

Course Name: Theory of Fire Propagation (Fire Dynamics)

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Week – 02

Lecture – 03

Module 1 – Basics of Fires

Definitions

Flame spread rate:

Flame spread rate is commonly determined by FPA and a device called the Lateral Ignition and Flame spread Test (LIFT) apparatus, similar to FPA. Quantities such as the location of the pyrolysis front (the length until which pyrolysis has happened on the surface of the solid fuel), flame spread rate, flame height, and heat release rate as a function of time are measured under various conditions. Empirical relations for flame height as a function of pyrolysis front, normalized heat release rate, and fire propagation rate are proposed.

Flame propagation index:

The fire propagation index (FPI) is correlated in terms of heat release rate and Thermal Response Parameter (TRP). A flame propagation apparatus is used to determine the FPI of various materials by conducting concurrent flame spread tests, considering the aspects of flame radiation, to categorize these materials. Based on the value of

FPI, it can be determined whether flame will propagate over the material or not under a given ambient condition.

Heat release rate:

Heat release rate is measured commonly using techniques such as Carbon Dioxide Generation (CDG) calorimetry and Oxygen Calorimetry (OC). In CDG calorimetry, precise measurements of mass burning rate and rates of generation ($\text{kg/m}^2\text{-s}$) of carbon monoxide (CO) and carbon dioxide (CO_2) are made. With these, the heat release rate can be determined.

For several fuels, the net heat of complete combustion per unit mass of CO_2 generated is 13.3 ± 1.5 MJ/kg, and the net heat of complete combustion per unit mass of CO generated is 11.1 ± 2 MJ/kg. In OC, precise measurements of the mass burning rate and mass consumption rate of oxygen are made. The net heat of combustion per unit mass of oxygen consumed is 13.3 ± 0.7 MJ/kg.

Compartment fire test facility:

Fire in a compartment (an enclosed space) is studied using a standard compartmental test facility.

