

# Engineering Software

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# Combustion Analysis

Here are some of the basic combustion information and plots when considering coal, oil and gas (methane) as the fuel and air as the oxidant.

# **Combustion Assumptions**

- Fuel Temperature 298 [K]**
- Oxidant Temperature 298 [K]**
- Stoichiometric Combustion**
- No Heat Losses**

# Fuel (Coal) Composition

Element	Weight [kg/kg]
<b>C</b>	<b>0.78</b>
<b>H</b>	<b>0.05</b>
<b>S</b>	<b>0.03</b>
<b>N</b>	<b>0.04</b>
<b>O</b>	<b>0.08</b>
<b>W</b>	<b>0.02</b>

## Oxidant (Air) Composition

Element	Weight [kg/kg]	Mole [kmol/kmol]
<b>N</b>	<b>0.767</b>	<b>0.790</b>
<b>O</b>	<b>0.233</b>	<b>0.210</b>

# Combustion Schematic Layout

Fuel -- Coal



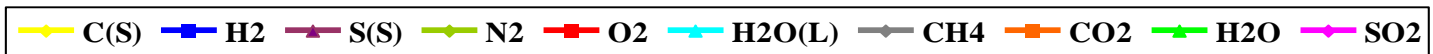
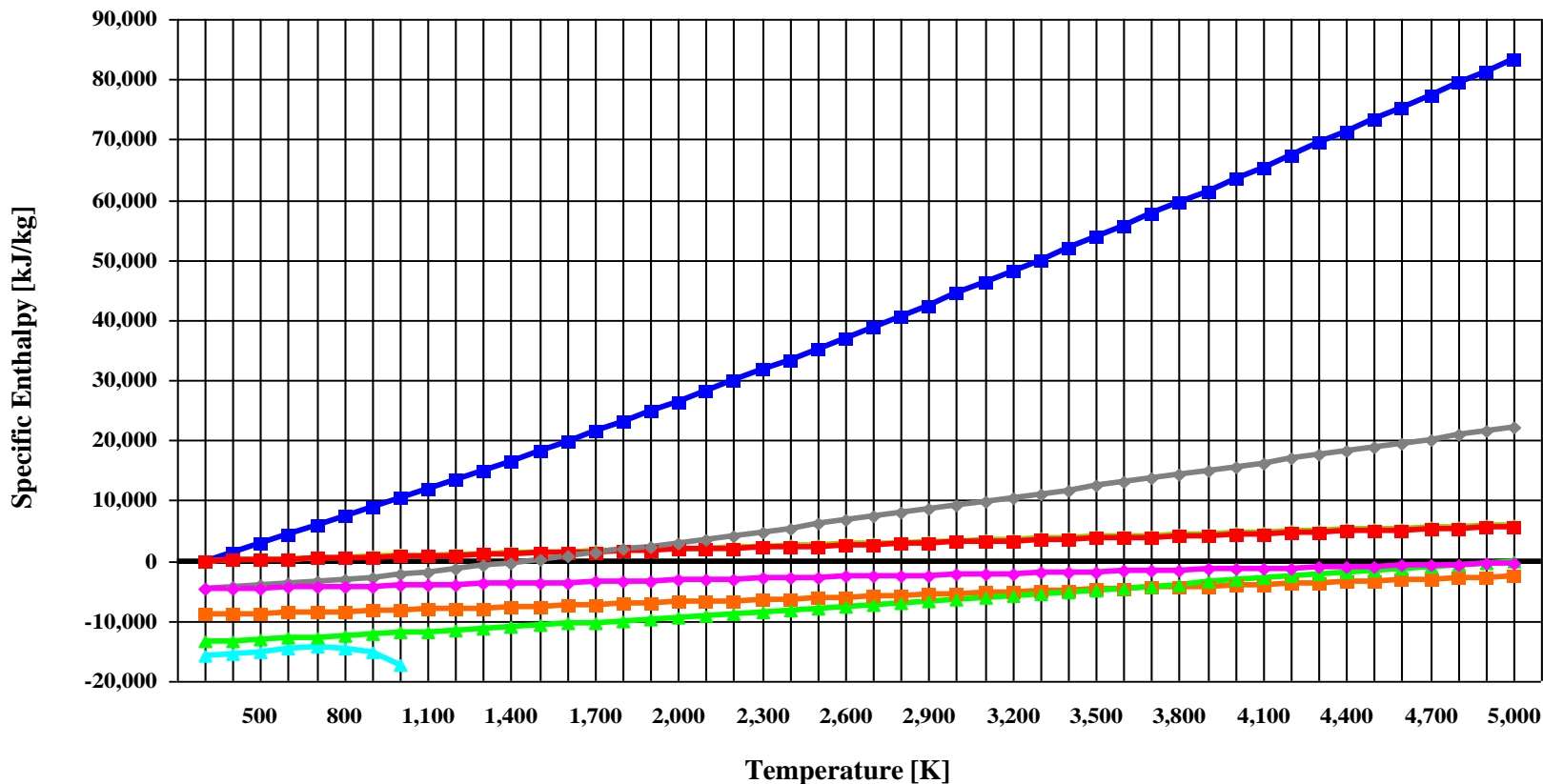
Oxidant -- Air

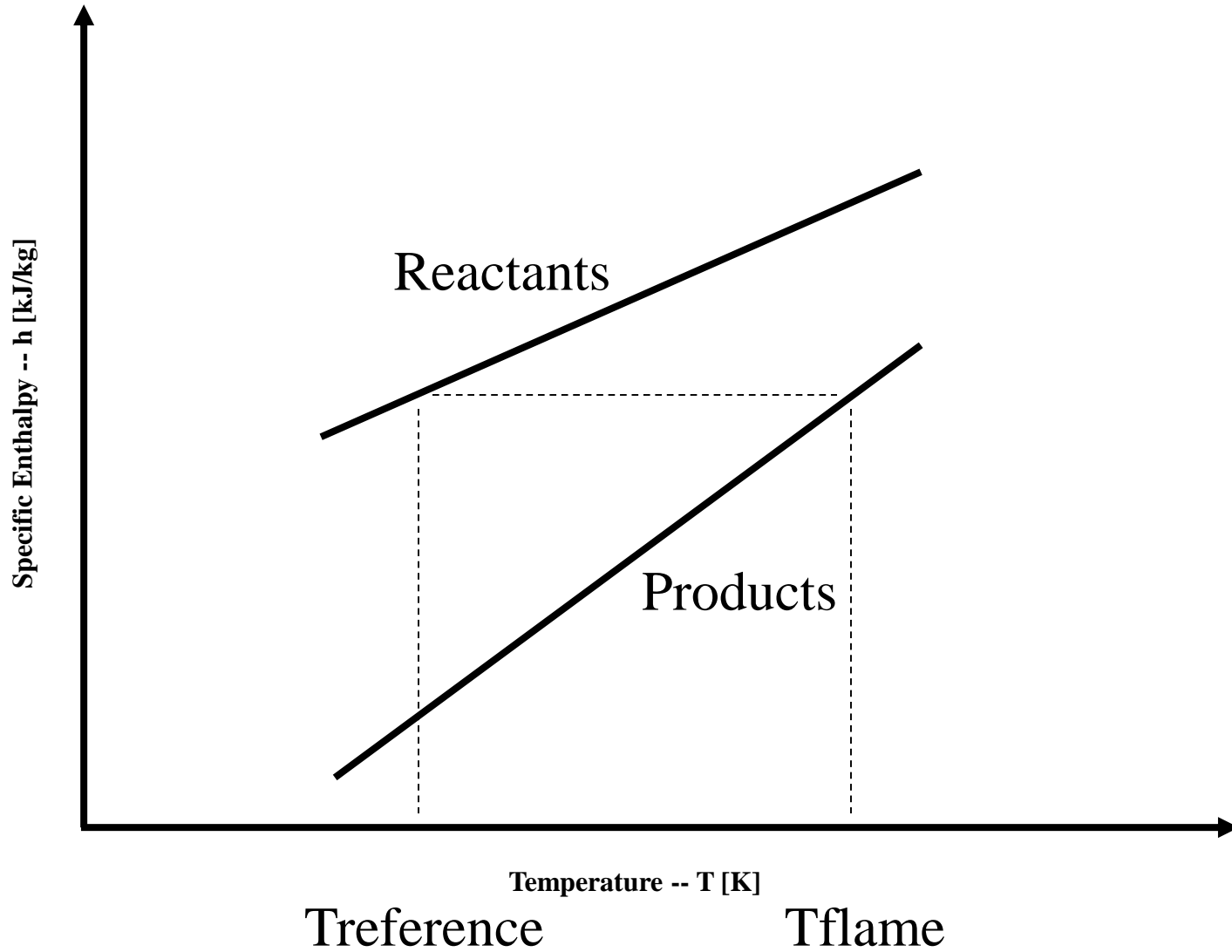


Combustion Products



# Specific Enthalpy vs Temperature





Combustion  $h - T$  Diagram



## Combustion Products Composition

Element	Weight [kg/kg]	Mole [kmol/kmol]
CO <sub>2</sub>	0.249	0.170
H <sub>2</sub> O	0.041	0.068
SO <sub>2</sub>	0.005	0.002
N <sub>2</sub>	0.705	0.759
O <sub>2</sub>	0.000	0.000

# **Combustion Values**

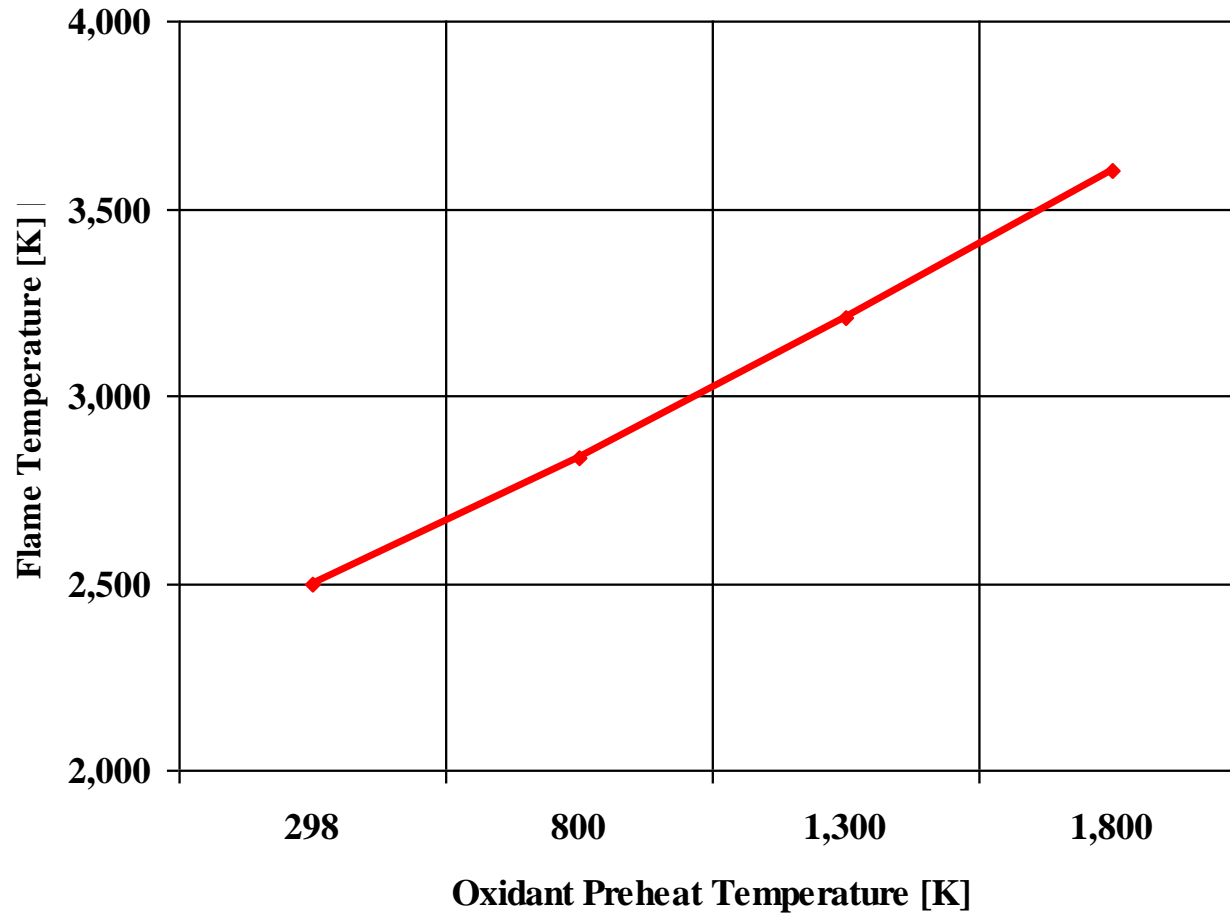
**Flame Temperature**

**2,484 [K]**

**Oxidant To Fuel Ratio**

**10.487 [/]**

# Combustion Products Flame Temperature (Coal as Fuel)



—◆— Flame Temperature [K]

Fuel Inlet Temperature: 298 [K]

# Fuel (Oil) Composition

Element	Weight [kg/kg]
<b>C</b>	<b>0.86</b>
<b>H</b>	<b>0.14</b>
<b>S</b>	<b>0.00</b>
<b>N</b>	<b>0.00</b>
<b>O</b>	<b>0.00</b>
<b>W</b>	<b>0.00</b>

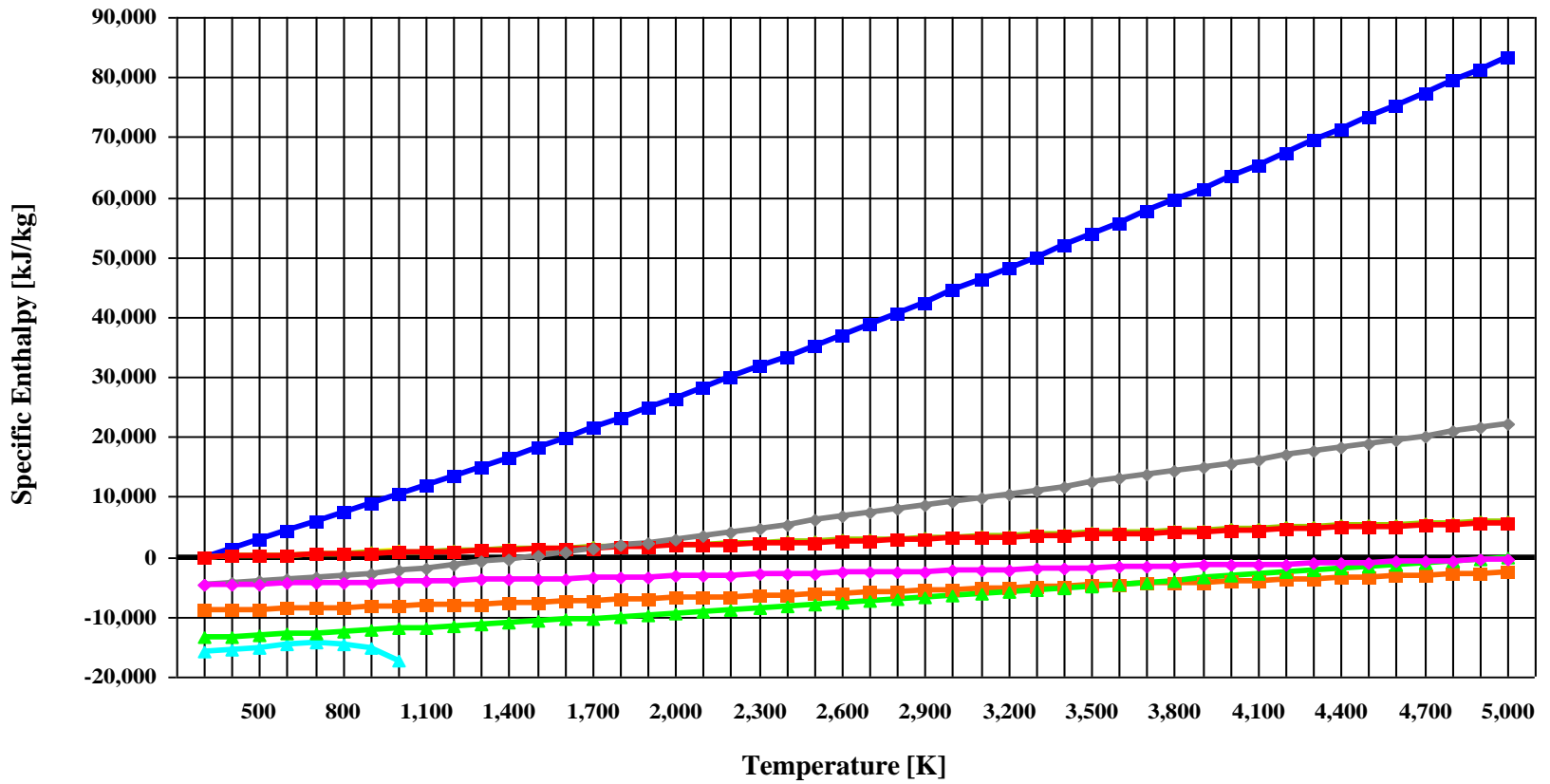
## Oxidant (Air) Composition

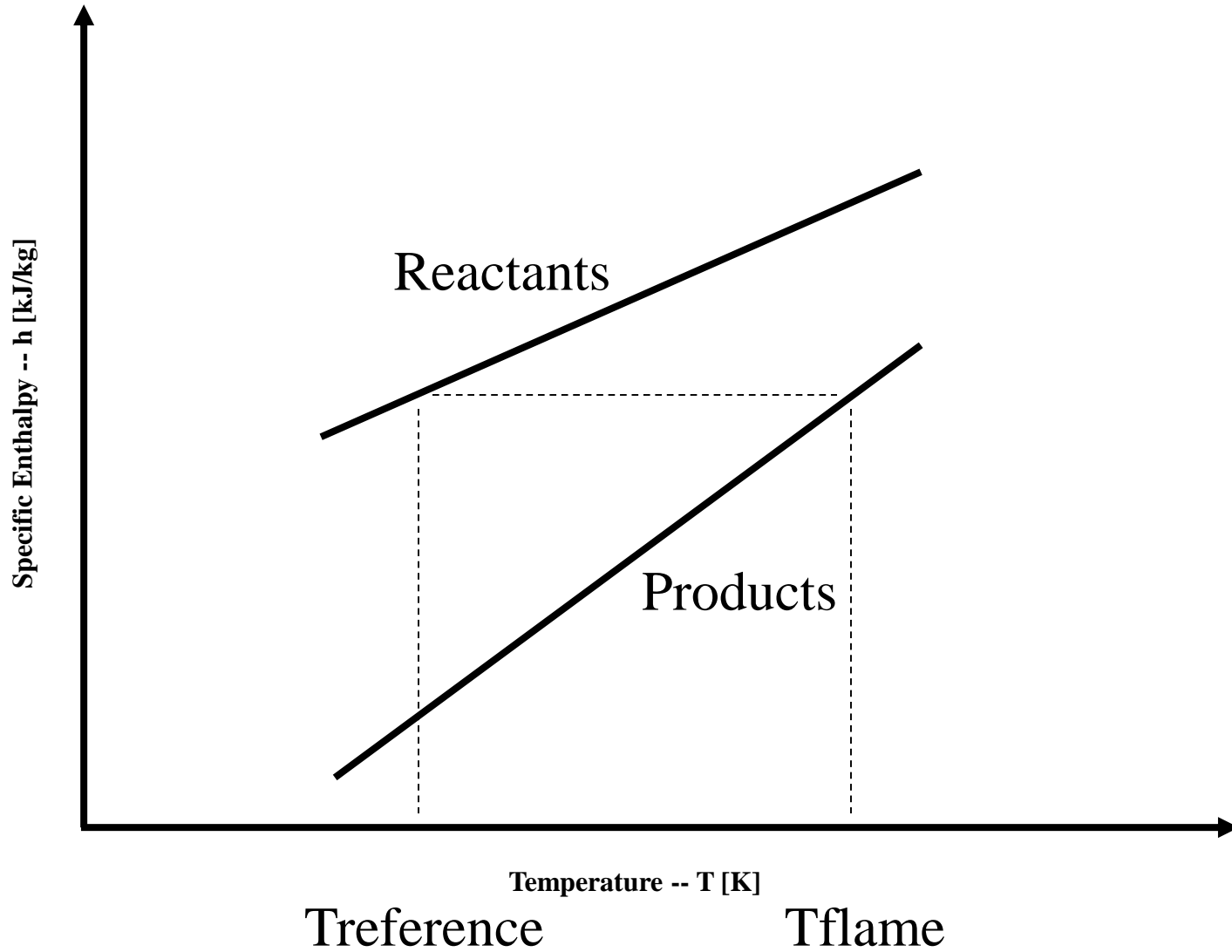
Element	Weight [kg/kg]	Mole [kmol/kmol]
<b>N</b>	<b>0.767</b>	<b>0.790</b>
<b>O</b>	<b>0.233</b>	<b>0.210</b>

# Combustion Schematic Layout



# Specific Enthalpy vs Temperature





**Combustion  $h - T$  Diagram**



## Combustion Products Composition

Element	Weight [kg/kg]	Mole [kmol/kmol]
CO <sub>2</sub>	0.202	0.132
H <sub>2</sub> O	0.080	0.129
SO <sub>2</sub>	0.000	0.000
N <sub>2</sub>	0.718	0.739
O <sub>2</sub>	0.000	0.000

# **Combustion Values**

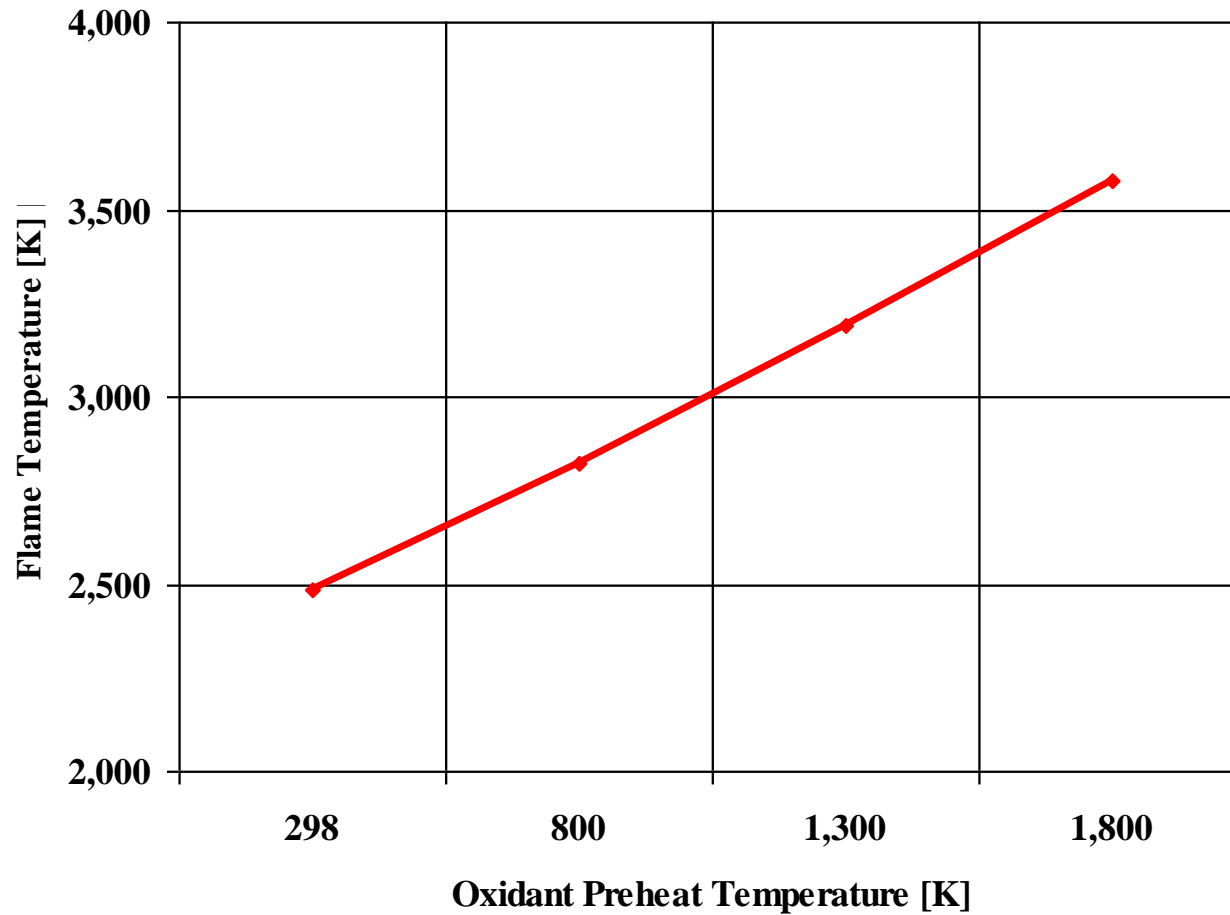
**Flame Temperature**

**2,484 [K]**

**Oxidant To Fuel Ratio**

**14.649 [/]**

# Combustion Products Flame Temperature (Oil as Fuel)



—◆— Flame Temperature [K]

Fuel Inlet Temperature: 298 [K]

## Fuel (Gas -- Methane) Composition

Element	Weight [kg/kg]	Mole [kmol/kmol]
$\text{CH}_4$	1.00	1.00

## Oxidant (Air) Composition

Element	Weight [kg/kg]	Mole [kmol/kmol]
<b>N</b>	<b>0.767</b>	<b>0.790</b>
<b>O</b>	<b>0.233</b>	<b>0.210</b>

# Combustion Schematic Layout

**Fuel -- Gas (Methane)**



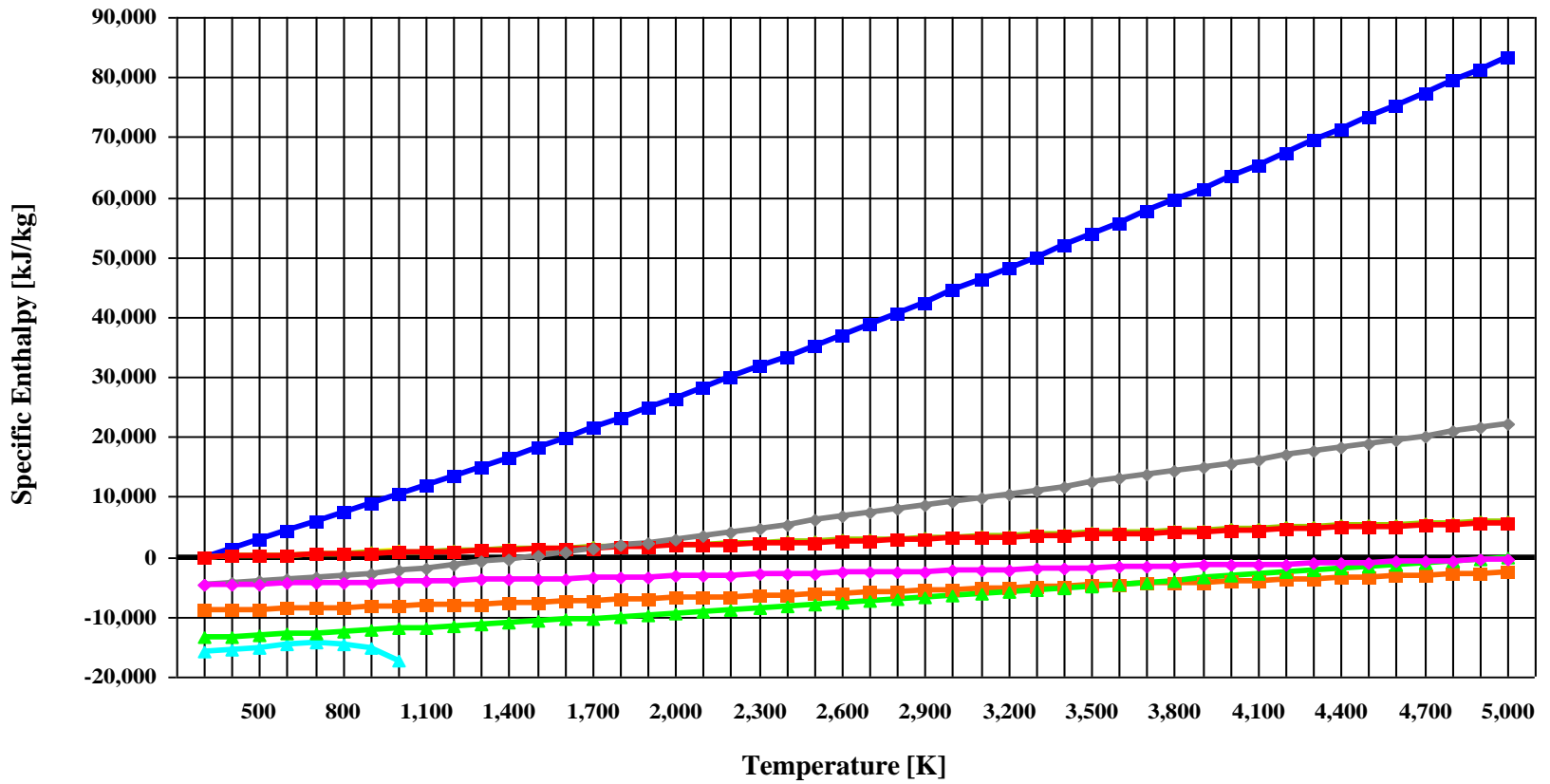
**Oxidant -- Air**

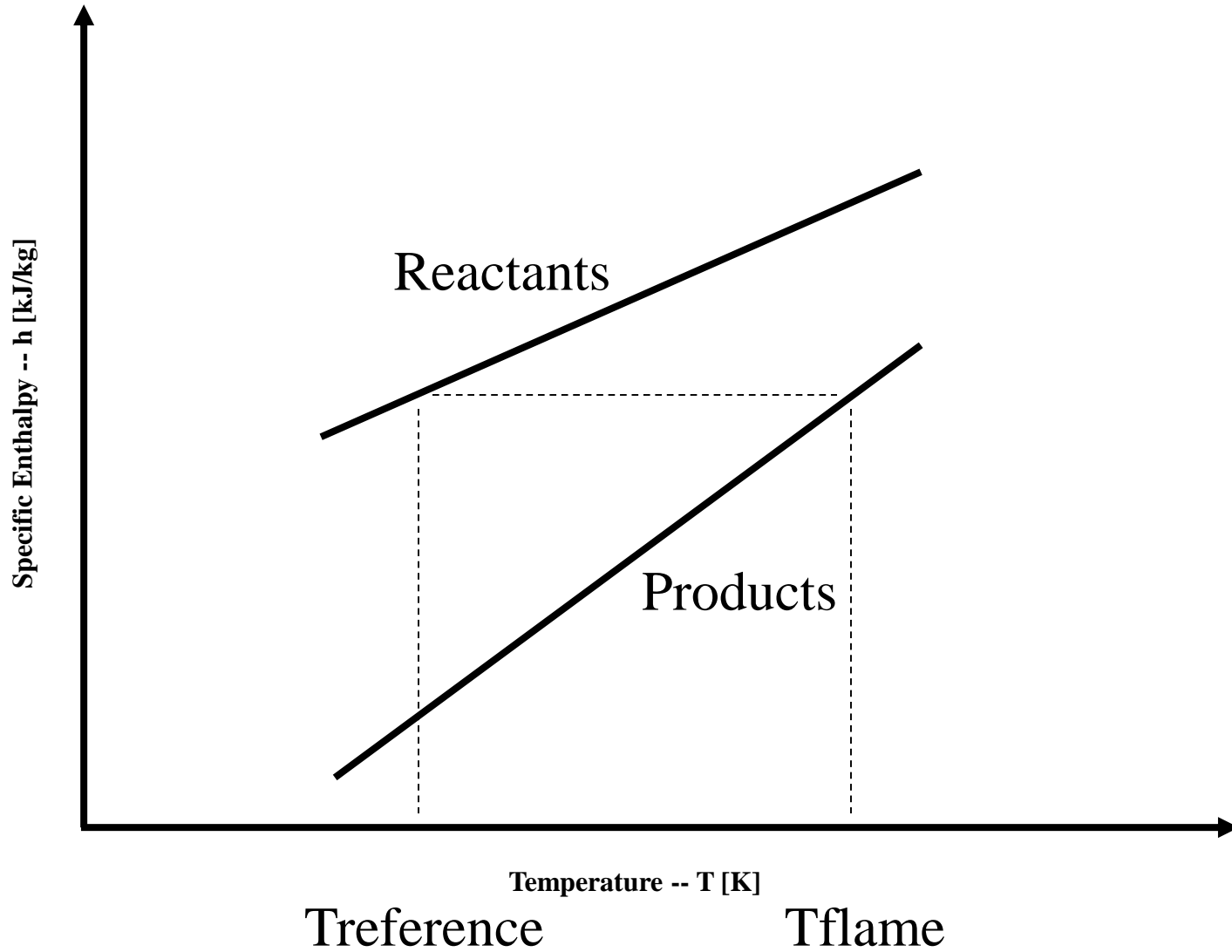


**Combustion Products**



# Specific Enthalpy vs Temperature





**Combustion  $h - T$  Diagram**



## Combustion Products Composition

Element	Weight [kg/kg]	Mole [kmol/kmol]
CO <sub>2</sub>	0.151	0.095
H <sub>2</sub> O	0.124	0.190
SO <sub>2</sub>	0.000	0.000
N <sub>2</sub>	0.725	0.715
O <sub>2</sub>	0.000	0.000

# **Combustion Values**

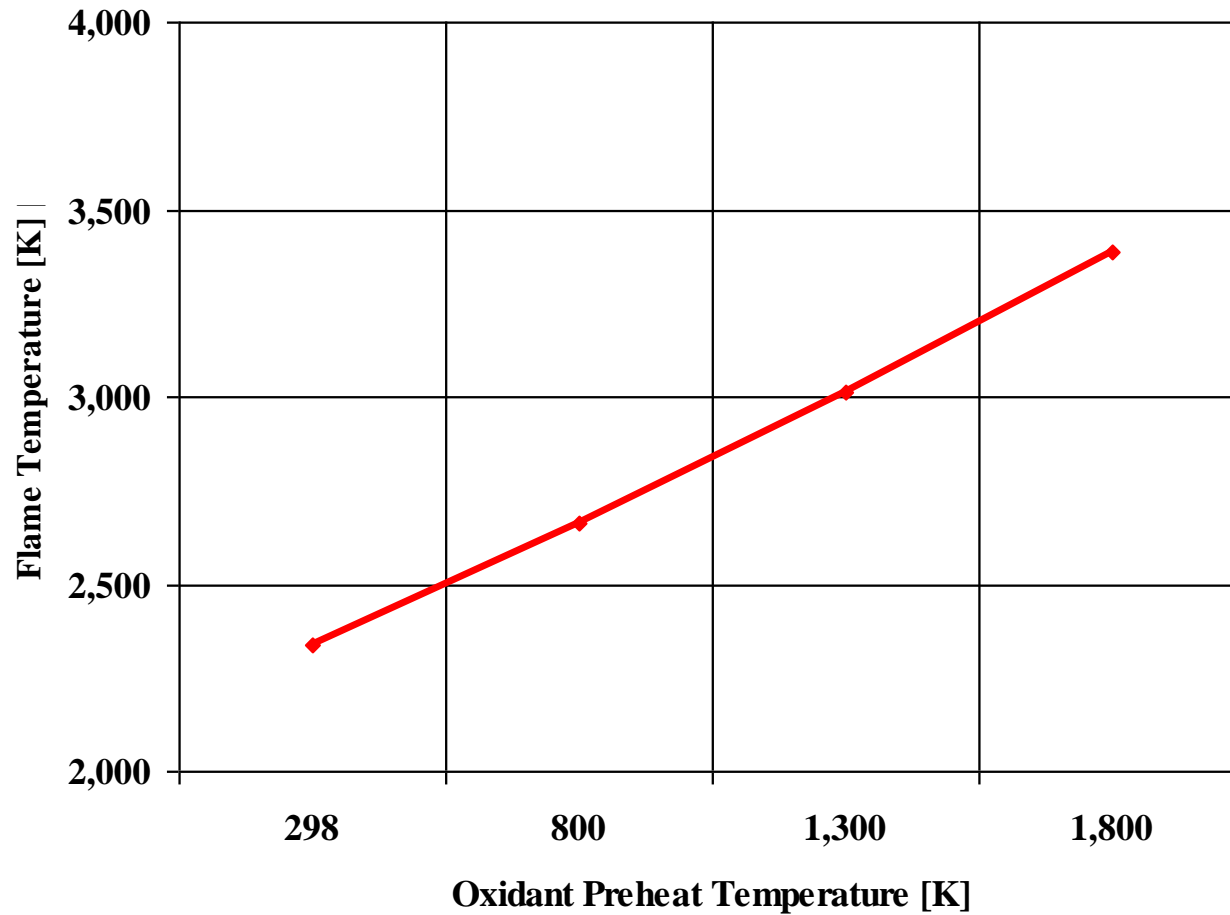
**Flame Temperature**

**2,327 [K]**

**Oxidant To Fuel Ratio**

**17.167 [/]**

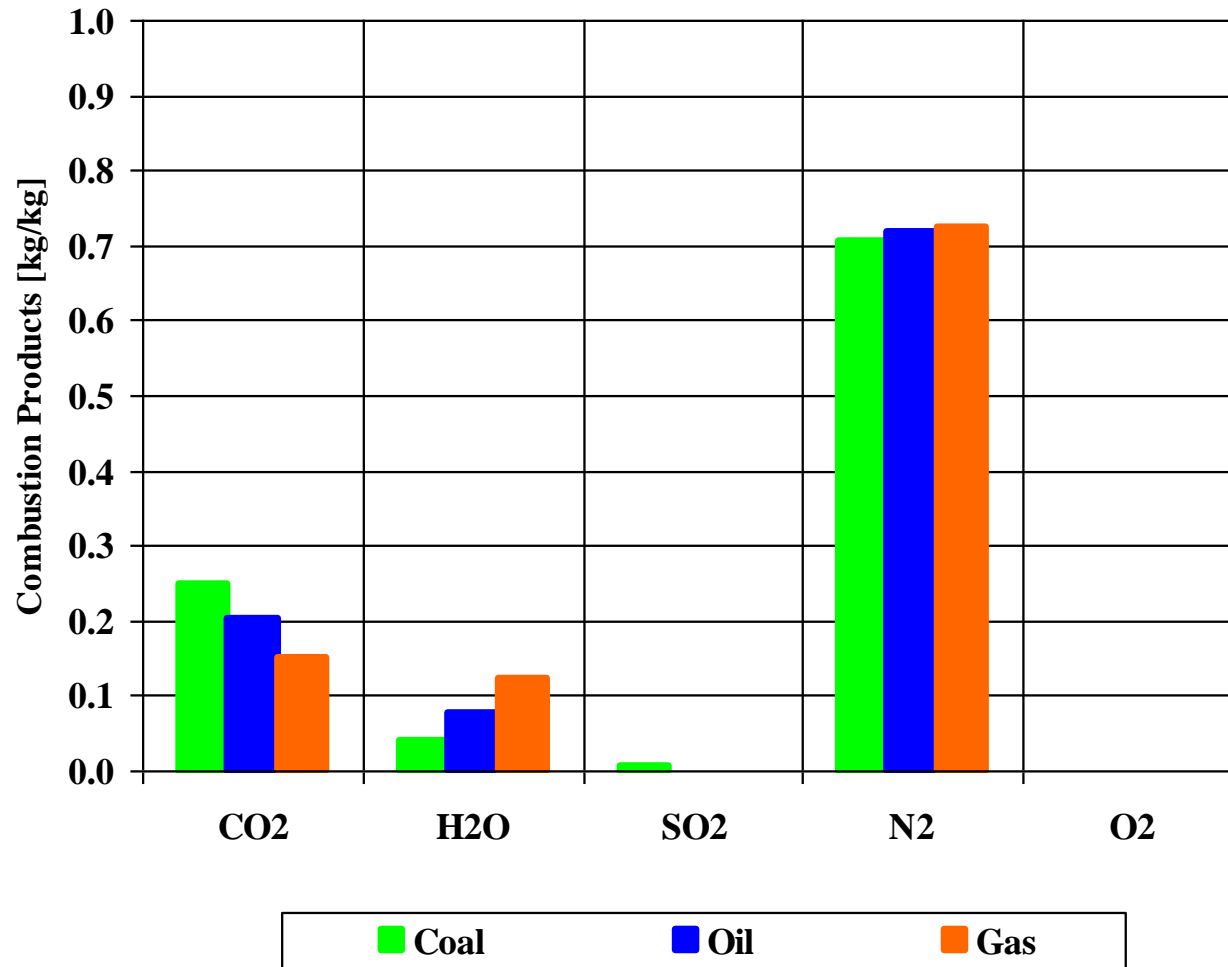
# Combustion Products Flame Temperature (Gas as Fuel)



—◆— Flame Temperature [K]

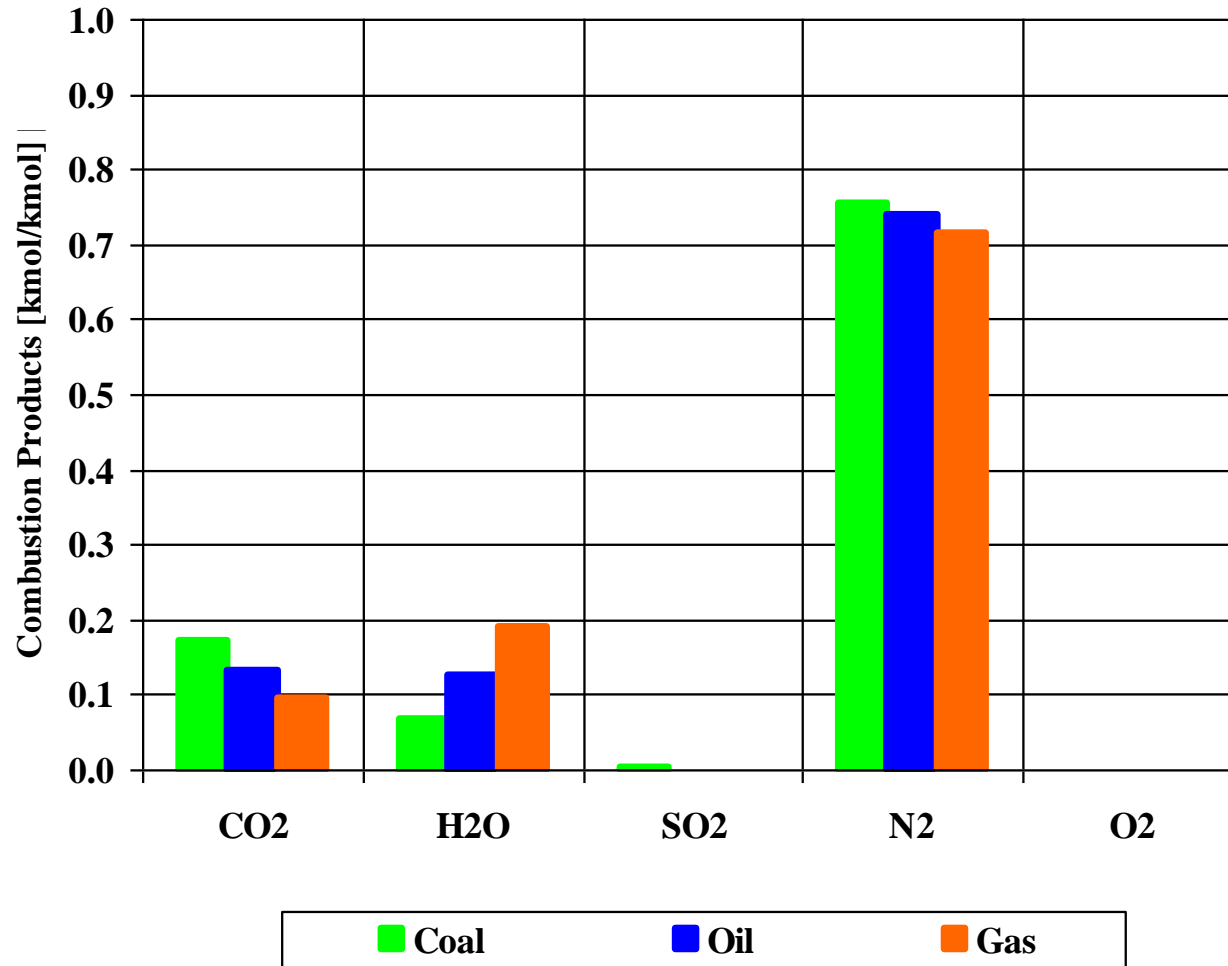
Fuel Inlet Temperature: 298 [K]

## Combustion Products -- Weight Basis



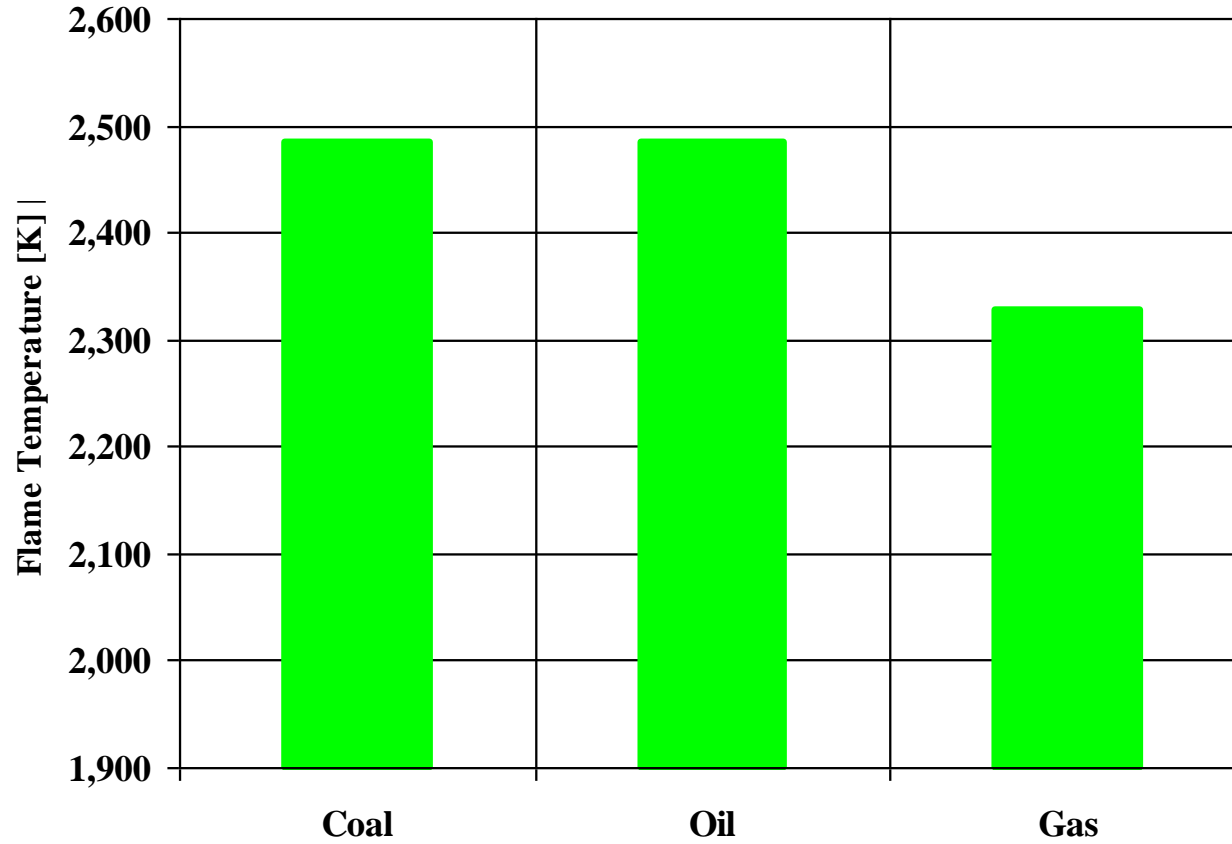
Fuel and Oxidant Inlet Temperature: 298 [K]

## Combustion Products -- Mole Basis



Fuel and Oxidant Inlet Temperature: 298 [K]

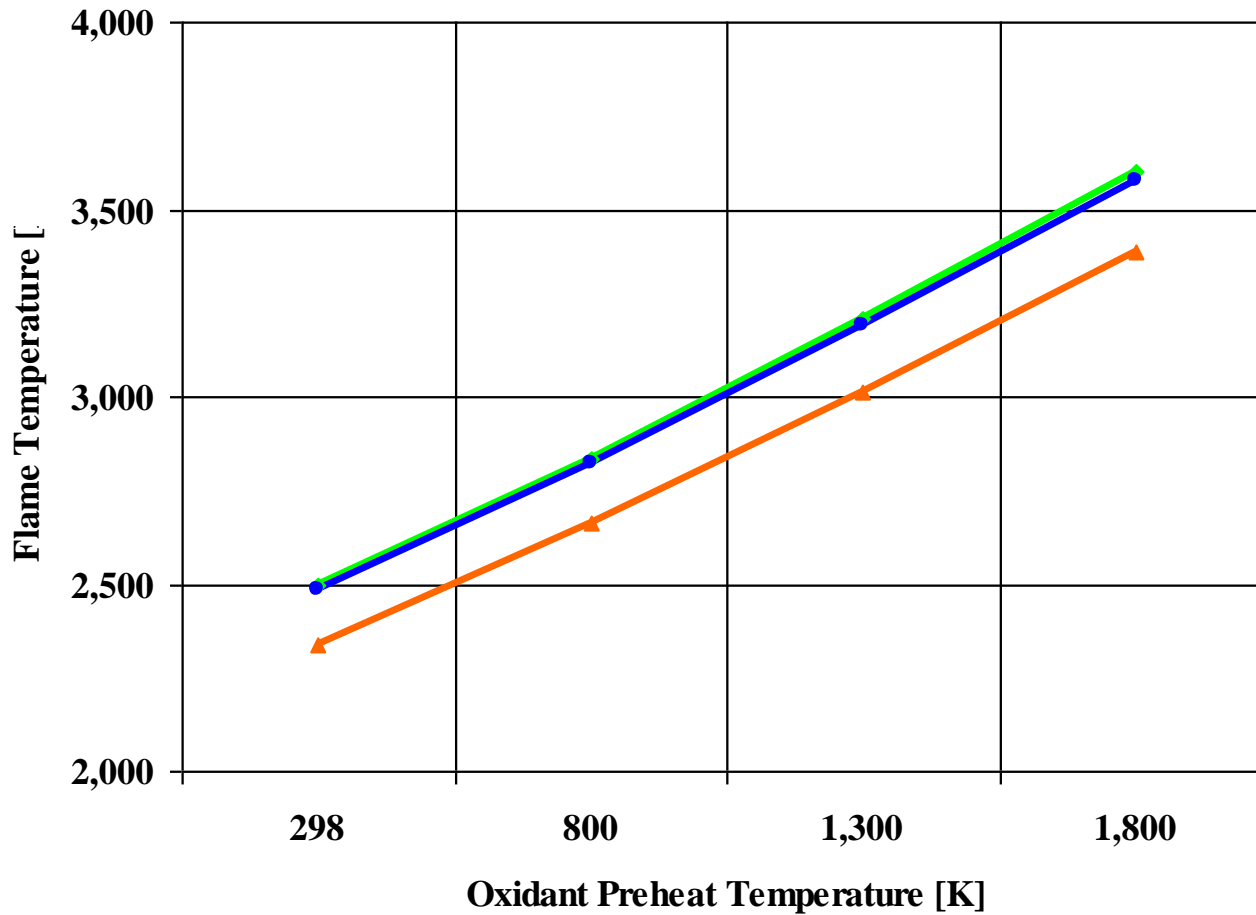
# Combustion Products Flame Temperature



■ Flame Temperature [K]

Fuel and Oxidant Inlet Temperature: 298 [K]

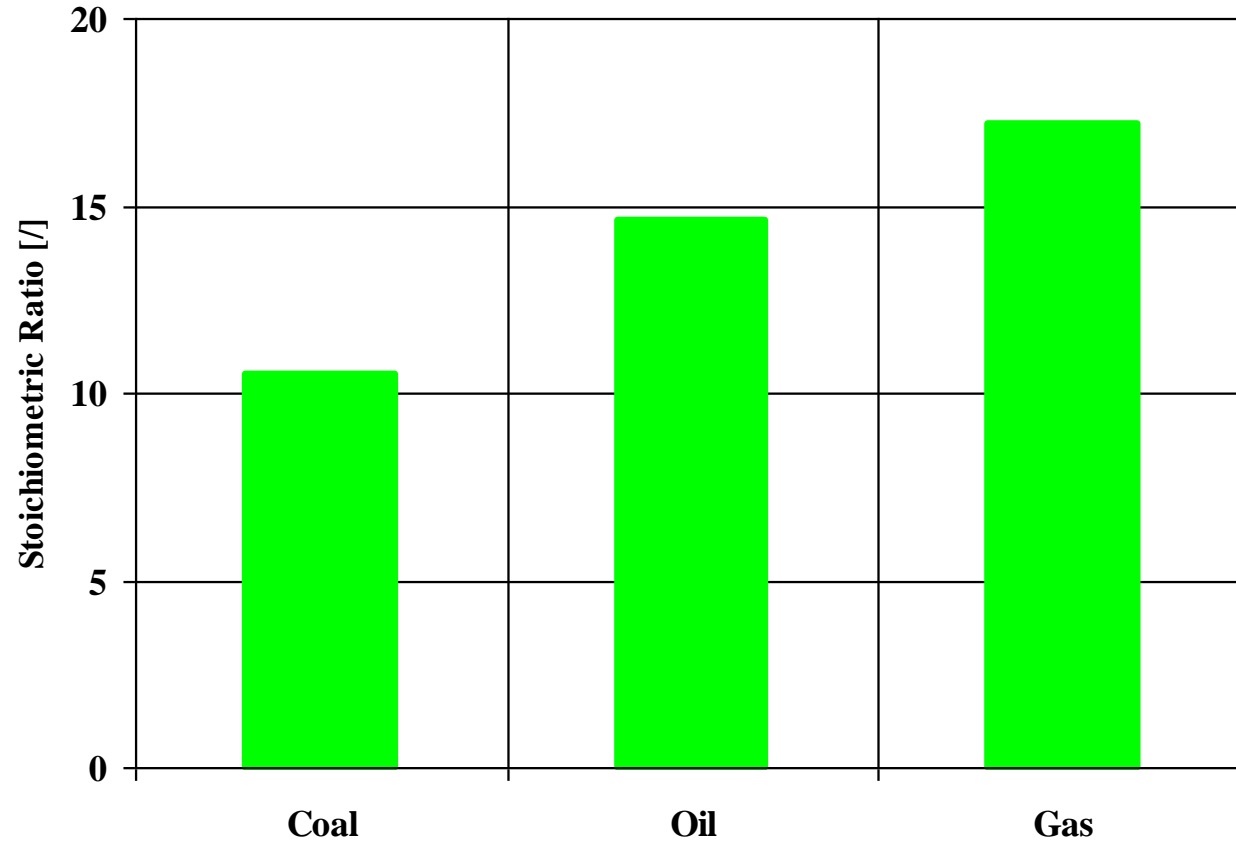
# Combustion Products Flame Temperature (Coal, Oil and Gas as Fuel)



—◆— Coal —●— Oil —▲— Gas

Fuel Inlet Temperature: 298 [K]

# Combustion Stoichiometric Ratio

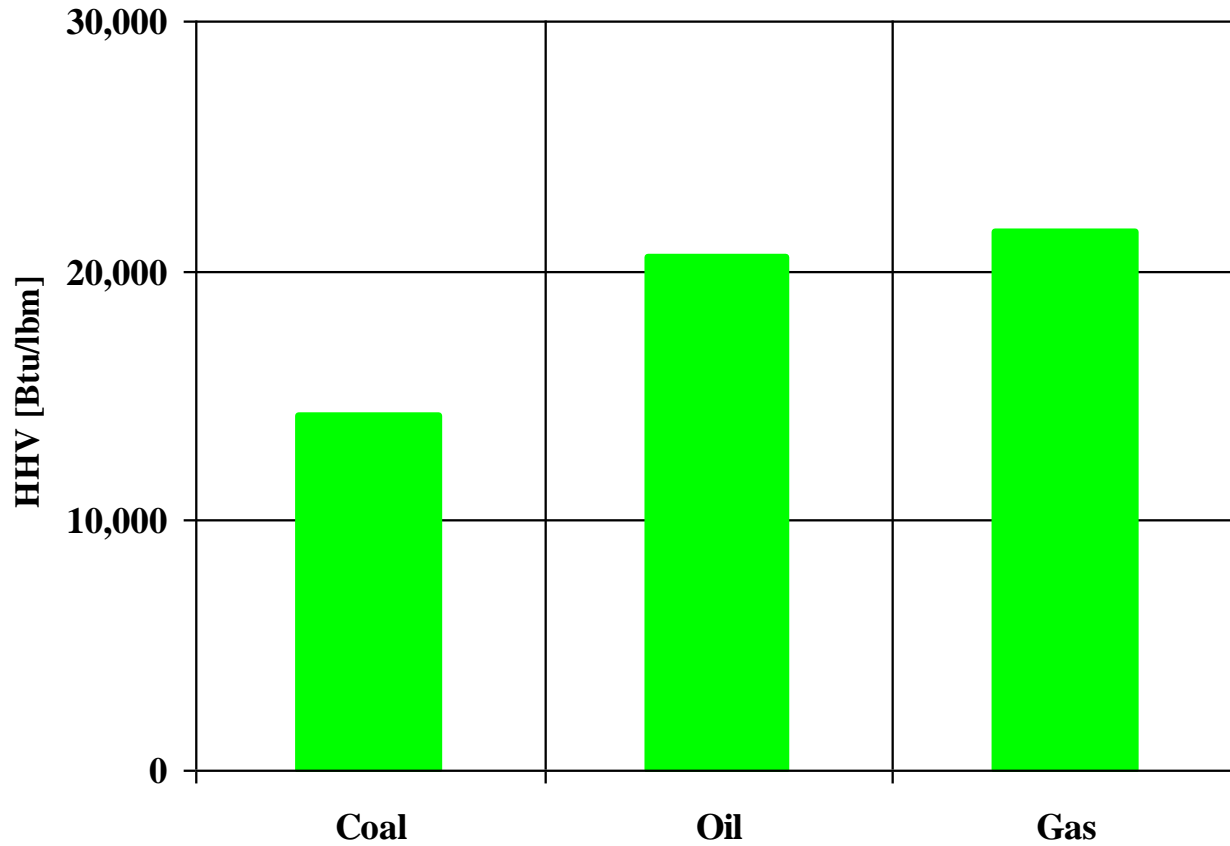


■ Stoichiometric Ratio (Oxidant to Fuel) [l]

Fuel and Oxidant Inlet Temperature: 298 [K]



# Higher Heating Value (HHV)



■ HHV [Btu/lbm]

Fuel and Oxidant Inlet Temperature: 298 [K]

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