THERMOCHEMICAL MODELING

505-08-25

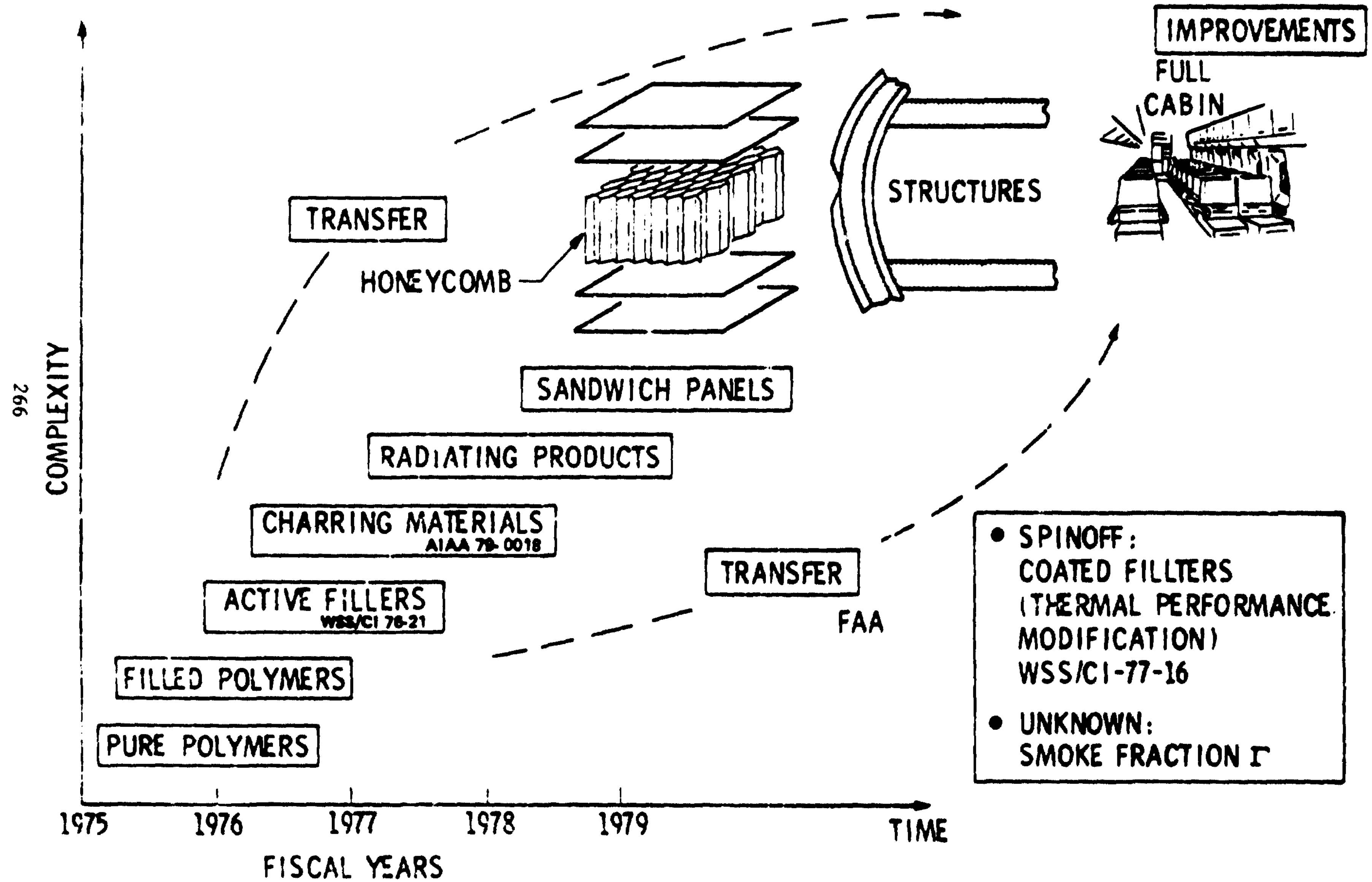
KUMAR RAMOHALLI

MARCH 1, 1979

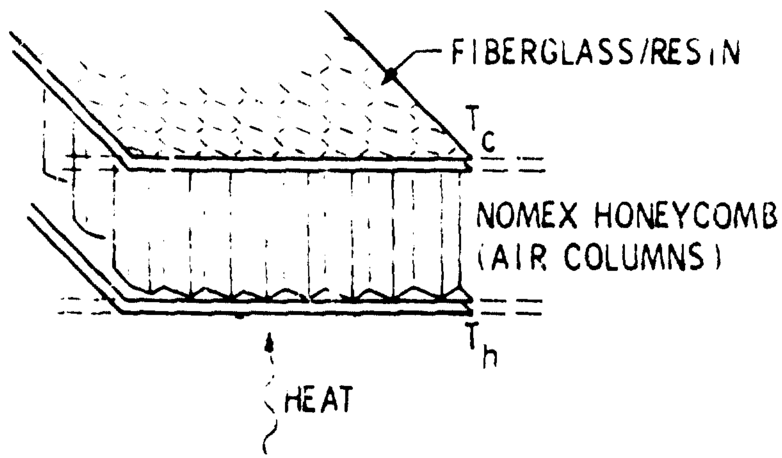
- AIMS
    - PREDICT FIRE AND SMOKE BEHAVIOR USING ONLY
        - INGREDIENT THERMOCHEMICAL PROPERTIES
        - GEOMETRY AND FLOW

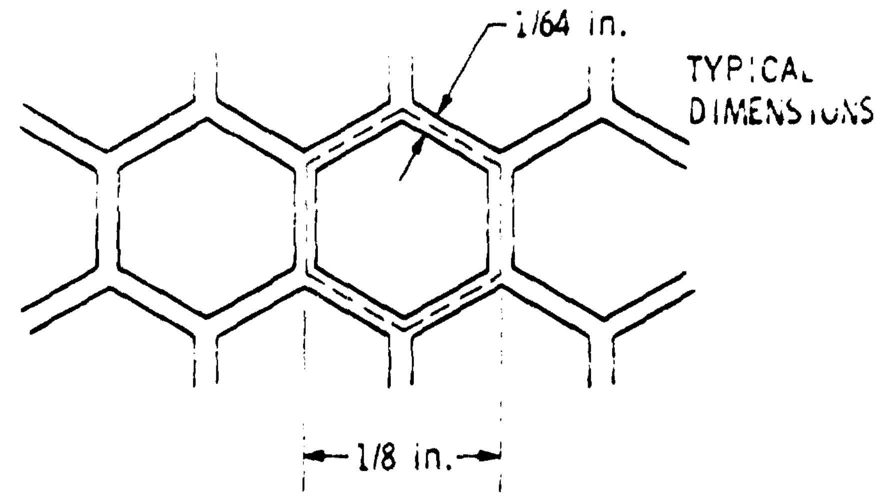
      } NON-EMPERICAL
    - SUGGEST ECONOMICAL METHODS FOR BETTER MATERIALS
    - TRANSFER TO INDUSTRY
- PROGRESSIVE STEPS IN COMPLEXITY

PLAN OF PROGRAM



HONEYCOMB SANDWICHES





- CONDUCTION:

$$\left.\begin{array}{lll} \text{SOLID NOMEX:} & k_{nomex} \times A_{nomex} & \cong 0.092 \times 0.0024 = 2.2 \times 10^{-4} \\ \text{AIR COLUMNS:} & k_{air} \times A_{air} & \cong 0.020 \times 0.01 = 2.0 \times 10^{-4} \end{array}\right\} \text{RATIO} \sim 1$$

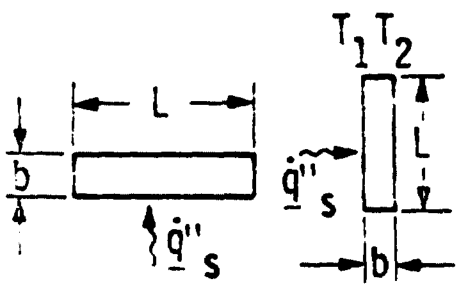
  - SIMPLIFICATIONS NOT FEASIBLE

- CONVECTION

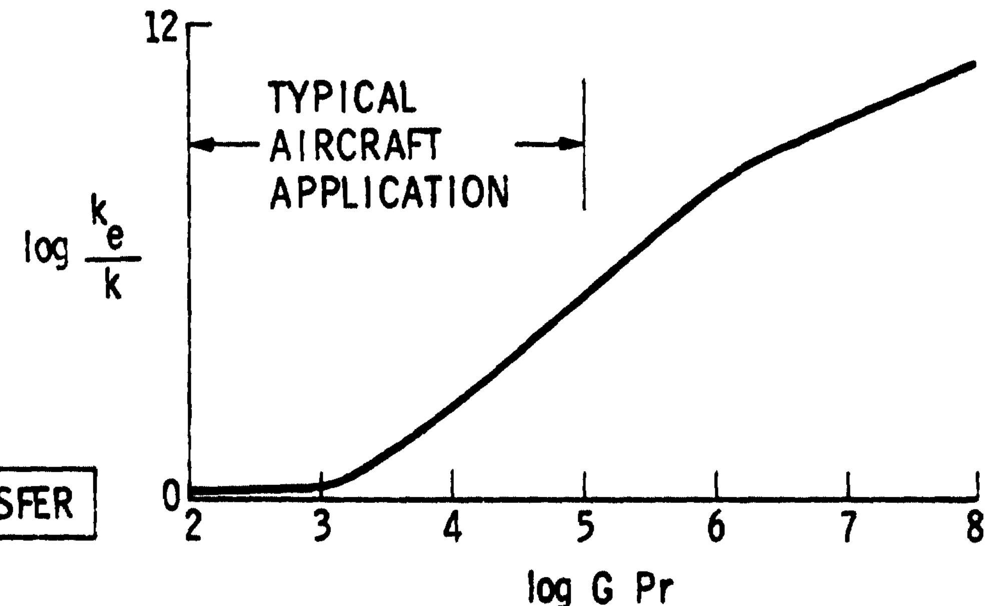
$$\underset{\text{Rayleigh Number}}{R} = \underset{\text{Grashof Number}}{G} \cdot \underset{\text{Prandtl Number}}{P_r} = \frac{g\beta\theta_w X^3}{\nu^2} \cdot \frac{\mu c_p}{k} \left\{ \begin{array}{l} < 1700 \text{ NO CONVECTION} \\ 1700\text{-}47000 \text{ CELLULAR} \\ > 47000 \text{ TURBULENCE} \end{array} \right.$$

APPROACH

- AVAILABLE SOLUTIONS AND EXPERIMENTS



$$\underline{q} = \frac{k_e}{b}(T_1 - T_2)$$



SIGNIFICANT INCREASE IN HEAT TRANSFER

- SOLUTION FOR SPECIFIC CASE NOT AVAILABLE
- CHEMICAL DEGRADATION
- DEBONDING
- GAS EVOLUTION AND FLOW

SUMMARY
(Feb 1979)

- COMPLEX CHARRING CASE SOLVED
- CONFIRMED BY EXPERIMENTS

AIAA PAPER 79-0018

- PROBLEMS IDENTIFIED IN SANDWICH PANELS
- FORMULATION COMPLETED

- SPINOFFS
  - APPLICATIONS IN GRAPHITE FIBER COMPOSITES
  - THERMAL PERFORMANCE CONTROL (COATED FILLERS AND PROPELLANTS)