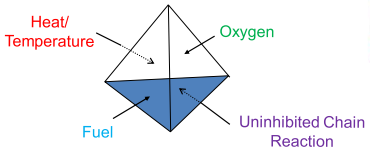
UNIVERSITY OF MARYLAND
Department of Fire Protection Engineering

Fire Suppression Systems

Mechanisms of Fire Suppression

- Haessler's fire tetrahedron:



Suppression Characteristics: Water

- Cooling
  - Vaporization of water:
    - increase temperature of from 20°C to 100 °C: 330 J/g
    - Heat of evaporation: 2260 J/g
    - 2590 J/g total!
- Oxygen dilution
  - Expansion ratio:
    - Liquid: vapor = 1:1600
    - 1 Liter H_2O → 1.6 m^3 steam

Special Hazard Suppression Agents

Agent Type	Primary Extinguishing Mechanism	Major Application
CO_2	Reduces O_2	Flammable liquids, electrical equipment, record and fur storage
Clean agents	Heat removal	Electronic equipment, water-sensitive objects
Dry chemicals	Interrupts chain reaction, heat removal	Flammable liquids and gases
Foam	Physical separation of air from fuel, suppresses fuel vapors	Flammable liquids

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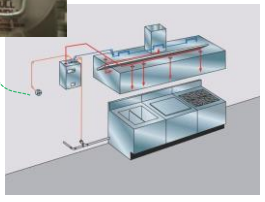
Manual Suppression



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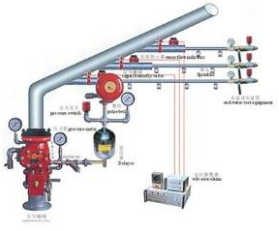
Automatic Suppression



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Suppression System Design

Suitability for hazard/equipment	•Suppression speed/effectiveness •Equipment damage •Agent-fuel interaction
Personnel hazards	•Toxicity of agent •Reduced oxygen •Obscuration
Cost	•Life cycle cost: design, installation, maintenance •Performance: Direct losses, collateral damage
Fixed agent supply	•Agent availability •Recharge availability •Storage requirements
Application methods	•Total flooding •Local application

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Special Hazard System Application Examples

- Water ineffective or hazardous: e.g. fuel oil tank fire (water may sink to bottom and not float above fuel).
- Water reactive fuels: e.g. dry chemical for sodium fire.
- Collateral damage by water: e.g. printing press or computer room.
- More cost-effective than water: e.g. system for small hazard vs. cost of water main or water tank at remote location.
- Weight of water: e.g. aircraft, space shuttle.
- Shipboard operation: e.g. machine room on a submarine, flooded space may affect ship balance and/or flotation.

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Clean Agents

http://www.youtube.com/watch?v=y76c2hQrLEw

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Foam in Aircraft Hangar

http://www.youtube.com/watch?v=4EQa4qz8V30

Summary

- Fire suppression agents act to 'remove' one or more sides of the fire tetrahedron
- Fire suppression agents are selected considering:
  - Effectiveness
  - Toxicity
  - Collateral damage
  - Cost

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