

# FPST 1373 Fire Behavior Outline

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- I. Behavior
  - a. Fire tetrahedron
    - i. Must have all parts in sufficient quantities for fire to occur
      - 1. Heat
      - 2. Fuel
      - 3. Oxygen
      - 4. Chemical chain reaction
  - b. Gas phase reaction
    - i. Pyrolysis: Solid fuel to gas
    - ii. Vaporization: Liquid fuel to gas
  - c. Types of fires
    - i. Flaming
      - 1. More energy released per unit time
      - 2. More complete combustion
      - 3. Fire can transition to and from smoldering
    - ii. Smoldering
- II. Products of combustion
  - a. Complete combustion
    - i. CO<sub>2</sub>
    - ii. H<sub>2</sub>O
  - b. Incomplete combustion
    - i. Reaction interrupted
    - ii. Other gases containing C, H, and O
- III. Hazards
  - a. Most fatalities from gases remote from fire, not direct exposure to flames
  - b. Smoke
    - i. CO leads to most fatalities
    - ii. Other gases (like HCN) can be more toxic, but much less produced
  - c. Low oxygen
- IV. Fire signatures
  - a. Aerosols
    - i. Smoke
      - 1. Commonly used for detection
      - 2. Primarily entrained air
        - a. Properties and behavior that of heated air
      - 3. Early detection
        - a. Before visible
        - b. Allows for response during incipient phase
      - 4. Normal detection
        - a. Described in detail in detectors lecture
        - b. Light scattering
        - c. Photoelectric
        - d. Ionization
  - b. Energy release
    - i. Heat
      - 1. Commonly used for detection

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- 2. Described in detail in detectors lecture
  - 3. Fixed temperature
    - a. Thermal lag: size of element leading to change in response time of detector
  - 4. Rate of rise
- ii. Light
  - 1. Used regularly where fast detection is needed
  - 2. Described in detail in detectors lecture
  - 3. UV
  - 4. IR
- c. Gases
  - i. Products of complete and incomplete combustion
    - 1. Not typically used independently for fire detection
      - a. Quantity produced varies
      - b. Develop artificial nose to mimic people's ability to detect
  - ii. Others
    - 1. Potential to use to detect fires, but have not been to date
      - a. Sound