

Fire and Combustion Research Centre

FCRC-JU

Vision – journey ahead

Where are we?

Combining research and commercial roles?

Open areas are more in Fire than in Combustion research? What are they?

Intended Ingredients on foundation and invitation to participate

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Where are we?

- The work on fire research got started after the MoU was signed with UL in 2009. I was one of the early inductees by Prof. R N Iyengar and the Chairman.
- Research on roof treatment of EPS roof system was begun and culminated in a Ph. D in 2015 for Dr. Sowrirajan, V.
- The commercial activity with UL on fire tests in outdoor test facility beginning in 2012 has completed more than 120 tests with half-a-dozen staff with Prof. Bhaskar Dixit for various clients, done carefully and diligently.
- This activity provided the arena for active thinking of the processes in foam and other fire extinguishing systems.
- Foam fundamentals were examined from earlier work and definitive progress on simplifying the approach to understand static drainage has been made.
- Deeper insight needs to be gained, but this has to wait for more important research needs to be dealt with.

Combining research and commercial roles - 1?

- The activities with UL are largely commercial in nature based on UL standards. One activity that will continue unhindered is the UL expected testing. The extent of these tests may increase up to 300 tests per year. Therefore, the questions will be:
- What may be the role of research in relation to UL? If research is contemplated will it be outside of UL related questions? Will research be relevant to others - industries or agencies?
- We uncovered that there UL standards specify the pan geometry in great detail, but do not specify all the operational parameters - the pool temperature. The pool temperature is stated to be a minimum of 15 C. There is no upper limit. Commonsense is supposed to be used to set it to local ambient temperature. It is clear that it affects significantly the results of the full test protocol.
- From the point of view of understanding the phenomenon, it is considered important to settle the influence of this parameter (+ a few others).

Examples of research on large fires - JU



1725 s

4 m x 4 m diesel pool fire, 1800s +
with test article for **BARC**



2.1 m x 2.1 m n-heptane, 90 s +
pool fire, with **UL**

Combining research and commercial roles - 2?

- Crib or panel fire tests specify the wood material as spruce or fir and not technical details - like its density and other features that are known to affect their combustion - not so widely though.
- In fact studies conducted at this laboratory has shown significant dependence on the density of the wood chosen to make the cribs.
- Density affects the ignition and the burn rate both of which are important in the test protocol.
- The crucial point is that the density of wood in the inner growth layers is smaller than in the outer layers that have undergone growth for longer time.
- Hence it is important to explore the possibility of better definitions in the standard.
- It is to be understood that these are scientific studies at this stage.

Open questions are more in Fire than in classical combustion research?

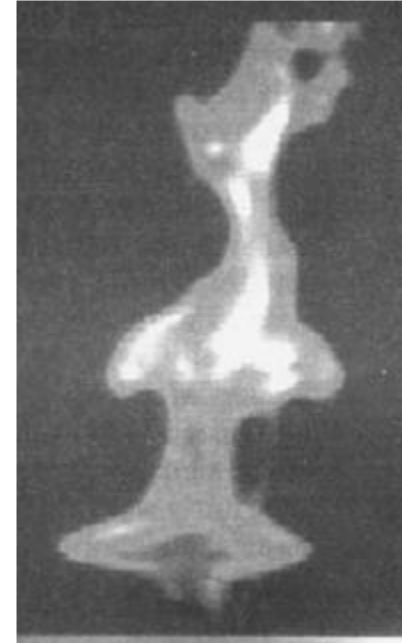
- Combustion is a desired phenomenon. It gets aided by supply of oxidant - air in the current context. By managing this, one can get results - some better than others.
- Because it is what is desired, far more intense work has gone on for over sixty years. Most important questions are largely answered. True challenges in combustion research need to be sought more intensively.
- The order of intensity of exploration of fuels - **gaseous, the most, liquids next** and **solids least**.
- Fire has been explored as well quite seriously. Largely, fires are unintended and unwanted events and occur in somewhat random ways - both liquids and solids are large partners as the fuels here. They allow for greater opportunities for determining the issues and finding resolutions.
- Looking for unresolved problems is not that difficult.....

What are these questions possibly - 1?

- The burn rate prediction in a pan fire from first principles is still not done!.....why?
- The true complexity lies in the coupling between buoyancy driven air currents around the pan, the radiation and soot in a 3-d environment transferring heat to the liquid surface. The other parameters that influence the burn rate are: the pan material, the free board and lip geometry.
- Simplified treatments have been tried but have received little attention from the fire community because they are simplistic.
- The gaps do not allow reliable predictions and hence, attention needs to be given to this outstanding problem.
- Both inventive experiments and modeling (not simply FDS calculations) need to be explored.

What are these questions possibly - 2?

- NIST based FDS does not predict the familiar pulsing frequency - "...results have shown the limitation of the code in predicting the puffing frequency, this is thought to be due to some approximation in FDS which is to be there in order to obtain the high efficiency of FFT-based fast solver for the Poisson equation.." Wen et al, Fire safety Journal, 2007, p 127
- A 2.1 m x 2.1 m pan with about 200 liters of n-heptane is used for qualification tests. The question is: Can a lower scale test be made reliable.....comparable to the standard test?
- Exploration will enhance understanding and has possible lateral benefits of lowering costs of qualification.



Normally observed
in all pool fires.

Frequency for a
2 m pool fire -
~1 Hz – once per sec

What are these questions possibly - 3?

- Wood panel and crib fire dependences on the nature of wood should be explored experimentally.
- The exploration on the nature of wood may contribute to using lower cost woods locally available for testing. It will certainly help define the fundamental properties of wood to be met with in a "standard" without worrying about the specific species.
- Questions like what is the minimum extinguishing agent and what would be the optimal application strategy await exploration.
- These hopefully impact the improvement of business too.

It may be that the path of uncharted exploration is outside the warmth of standard testing, but surely more exciting and **rewarding for all concerned.**

Intended steps for improving the foundation

- Research collaboration with other organizations IISc and IITs - faculty and students
- With IISc, civil engineering department - on Structural safety in buildings
- With IITM, Mechanical engineering department - on burn rate predictive modeling, soot - radiation relationship being the target.
- Invitations to faculty to spend a few days at this laboratory will be sent out. Those who wish to use the present laboratory as a sabbatical venue for new research will be welcome.
- Short term courses on fire and combustion - target audience - working engineers in consulting organizations (along the lines already conducted) and for research students of IISc/IITs/other interested institutions
- Holding specialist workshops with scientists within the country and from outside - in cooperation with UL are intended.
- On the awareness side, holding one-day open house for students of JU and others to bring home ideas of fire safety in domestic and industrial spaces is considered.
-*Thanking you all ... With Invitation to participate*