STUDY OF SOOT FROM JET FUEL AND MODEL COMPOUNDS IN A DROP TUBE FURNACE

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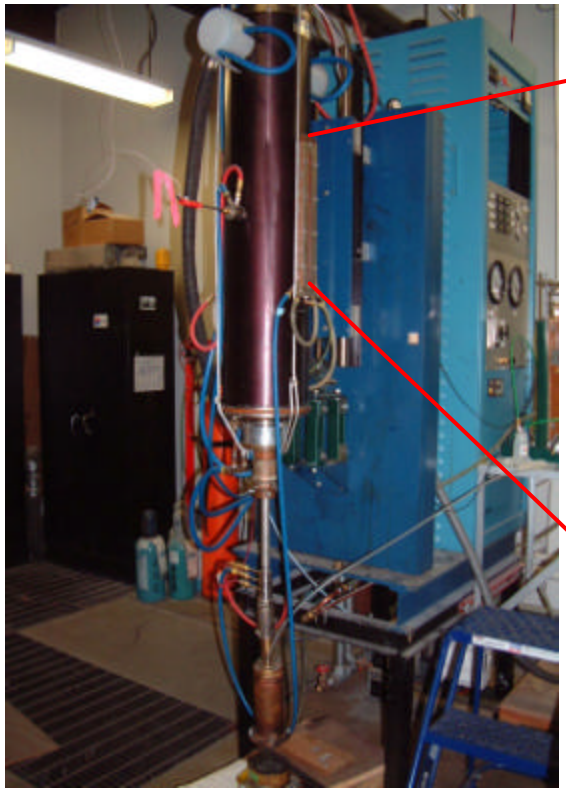
BACKGROUND

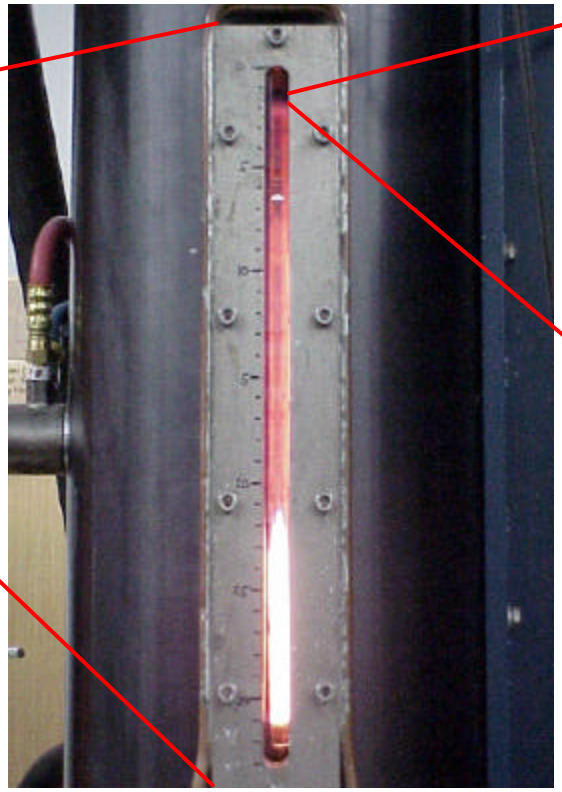
- Ongoing pool fire experiments measure bulk properties—soot deposition rate, radiant flux, etc.—and transient behavior such as local temperature.
- Simulation: models developed to describe and predict pool fires behavior.
- Analysis of soot formed under controlled conditions in laminar diffusion flames allows the isolation of fundamental details which may be lost in more complex experiments.

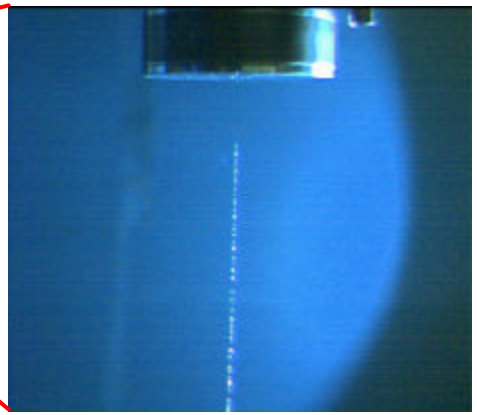
OBJECTIVES

- Develop capability for creating soot samples from various liquid fuels in a controlled environment to be used for detailed NMR study to identify soot structures.
- Compare soot structures from jet fuel with those of surrogate to provide validation of surrogate formulation.
- Validate / improve soot formation model

DROP TUBE FURNACE







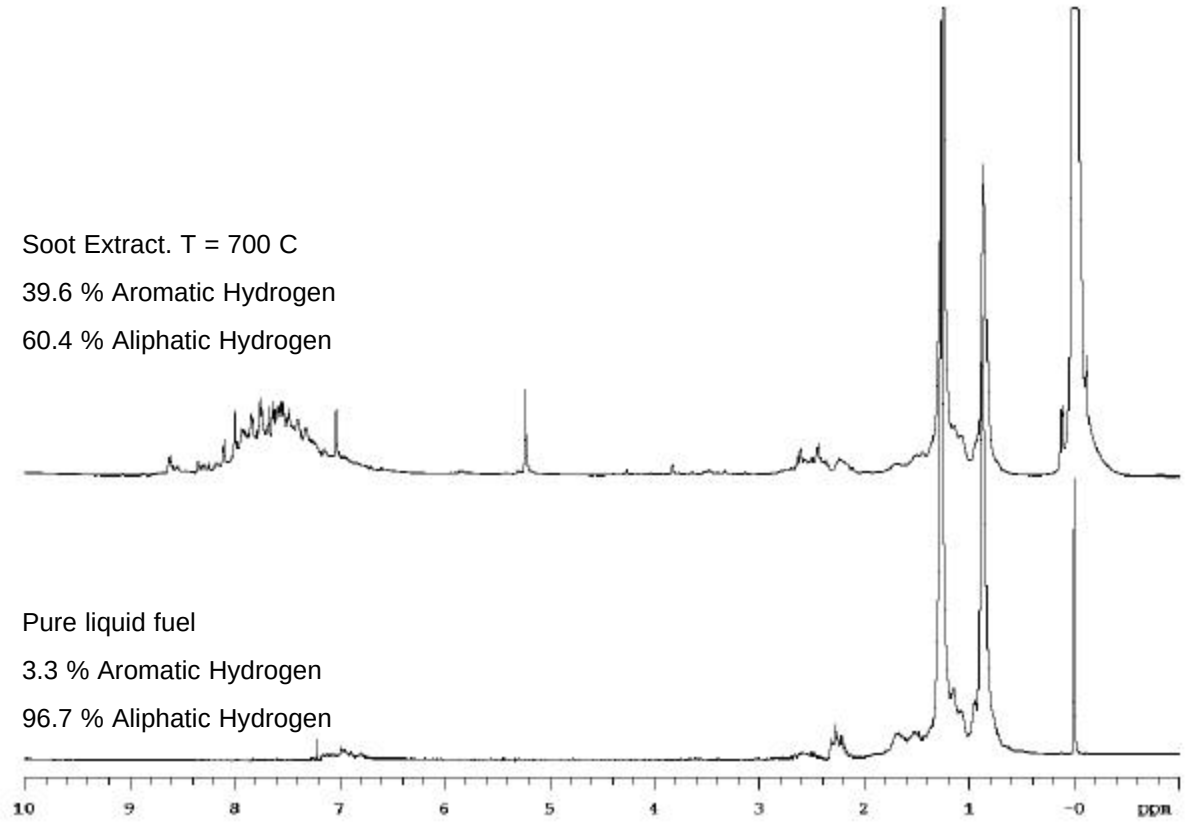
A monodisperse droplet stream is injected into a hot, co-flow air stream, producing a laminar diffusion flame.

At the reactor exit, the flame is quenched and the **SOOT** is collected for further analysis.

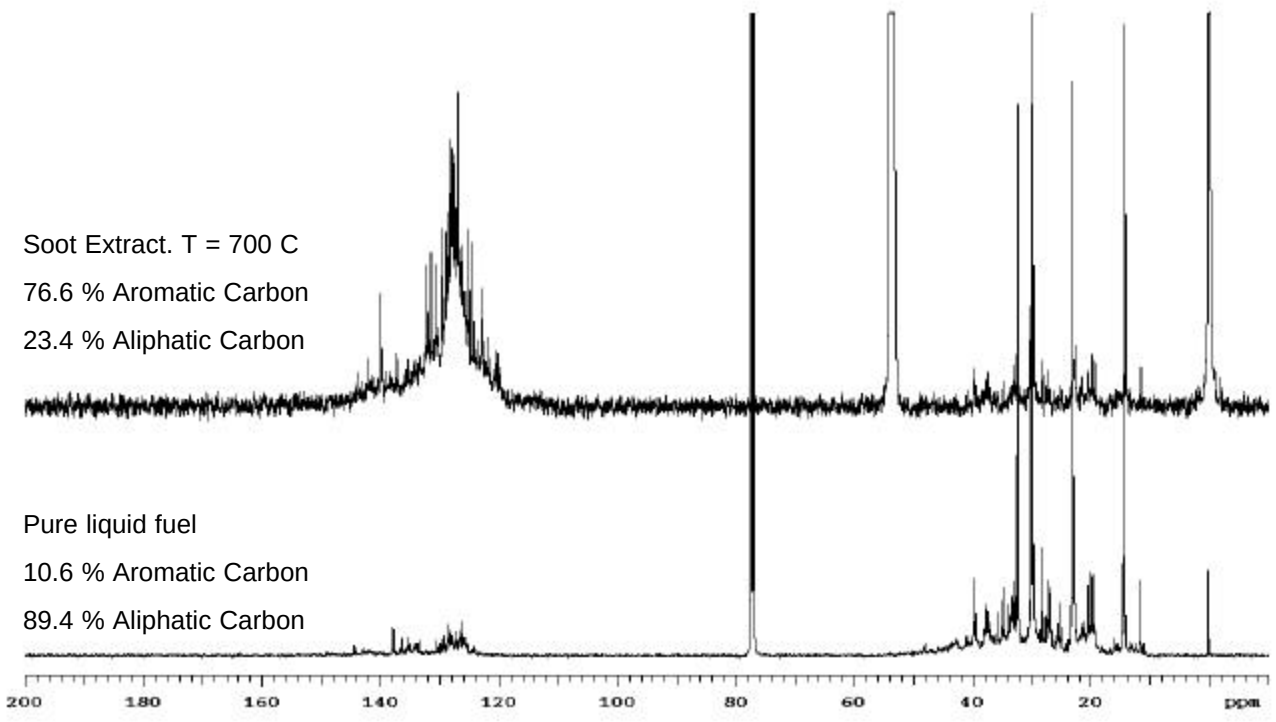
NMR SPECTROSCOPY

- Reveals elements of molecular structure, *e.g.*, aromatic, aliphatic, etc.
- Insoluble and soluble soot fractions analyzed separately
- Are soots from JP-8 and surrogates structurally similar?
- Are soot structures like those assumed / predicted by our soot formation model?
- How do individual surrogate components contribute to overall soot formation picture?

^{1}H NMR SPECTRA OF SOOT EXTRACT VS SPECTRA OF PURE LIQUID FUEL (JET- A)



^{13}C NMR SPECTRA OF SOOT EXTRACT VS SPECTRA OF PURE LIQUID FUEL (JET- A)



Most of the aliphatic carbon becomes aromatic carbon when the Jet Fuel is burned at 700 C.

FUTURE WORK

- NMR characterization of soot from JP-8, surrogate fuels, and surrogate components
- GC-MS analysis of soot extract from JP-8 and surrogate fuels: a complimentary tool
  - Aspects of fundamental chemistry can be identified!
- In-situ optical diagnostics applied to diffusion flame: yet another way to characterize soot formation and growth