




Module 1: Introduction to Combustion

Lecture 4: Characterization of Solid Fuels

The Lecture Contains:

-  [Oxygen, Water and Ash Content of Certain Solid Fuels](#)
-  [Characterization of Solid Fuels](#)
-  [Various Combustion Modes](#)

 **Previous**   **Next** 

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## Oxygen, Water and Ash Content of Certain Solid Fuels

## Moisture in Solid Fuel:

1. Free
2. Bound water

Fuel moisture content will affect rate of combustion and overall efficiency.

**Ash:** The inorganic materials, which remain as residue even after complete combustion.

Ash content affects the performance of the combustion system.

Ash content causes fouling of the boilers.

Fuel	Oxygen (Dry, Ash-free)	Moisture (Ash-free)	Ash (Dry)
Wood	40-45%	15-70%	0.1-1.0%
Peat	30-35%	70-90%	0.1-20%
Lignite coal	20-25%	20-30%	>5%
Bituminous coal	3-5%	10-5%	>5%
Anthracite coal	1-2%	2-4%	>5%

◀ Previous   Next ▶

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#### Characterization of Solid Fuels:

##### Proximate Analysis:

- Used to determine the moisture content, volatile matter, fixed carbon and ash content in the solid fuel.
- To determine water content, few grams of fuel is heated around 378 K till it attains constant weight.
- Volatile matter is determined by heating the sample at 1173 K.

##### Ultimate Analysis:

- Used to determine the major elemental composition of the solid fuel.
- Nitrogen content is determined by chemical method.
- Sulphur content is evaluated by burning the fuel to convert it into  $\text{SO}_4$  followed by precipitation method. Calorific value can be determined by bomb calorimeter.

 **Previous**   **Next** 

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#### Various Combustion Modes

**Premixed Flame** : Fuel and oxidizer are mixed before actual combustion.

**Examples:** Bunsen burner, LPG Stove

**Diffusion Flame** : Fuel and oxidizer are mixed in the region where chemical reaction takes place.

**Laminar and Turbulent Flames** : Based on the flow characteristics; Turbulent flow occurs in practical combustion devices.

◀ Previous   Next ▶