Prediction of TACOT Decomposition
Using the Chaleur Code

5th Ablation Workshop
February 28, 2012

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Chaleur

• 1-D control volume finite element discretization on contracting grid
• Full Newton iteration scheme
• 2\textsuperscript{nd} order spatial discretization
• 1\textsuperscript{st} and 2\textsuperscript{nd} order time integrator
• Updated thermal properties within iteration loop
• Segregated solution of energy (T) and gas phase continuity ($\rho_g$) on same grid
• Semi-analytical integration of decomposition kinetics
TACOT Case 1 – Temperature History
TACOT Case 1 – Blowing Rate, Pyrolysis Zones, Recession
TACOT Case 2 – Temperature History

![Graph showing temperature history with various thermocouple data points and time axis.](image)
TACOT Case 2 – Blowing Rate, Pyrolysis Zones, Recession

Test Case 2.2
Blowing Rates, Pyrolysis Zone, Recession

Solid Lines = PATO
Squares = Chaleur

Mass Flux [kg/m²/s]

Depth [m]

Time [s]
TACOT Case 3 – Temperature History

Test Case 2.3
Thermocouple Data

Solid Lines = PATO
Squares = Chaleur

T [K] vs. Time [s]
TACOT Case 3 – Blowing Rate, Pyrolysis Zones, Recession

![Graph showing mass flux and depth against time for different materials and scenarios.](Image)
EST

- Element potential based equilibrium surface thermochemistry solver
- Currently being developed for solving ablation thermochemistry problems
- Can be used in two modes
  - Stand-alone to generate B’ tables
  - Coupled with Chaleur to generate B’ on-the-fly
$B'_c$ for TACOT in Air – Mutation vs. EST

Considering 25 species reduced set
TACOT Case 4 – Temperature History
TACOT Case 4 – Blowing Rate, Pyrolysis Zones, Recession

![Graph showing Mass Flux vs. Time for different cases.](image-url)
TACOT Case 4 – Temperature History

![Temperature History Graph]

Test Case 2.3
Thermocouple Data

- TC₁ (0 mm)
- TC₂ (1 mm)
- TC₃ (2 mm)
- TC₄ (4 mm)
- TC₅ (8 mm)
- TC₆ (12 mm)
- TC₇ (16 mm)
- TC₈ (24 mm)
- TC₉ (50 mm)

Solid = Chaleur+EST/CEA (tabular)
Sqrş = Chaleur+EST/CEA (on-the-fly)
TACOT Case 4 – Blowing Rate, Pyrolysis Zones, Recession

Test Case 2.3
Blowing Rates, Pyrolysis Zone, Recession

- \( m_{dot, g} \)
- \( m_{dot, c} \)
- virgin 98
- char 2
- wall recession

Solid = Chaleur+EST/CEA (tabular)
SqrS = Chaleur+EST/CEA (on-the-fly)
TACOT Case 4 – Temperature History
TACOT Case 4 – Wall Data History
TACOT Case 4 – Blowing Rate, Pyrolysis Zones, Recession
Questions?