MOPAR: Results for the Inter-code Calibration

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MOPAR Overview

- **Modeling of Pyrolysis and Ablation Response**
- Uses the same formulation as a code developed at Sandia National Laboratory and North Carolina State University (Amar, Blackwell, and Edwards)
- Includes pyrolysis gas phase equation
- Includes moving boundaries using Landau coordinates
- Includes spherical and cylindrical coordinates
- Allows ablation of both sides of the domain
- Takes into account the kinetic energy of the pyrolysis gas
- Models the flow through porous media using Forchheimer’s Law
Mixture Energy Equation

\[ \int \dot{q}'' \cdot dS + \int \phi \rho_g h_g v_g \cdot dS - \int \rho h v_{cs} \cdot dS + \frac{d}{dt} \int \rho e dV = 0 \]

- conduction
- gas flux
- grid convection
- energy content

Solid Phase Continuity Equation

\[ \frac{d}{dt} \int \rho_s dV - \int \rho_s v_{cs} \cdot dS = \int \dot{m}_s''' dV \]

- solid mass content
- grid convection
- solid mass source

Gas Phase Continuity Equation

\[ \frac{d}{dt} \int \phi \rho_g dV + \int \phi \rho_g v_g \cdot dS - \int \phi \rho_g v_{cs} \cdot dS = \int \dot{m}_g''' dV \]

- gas mass content
- gas flux
- grid convection
- gas mass source

Forchheimer’s law

\[ \frac{\partial p}{\partial x} = -\frac{\mu}{K} v_g' - \beta \rho v_g'^2 \]
Test Case 2.1

Graphs showing temperature and mass flux over time for different scenarios.
Test Case 2.2

Graphs showing temperature and mass flux over time for different materials.
Comments

- Needed to set recession rate to 0.0 after 60s for case 2.3 to prevent negative recession during cool down
- Other cases ran robustly without specifying recession rate