



The nature of combustion:

What the combustion or burning?

the sequence of exothermic chemical reactions between a fuel and an oxidant accompanied by the production of heat and conversion of chemical species.

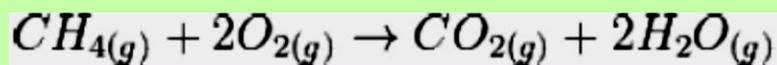
The release of heat can produce light in the form of:

1. Glowing
2. Flame

Fuels of interest often include organic compounds (especially hydrocarbons) in the gas, liquid or solid phase.

When the combustion is occurs?

In a complete combustion reaction, a compound reacts with an oxidizing element, such as **oxygen or fluorine**, and the products are compounds of each element in the fuel with the oxidizing element. For example:



What is the content of air?

As actual combustion reactions come to air, which is **78 percent nitrogen**, will also create small amounts of several **nitrogen oxides**, commonly referred to as NO_x

What is the method used in engineering practice? and what is the disadvantage of it?

increasing surface area to increase reaction rate . for example liquid spray combustors which are used in burners ,diesel engines increases in surface area can also produce undesirable results such as accidental explosions. Another common method of causing fast reaction is to increase the temperature.

What the reactant burns producing?

The reactant burns in oxygen, producing a limited number of products. When a hydrocarbon burns in oxygen, the reaction will primarily yield carbon dioxide and water.

What is the complete combustion?

When elements are burned, the products are primarily the most common oxides. Carbon will yield carbon dioxide, sulfur will yield sulfur dioxide

When the NO_x appear?

NO_x species appear in significant amounts above about 2,800 °F (1,540 °C), and more is produced at higher temperatures. The amount of NO_x is also a function of oxygen excess.

In most industrial applications and in fires, air is the source of oxygen (O₂). In air, each mole of oxygen is mixed with approximately 3.76 mol of nitrogen.

Incomplete combustion

Incomplete combustion will only occur when there is not enough oxygen to allow the fuel to react completely to produce carbon dioxide and water.

What the useful of heat sink?

To reduce the heat flame or quenched the fire by using such as a solid surface or flame trap .

How the pyrolysis in most fuel and in incomplete combustion occurs?

For most fuels, such as diesel oil, coal or wood, pyrolysis (الانحلال الحراري) occurs before combustion. In incomplete combustion, products of pyrolysis remain unburnt and contaminate the smoke with noxious particulate matter and gases

Partially oxidized compounds are also a concern; partial oxidation of ethanol can produce harmful acetaldehyde, and carbon can produce toxic carbon monoxide.

How can we improve the quality of combustion?

The quality of combustion can be improved by the designs of combustion devices, such as burners and internal combustion engines. Further improvements are achievable by catalytic after-burning devices (such as catalytic converters) or by the simple partial return of the exhaust gases into the combustion process.

Smoldering

is the slow, low-temperature, flameless form of combustion, sustained by the heat evolved when oxygen directly attacks the surface of a condensed-phase fuel. It is a typically **incomplete combustion reaction**.

Smoldering example

Solid materials that can sustain a smoldering reaction include:

1. Coal
2. Cellulose
3. Wood
4. Cotton
5. Tobacco and dust.

Common examples of smoldering phenomena are the persistent combustion of biomass behind the flaming fronts of wildfires.

Rapid combustion

Bunsen burner

The Bunsen burner consists of a metal tube on a base with a gas inlet at the lower end of the tube, which may have an adjusting valve; openings in the sides of the tube can be regulated by a admit as much air as desired.

Where we use Bunsen burner?

used in heating, sterilization, and combustion

What is the type of gas used in Bunsen burner

The gas can be natural gas (which is mainly methane) or a liquefied petroleum gas, such as propane, butane, or a mixture of both



The type of flame in Bunsen burner

It burns with a pale blue flame, **the primary flame**, seen as a small inner cone, and a **secondary**, almost colorless flame, seen as a larger, outer cone, **which results when the remaining gas is completely oxidized by the surrounding air**.

What is the boiler

boiler

is a device which burns gas, oil, electricity, or coal in order to provide hot water. A boiler incorporates a firebox or furnace in order to burn the fuel and generate heat.

What is the boiler process?

The generated heat is transferred to water to make steam, the process of boiling. This produces saturated steam at a rate which can vary according to the pressure above the boiling water.

The saturated steam thus produced can then either be **used immediately** to produce **power via a turbine and alternator**, or **else** may be further **superheated to a higher temperature**.

The internal combustion engine

Internal combustion engine

is an engine in which the combustion of a fuel (normally a fossil) occurs with an oxidizer (usually air)

What happens After the reaction is initiated by a spark

After the reaction is initiated by a spark, a flame should spread rapidly and smoothly through the gas mixture and the expanding gas drives the piston down the cylinder

What happens when the gas expands in (ICE)?

In an internal combustion engine (ICE) the expansion of the high-temperature and high-pressure gases produced by combustion apply direct force to some component of the engine. The force is applied typically to pistons, turbine blades, or nozzle. This force moves the component over a distance, transforming chemical energy into useful mechanical energy.

Summery /comment:

