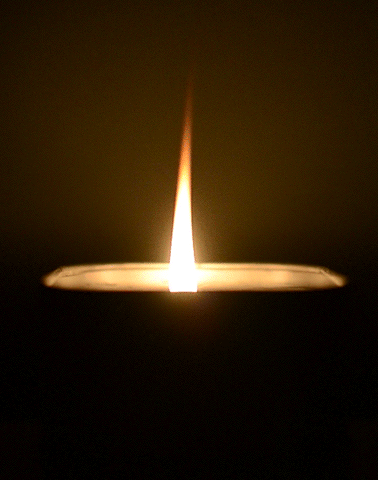
**Combustion and Flames**

Flame propagation is the the speed and spread of the flame outward from the environment at which combustion started.

The flame of a candle on the right flicker: it is not a stable flame.

Stability of a flame is significant since it gives you an idea about

Combustion type – complete or incomplete.

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Combustion basically needs flow, mixing and chemical reaction. Chemical reaction is the most essential element.

What types of reactions are combustion reactions?

-Exothermic

-Oxidation

-Fast reactions – the fuels must vaporize for the reaction to occur. *They have to be transported into gaseous phase***.** Because mobility of molecules is higher for gaseous fuels.

Flame is simply the combustion zone where chemical reactions occur.

**FLAMES**

|  |  |
| --- | --- |
| **Diffusion Flames**  When a fuel alone is supplied to the  combustion chamber through one port  and the oxidizer alone is supplied  through another port.  Transport processes (such as diffusion  and convection) occuring in the  chamber cause these two components  to mix.  Combustion reaction is iniated at locations  where the fuel and the oxidizer are mixed  in proper propertions. Diffusion governs the  reaction zone.  Incomplete combustion occurs |  |

|  |  |
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| **Premixed Flames**  When the reaction mixture is supplied  continously through a burner and ignition  source is initiated at the exit of the burner. A stationary flame (non moving localized zone) may be established near the burner exit. This mode of combustion is called premixed combustion and this type of flame is premixed flame.  Complete combustion occurs. |  |

**Adiabatic Flame Temperature** is the highest temperature that the flame can attain during combustion taking place without heat loss.

**Gaseous fuels** are

* cleaner, devoid of ash and mineral particulates.
* Initiate combustion faster.
* Transport through pipelines.
* Atomization of the fuel is not necessary.
* They have lower densities and therefore, require large storage spaces (tanks) for storing sufficient amounts of fuel for practical applications.
* Stored in leak proof tanks – receive more attention.
* Great fire hazards.

**Liquid fuels**

* have higher energy density.
* To increase the surface to volume ratio, a liquid fuel should be injected into a combustion chamber through atomization (a kind of sprayig process).
* They have to be vaporized before combustion.
* Costly
* Less fire hazards compared to gaseous fuels.

***Solid fuels***

* Ash and smoke formation
* Slowest combustion
* Easier transportation and storage
* Least risk considering the hazards
* Least calorific value due to the impurities

Reference: Ghazi A. Karim, Fuels, Energy and the Environment, 1st Edition, CRCPress.