Course Name: Theory of Fire Propagation (Fire Dynamics)

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Week – 12

Lecture – 02

Module 8 – Introduction to dust ignition, dust explosion and forest fires

Burning velocity from deflagration index:

Deflagration index has also been used to estimate the laminar burning velocity for a given dust concentration and particle size:

$$S_L = \frac{K_{st}}{4.84 \left(\frac{p_{max}}{p_0} - 1 \right) p_{max}}$$

Here, 4.84 is an empirical constant, p_0 and p_{max} are initial and maximum pressures, respectively. In turbulent regime, burning velocity, S_T is calculated as a function of laminar burning velocity, S_L, turbulent intensity, u'_{rms} and integral turbulent length scale, ℓ_0. However, such correlations for turbulent dust-air flames are not available. More research work is required in this field. Effect of dust concentration on turbulent burning velocity has been recently studied by Rockwell (2013) and Ranganathan (2018).

Forest (wildland) fires and causes:

Huge unwarranted fire occurring in a forest or wildland area is termed as forest fire.Fire is a natural feature in forest ecosystem. Several changes have occurred to the earth due to forest fires. Severe damage is caused to forest assets (**vegetation**), **animals**, **environment** and so on. Forest fire causes several changes in the features of earth and water systems, soil properties, vegetation accumulation, genetic features of plants and its regeneration, wildlife and insect habitation, and so on (Barnes et al., 1998). Forest fire is **caused naturally** or it can be **man-made**. Lightning is main natural cause for several forest fires. Other natural causes include, rubbing of dry slender trunks such as bamboos, rolling of rocks causing hot spots and sparks and so on.

Forest fires –types:

Fire from forest camps, leaving burning match stick or cigarette unextinguished, burning of vegetation fields (paddy straw before cultivating wheat) near forest area, and so on are examples for man-made fires.

Types:

Ground fire: decayed roots and debris underground or a duff layer (which is compacted vegetation such as leaves, barks and twigs) burn in this category, often without visible flame (only glowing combustion). Produce little smoke & spread slowly.
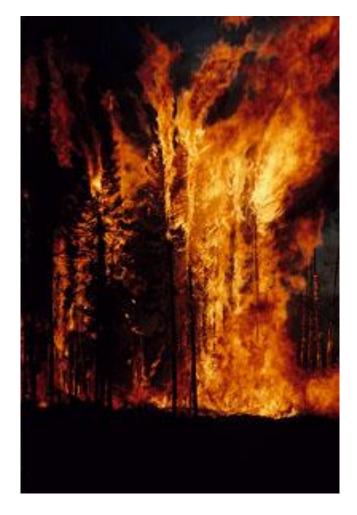
Surface fire: These involve burning of loose leaves, needles, herbs, shrubs, small plants around the surface of the ground. Surface fires can spread faster than ground fires, can grow to much higher intensities. Amount of material available for burning, slope and wind can aid its spread rate. Moisture affects the burning. Surface fires are also affected by the height of the material and density.

Crown fire: often caused by surface fire. Burns foliage on top part of trees, branches and tall shrubs well above the surface. It burns individual trees or small group of trees when in passive mode. Active crown fire spreads from one

tree crown to the next & burns several trees.

(stock.adobe.com)

(www.nrcan.gc.ca)

After effects of forest fires:

From the document "Forest Protection" released by the Directorate of forests, West Bengal, India, 2016.

Damage to the plants: Due to surface fire, shrubs, herbs and small plants are affected. Thin barks of trees and small leaves are much affected. Based on the age of the trees, many species in them are affected in variable manner. Several plants and trees are destroyed by active and passive crown fires.

Damage to regeneration: Plants and small plantations are severely affected due to ground and surface fires. If in-depth roots are affected, the possibility of regeneration is nil.

Damage to soil: Soil erosion gets enhanced due to forest fires. Organic material in the soil is also removed. Soil becomes more compact and non-porous.

Damage to wild animals: Nests, eggs & young birds in trees are much affected. Based on fire intensity, bigger animals are affected.

Measures to prevent forest fires:

"Forest Protection", Directorate of forests, West Bengal, India, 2016.

Apart from regulatory provisions in acts, rules, resolutions, etc., and educating people about forest fires, a few preventive measures exists:

Forecasting forest fire: Predictions using statistical means on fires can be made by analysing data of temperature, humidity and wind. Sophisticated instruments are used to collect these data.

Controlled burning: small parts and patches of dry grasses, shrubs, dry leaves on ground and wood twigs are voluntarily burnt under controlled conditions, such that the risk of onset and spread of ground and surface fires is avoided.

Fire line: Forest area is divided in to many blocks and 3 to 5 meter wide barriers (lines) are made, in which all flammable materials are intentionally burnt, restricting fire spread. Fire fighters can move through these to extinguish fires in identified blocks.