UNIVERSITY OF MARYLAND
Department of Fire Protection Engineering

Products of Fires

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Products of Fires

- Fire is a oxidation-reduction chemical reaction accompanied by light and heat
- Products
  - Energy
  - Chemical species

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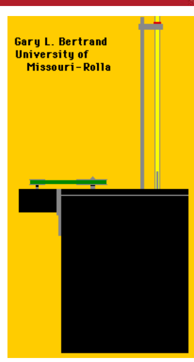
Heat of Combustion

- Total amount of heat (kJ) generated by the complete combustion of 1 g of fuel



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Heat of Combustion

Fuel	Heat Of Combustion
Wood (oak sawdust)	19.7 kJ/g
Wood (pine sawdust)	22.5 kJ/g
Polystyrene	39.2 kJ/g
Polyurethane	27.2 kJ/g
Polyvinylchloride	16.5 kJ/g
Corrugated carton	13.9 kJ/g
Newspaper	18.3 kJ/g

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Heat of Combustion

- Property used in fuel load calculations
  - Total quantity of fuel present

  - Where mixed fuels are present, combine weights of all fuels through equivalent weight of wood concept:
    - Fuel load = mass of wood that has same heat output as that produced by the mass of another material
    - Example: 10 kg of polyurethane = (23.2/16.4)x10 = 14 kg wood

Fuel Load

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Fuel Load

- Hospital room experiment:
  5 m x 3.2 m = 16 m^2, Fuel = 64 kg
  Fuel load = 4.0 kg/m^2
- Basing fire severity *only* on fuel load ignores:
  - Fuel distribution, arrangement
  - Ventilation
  - Compartment construction (insulation)

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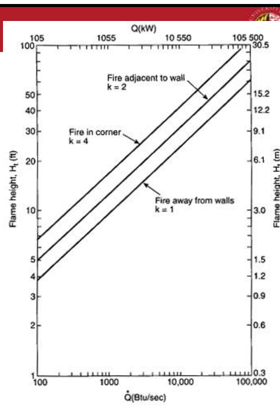
Heat Release Rate

- Amount of heat released per unit time (kW)



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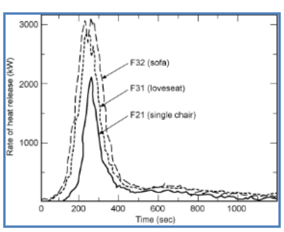
Heat Release Rate



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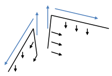
Heat Release Rate

- Ignition scenarios
- Fuel characteristics
  - Type
  - Quantity
  - Orientation
- Enclosure effects
  - Radiation enhancement
  - Oxygen concentration



Chemical Species

- Organic fuels:
  - For all fuels: CO_2, CO, H_2O, C, Hydrocarbons
  - Fuel-specific gases: NO_x, SO_x, HCl, Cl_2, HCN, $COCl_2$…
- Inorganic fuels:
  - metal oxides

Seaside Heights, NJ
Sept 12, 2013

Summary

- Fires generate energy and gaseous combustion products
- Two important characteristics of fuel packages is their heat of combustion and heat release rate