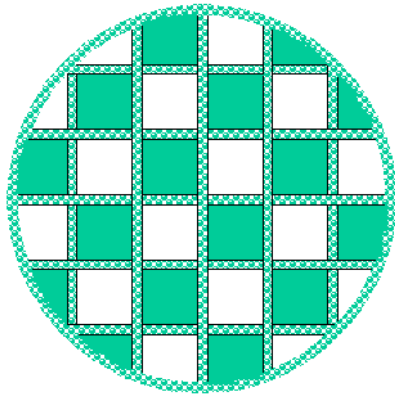


Third DOE Crosscut Workshop on Lean Emissions Reduction Simulation – DPF Control Needs

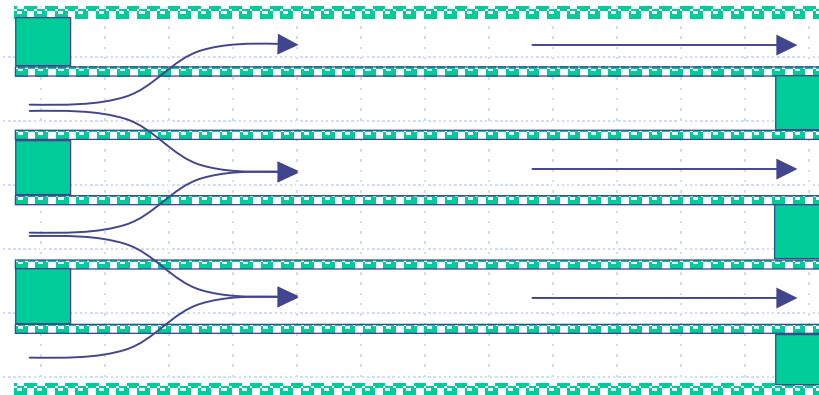
Paul M. Laing
Chemical Engineering Department



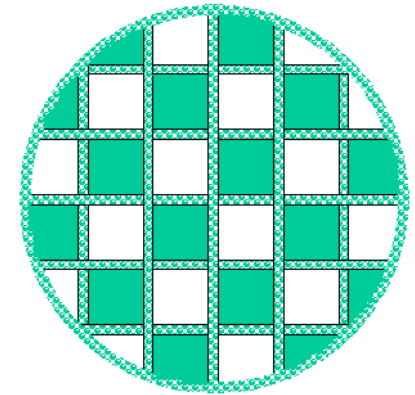
Typical Diesel Particulate Filter



Front Face
(showing alternate
plugged cells)



Side View
(showing gas flow
through the device)



Rear Face
(showing alternate
plugged cells)

Soot is collected or trapped on the walls of the inlet channels and must be periodically burned to clean or "regenerate" the filter.

DPF Models Are Needed to:

- ◆ Assess system performance:
 - Filtration efficiency
 - Backpressure as a function of soot loading
 - Thermal behavior (light-off & regeneration)
 - NVH
- ◆ Optimize design:
 - Component specifications (size, geometry, material, etc.)
 - Location
 - Adequate flow distribution
- ◆ Determine regeneration requirements and fuel economy impact

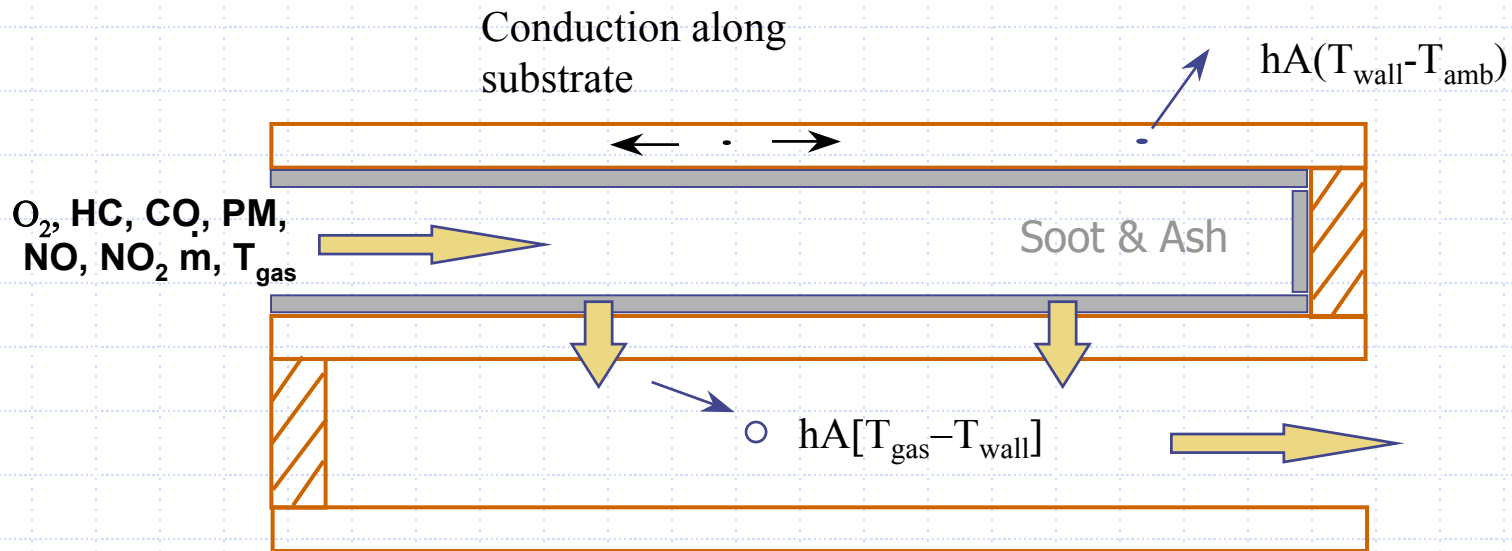
These models must also be simple to use, computationally fast, while providing reasonable accuracy.

Timeliness is **CRITICAL** – we must have these models within the next 2-3 years to be worthwhile.

Regeneration Strategies & Modeling Applications

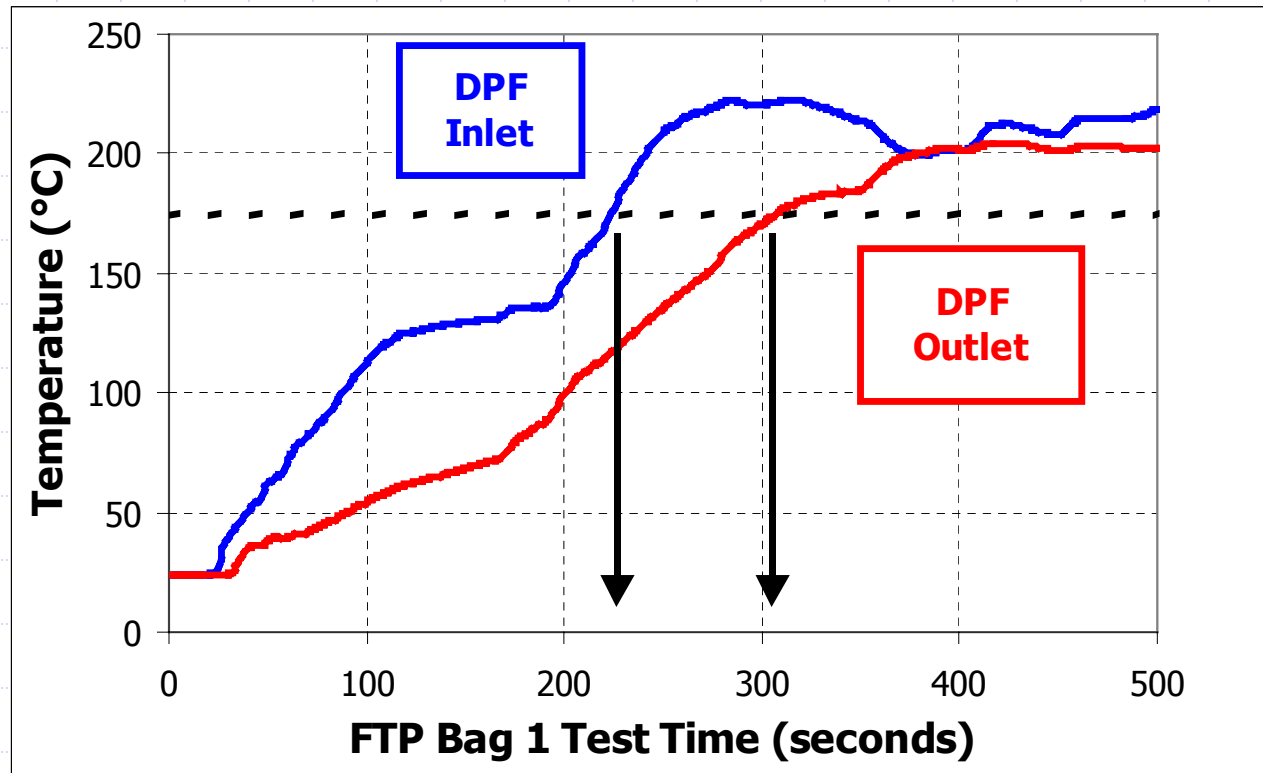
- ◆ Catalyst washcoat - impact of PM loading
- ◆ Fuel borne catalyst - impact of dosing level
- ◆ Sensible heat - what temperature is needed?
- ◆ NO₂ soot oxidation – is there enough?
- ◆ Exothermic heat – how much fuel?
- ◆ Electric – power requirements
- ◆ Microwave – impact on filter specifications
- ◆ Non-thermal plasma – synergy with NOx removal?

"1-D" Diesel Particulate Filter Model



Provides a means to calculate thermal behavior and effect on exhaust backpressure.

Aftertreatment System Configuration



When will catalyst downstream of the DPF light-off?

Areas to Consider for Further Development

- ◆ DPF soot distribution and impact on maximum temperatures reached during regeneration
- ◆ Effect of sulfur
- ◆ Effect of fuel additives (e.g. ceria)
- ◆ Particle size distribution
- ◆ Ash accumulation
- ◆ Gaseous emissions (especially during regeneration)
- ◆ Deterioration
- ◆ Structural integrity, canning and mounting