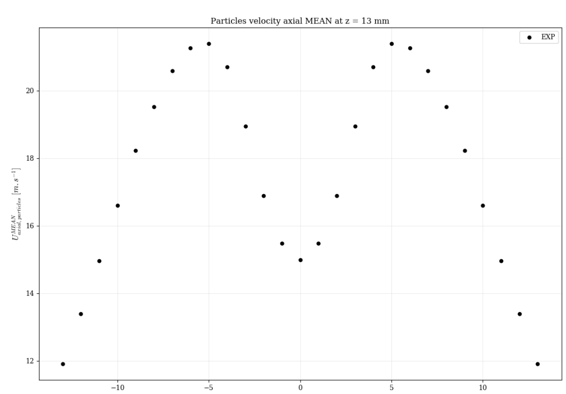


(c)

Figure 1: Droplet size distribution at $z = 13\ mm$ based on droplet's volume at a) $r = 1\ mm$, b) $r = 6\ mm$ and c) $r = 10\ mm$



(a)

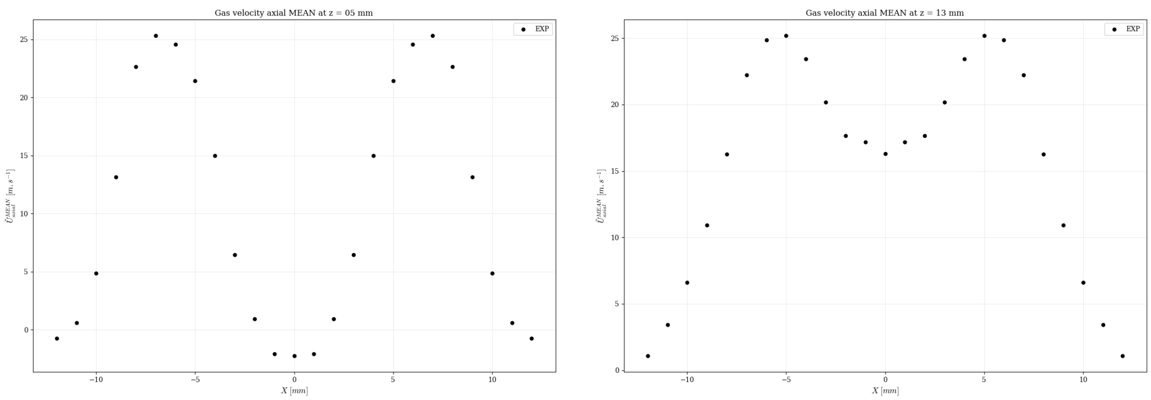


(b)

Figure 2: a) Radial profile of mean droplet diameter at $z = 13mm$: $d_{10\ (r,z=13mm)}$. b) Radial profile of droplets mean axial velocity at $z = 13mm$: $u^{MEAN}_{p,axial\ (r,z=13mm)}$. The average between positive and negative sides is here considered. Averaged experimental data are symmetrised.

Gas phase

For the dispersed phase, we also propose you to adjust the air inlet boundary conditions in order to fit mean axial gas velocity measured at $z = 5\ mm$ and $z = 13\ mm$ (Figure 3) : $u^{MEAN}_{g,axial\ (r,z=5mm)}$ and $u^{MEAN}_{g,axial\ (r,z=13mm)}$.



(a) (b)

Figure 3: Radial profile of gas mean axial velocity at a) $z = 5mm$ and b) $z = 13mm$: $u^{MEAN}_{g,axial\ (r,z=5mm)}$ and $u^{MEAN}_{g,axial\ (r,z=13mm)}$..

Please note that those profiles come from the non reactive configuration and that average were done between positive and negatives radial positions.

Data to post-process

The data that will be collected and compared to experimental one is described below.
All of them are radial profiles at $z = 10mm$, $z = 20mm$ and $z = 40\ mm$ for non reactive and reactive configurations.

Dispersed phase

For Lagrangian approaches, a minimum number of 500 particles is recommended for statistics.

- $MEAN$ droplet diameter : d_{10}
- $MEAN$ / RMS $AXIAL$ velocity : $u^{MEAN}_{p,axial}$, $u^{RMS}_{p,axial}$
- $MEAN$ / RMS $RADIAL$ velocity : $u^{MEAN}_{p,radial}$, $u^{RMS}_{g,radial}$
- $MEAN$ / RMS $AXIAL$ velocity size conditioned by mean droplet diameter d_{10}
  - for $d_{10} \in [10mm, 20mm]$: $u^{10-20,MEAN}_{p,axial}$, $u^{10-20,RMS}_{p,axial}$
  - for $d_{10} \in [40mm, 50mm]$: $u^{40-50,MEAN}_{p,axial}$, $u^{40-50,RMS}_{p,axial}$

Gas phase

- $MEAN$ / RMS $AXIAL$ velocity : $u_{g,axial}^{MEAN}$, $u_{g,axial}^{RMS}$
- $MEAN$ / RMS $RADIAL$ velocity :$u_{g,radial}^{MEAN}$, $u_{g,radial}^{RMS}$
- $INSTANTENEOUS$ / $MEAN$ $2D$ center plane of
  - OH mass fraction or/and heat release rate HR
  - NO concentration (in ppm)

Deadline for submission

5th June 2019

Resources

- To access experimental database or get further details about operating conditions, please contact directly B.Renou (bruno.renou@insa-rouen.fr)
- We will contact you later to inform you about the necessary file format to provide. Please be aware that any other formats will lead to considerable delays. When submitting your data, please also provide a figure of the data plotted by yourself for reference.
- Please add B.Renou (bruno.renou@insa-rouen.fr) and B.Fiorina (benoit.fiorina@centralesupelec.fr) in copy of your e-mails.