Fifth Workshop on the Turbulent Calculations of Sprays, TCS5

7 June, 2015 - Rhodes Greece

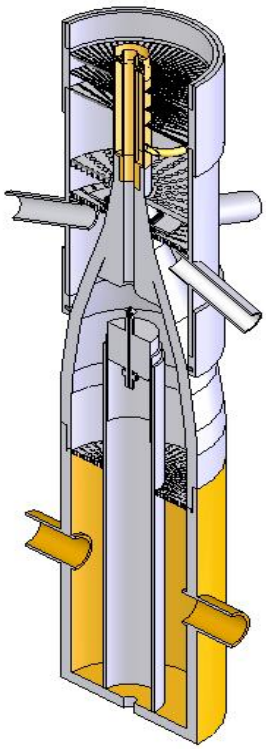
Goals related to the Sydney Piloted Spray Burner

Objective and plan for TCS5

The objective for TCS5 (related to the Sydney Piloted Spray Burner which is shown here) is to explore and understand the variability in the calculations with changes in the boundary conditions or in the models used. More specifically, answers are sought to the following questions:

1. What are the effects of the spatial distribution of droplets at the exit of the pipe on the downstream structure of the spray jet and/or flame?
2. What are the effects of the droplet size and velocity distributions at the exit of the pipe?
3. What role does evaporation in the pipe play in the organization of the reaction zones near the inlet?
4. Do non-equilibrium models change droplet size behavior? If so, what is the specific reason for this change?
5. Do combustion models affect flame behavior?

Groups interested in contributing to these studies are advised to contact Professors Assaad Masri and/or Venkat Raman



A detailed set of instructions will be generated soon as a guide for coordinating the calculations and for submitting the results.

Cases that are likely to be used for TCS5 are:
KS6, SP6, EtF6 and EtF7 (see below)

Some Background Information:

At the last workshop, (TCS4 in Cesme, Turkey 2013), the main burner used for comparison of calculation was the Sydney Piloted Spray Burner which is shown here. Some extensive comparisons were presented for the following sequence of cases:

1. KS6 as non-reacting, non-evaporating
2. SP2, SP6 and SP7 as non-reacting, evaporating and
3. EtF2, EtF6 and EtF7 as reacting with ethanol as fuel.
4. AcF2, AcF6 and AcF7 as reacting with acetone as fuel.

A total of seven contributions were submitted for comparison as shown in this Table.

Contributors	Institution	Data Label	KS6	SP6	EtF2	EtF6	EtF7
Chrigui, et al.	Univ. of Darmstadt	UDRM		✔		✔	
Prasad, et al.	Univ. of Sydney	USYD			✔		
Heye and Raman	Univ. of Texas at Austin	UT-A		✔	✔	✔	
El-Asrag, et al.	ANSYS, Inc.	ANSYS			✔	✔	✔
Rittler, et al.	Univ. of Duisburg-Essen	UDSBG	✔	✔		✔	
De and Kim	Michigan Techn. Univ.	MTU			✔	✔	✔
Amani	Amirkabir Univ. of Techn.	AMUT	✔	✔			

Here is a brief summary of the key findings:

1. In general, EtF2 and EtF6 were popular for reacting flow cases. Having a corresponding non-evaporating case (KS6) and non-reacting case (SP6) were useful. This mix should be maintained for TCS5. Case EtF7 could be useful and the Groups at Michigan and Heidelberg (and possibly others) can compute it. It will be interesting to see how many other groups can provide inputs.
2. Simulations from Duisburg for KS6 showed that LES boundary conditions do not impact droplet spread in non-reacting cases. The question is what changes in a reacting case? The models have no sense of the reactions, only the flow field responds to temperature/density changes.
3. Good results for SP6 only were obtained by Amani et al. (from Amirkabir) with RANS. LES results were poor. It would be good to revisit this case.
4. Results for EtF6 results were all over the place – some good results but sufficient variability even within the LES approach. Temperature results were off for all flames regardless of the models used.

A full presentation showing the comparisons and presenting the conclusions may be made available on request.