

# Engineering Software

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# Combustion

Here are some of the basic combustion information and plots when considering carbon, hydrogen and sulfur as the fuel and air as the oxidant.

# **Combustion Assumptions**

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

## Fuel Composition -- Carbon

| Element | Weight [kg/kg] |
|---------|----------------|
| C       | 1.00           |
| H       | 0.00           |
| S       | 0.00           |
| N       | 0.00           |
| O       | 0.00           |
| W       | 0.00           |

## 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 -- Carbon**



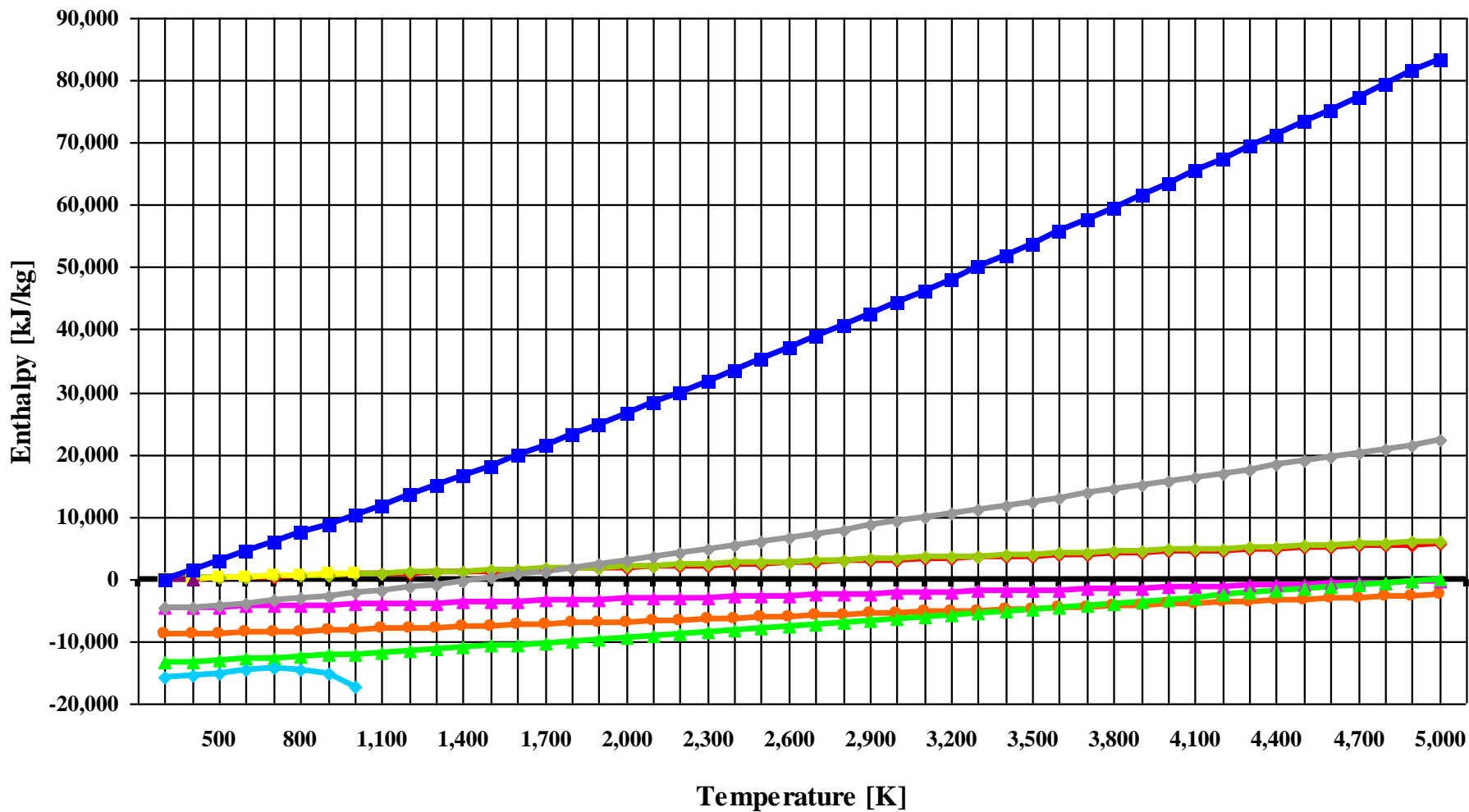
**Oxidant -- Air**

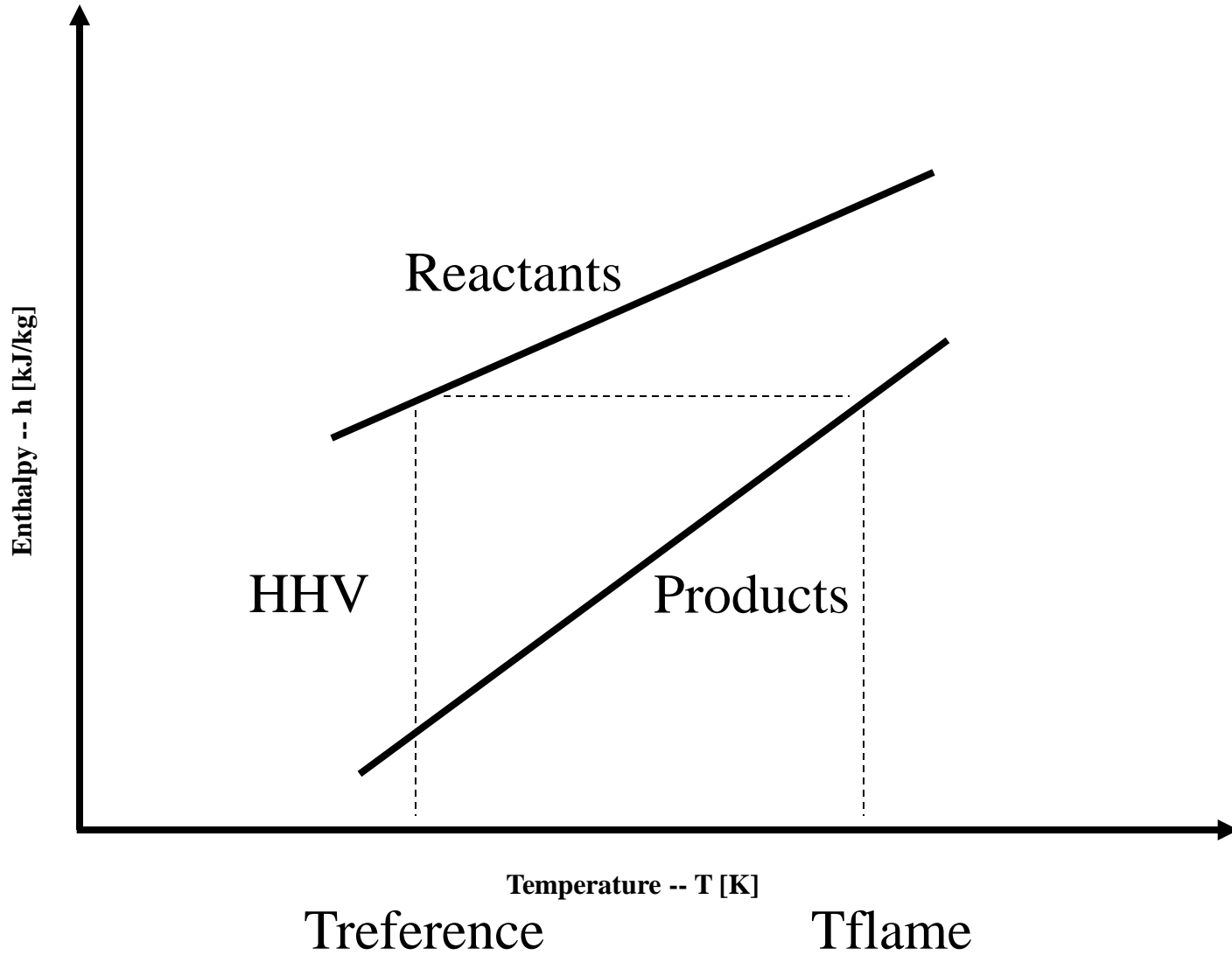


**Combustion Products**



# Enthalpy vs Temperature





**Enthalpy - Temperature  $h - T$  Diagram**

## Combustion Products Composition

| Element          | Weight [kg/kg] | Mole [kmol/kmol] |
|------------------|----------------|------------------|
| CO <sub>2</sub>  | 0.295          | 0.210            |
| H <sub>2</sub> O | 0.000          | 0.000            |
| SO <sub>2</sub>  | 0.000          | 0.000            |
| N <sub>2</sub>   | 0.705          | 0.790            |
| O <sub>2</sub>   | 0.000          | 0.000            |

# **Combustion Values**

**Flame Temperature**

**2,460 [K]**

**Oxidant To Fuel Ratio**

**11.443 [/]**

## Fuel Composition -- Hydrogen

| Element | Weight [kg/kg] |
|---------|----------------|
| C       | 0.00           |
| H       | 1.00           |
| S       | 0.00           |
| N       | 0.00           |
| O       | 0.00           |
| W       | 0.00           |

## 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 -- Hydrogen



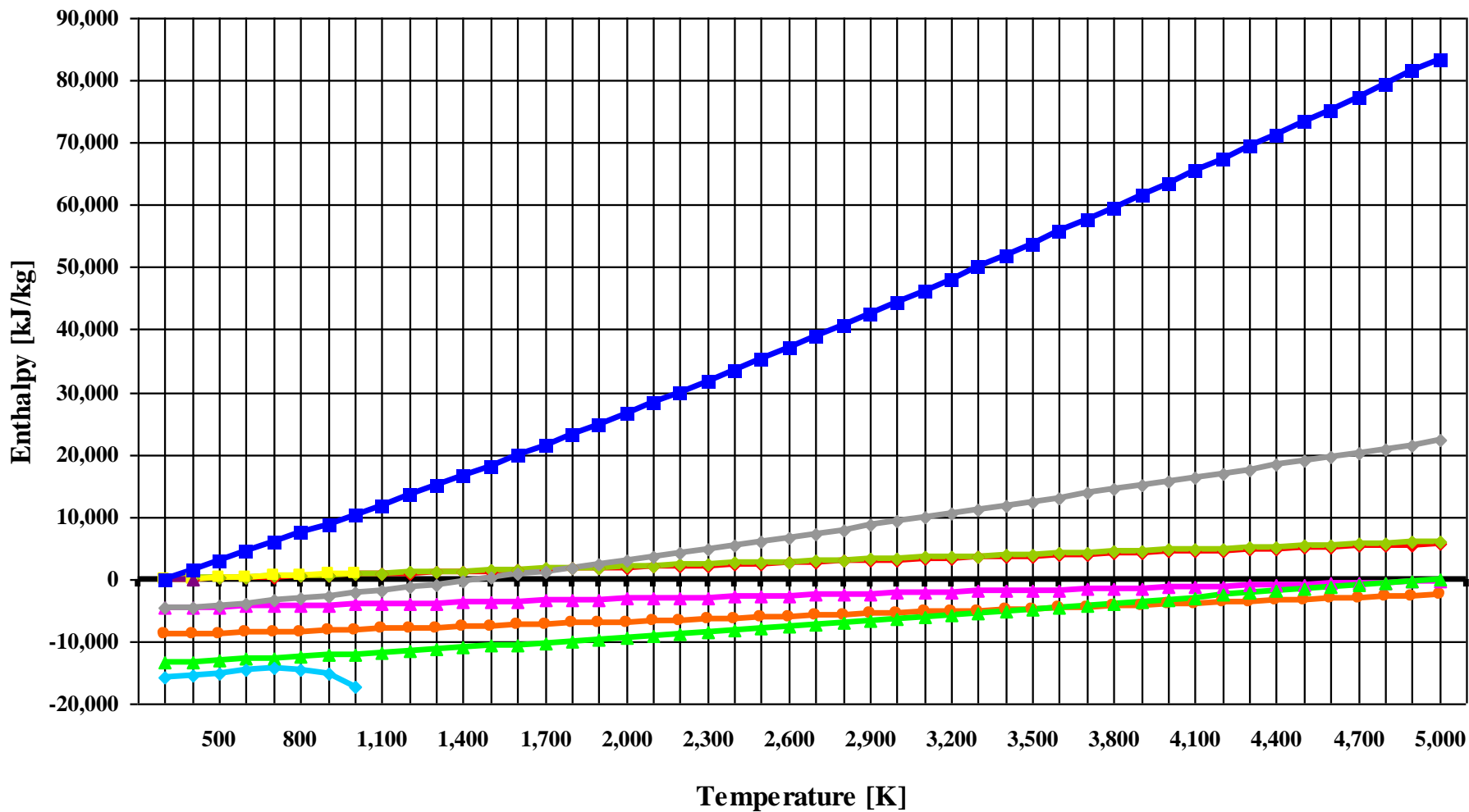
Oxidant -- Air

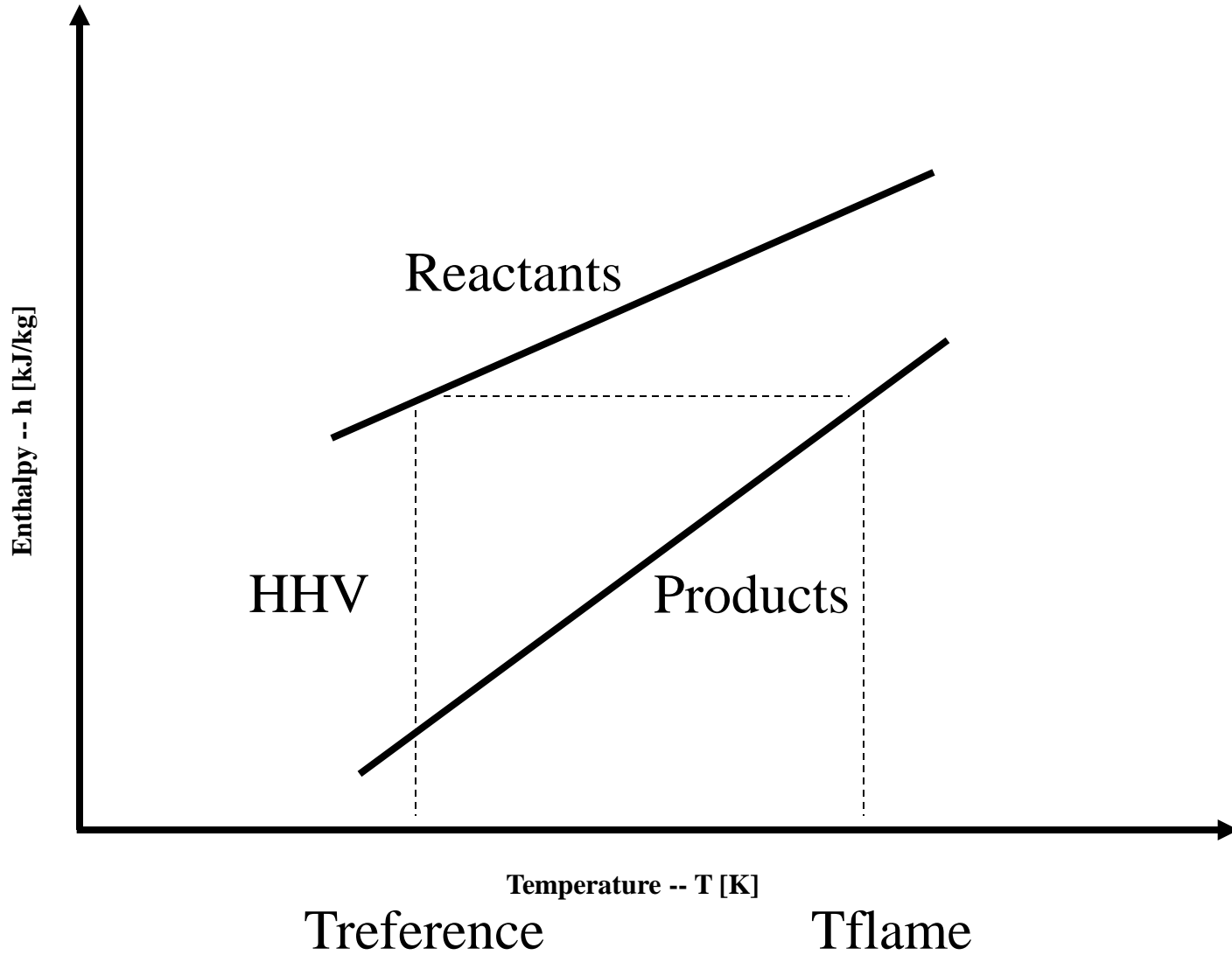


Combustion Products



# Enthalpy vs Temperature





**Enthalpy - Temperature  $h - T$  Diagram**

## Combustion Products Composition

| Element          | Weight [kg/kg] | Mole [kmol/kmol] |
|------------------|----------------|------------------|
| CO <sub>2</sub>  | 0 . 000        | 0 . 000          |
| H <sub>2</sub> O | 0 . 255        | 0 . 347          |
| SO <sub>2</sub>  | 0 . 000        | 0 . 000          |
| N <sub>2</sub>   | 0 . 745        | 0 . 653          |
| O <sub>2</sub>   | 0 . 000        | 0 . 000          |

# **Combustion Values**

**Flame Temperature**

**2,525 [K]**

**Oxidant To Fuel Ratio**

**34.333 [/]**

## Fuel Composition -- Sulfur

| Element | Weight [kg/kg] |
|---------|----------------|
| C       | 0.00           |
| H       | 0.00           |
| S       | 1.00           |
| N       | 0.00           |
| O       | 0.00           |
| W       | 0.00           |

## 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 -- Sulfur**



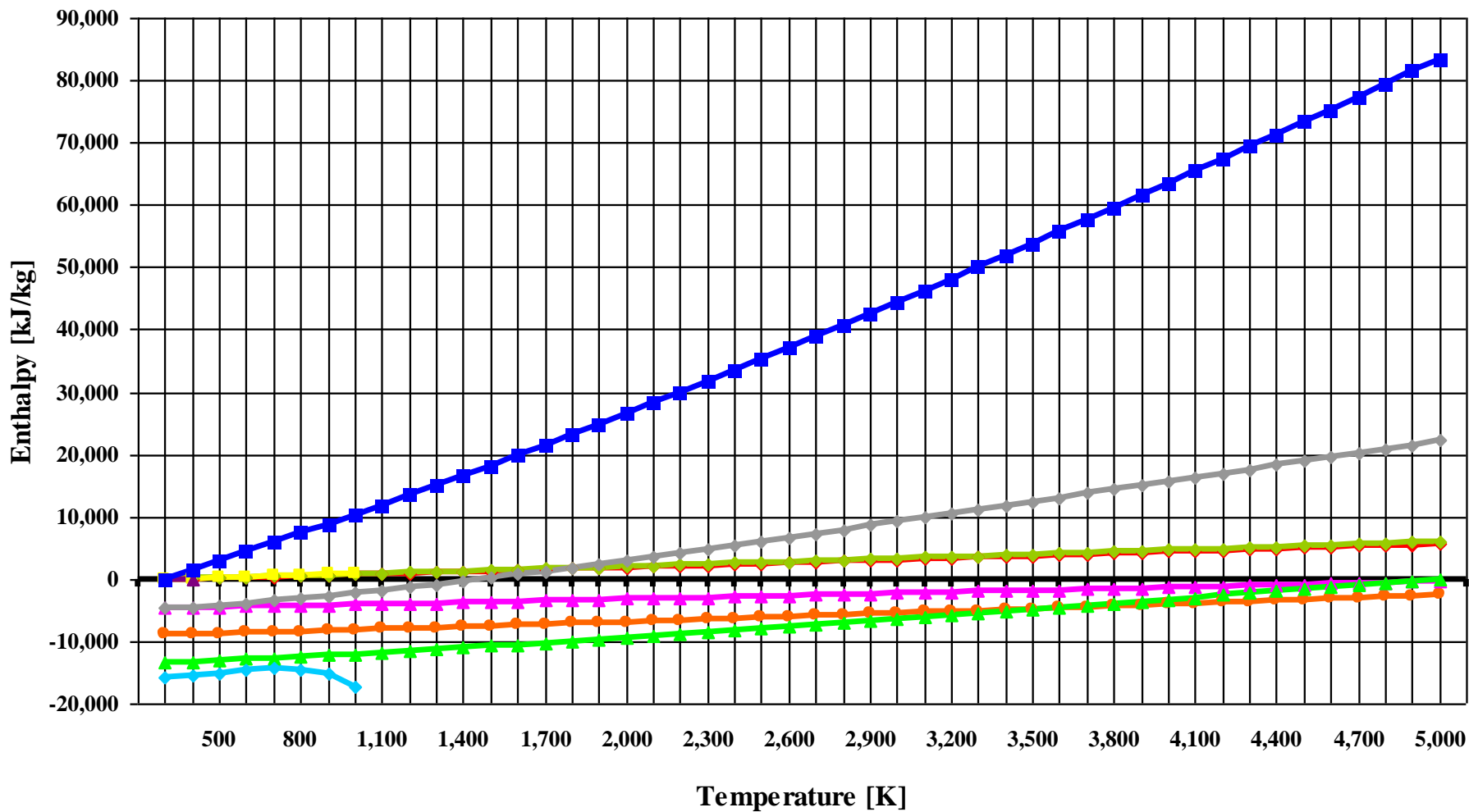
**Oxidant -- Air**

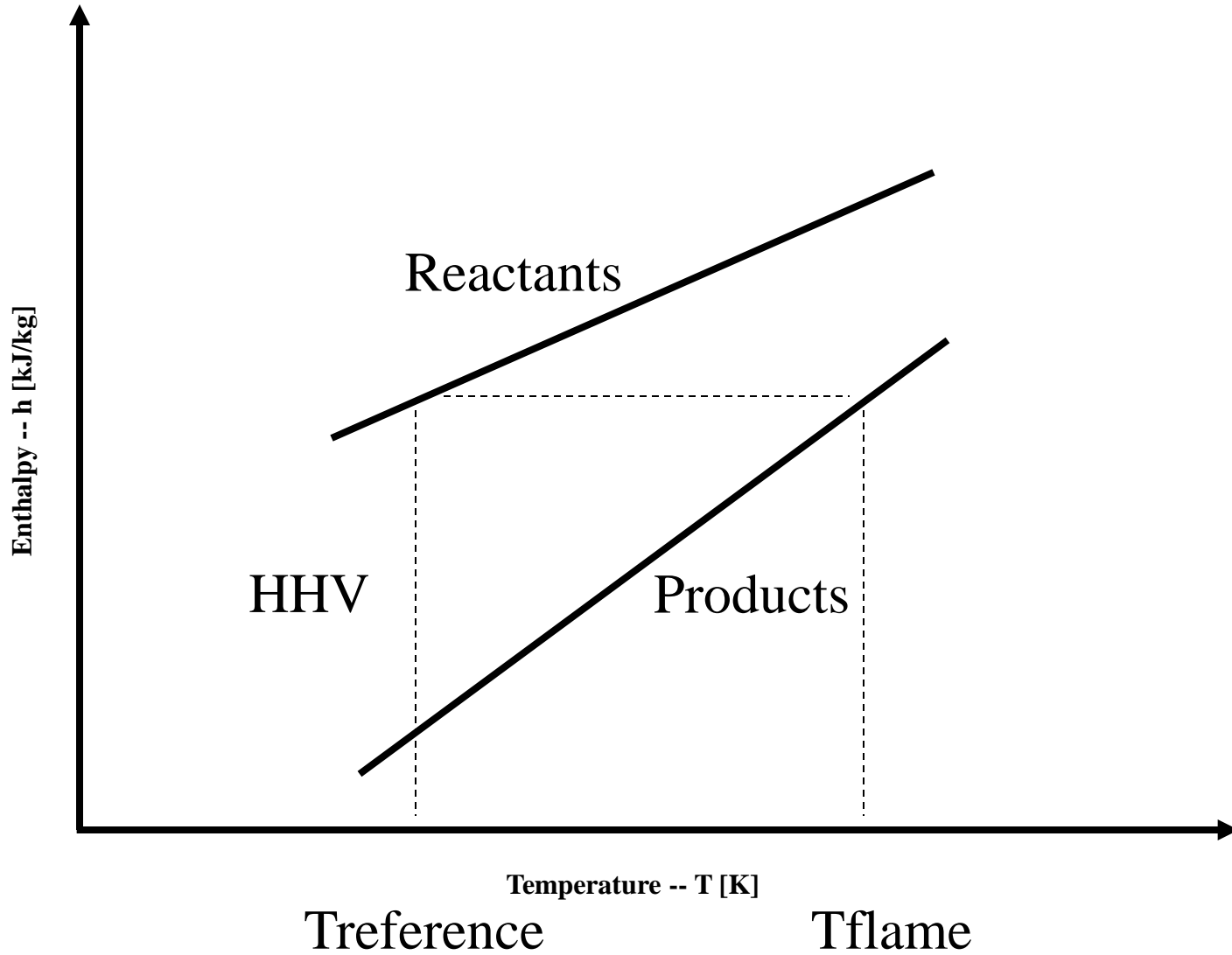


**Combustion Products**



# Enthalpy vs Temperature





**Enthalpy - Temperature  $h - T$  Diagram**

## Combustion Products Composition

| Element          | Weight [kg/kg] | Mole [kmol/kmol] |
|------------------|----------------|------------------|
| CO <sub>2</sub>  | 0 . 000        | 0 . 000          |
| H <sub>2</sub> O | 0 . 000        | 0 . 000          |
| SO <sub>2</sub>  | 0 . 378        | 0 . 210          |
| N <sub>2</sub>   | 0 . 622        | 0 . 790          |
| O <sub>2</sub>   | 0 . 000        | 0 . 000          |

# **Combustion Values**

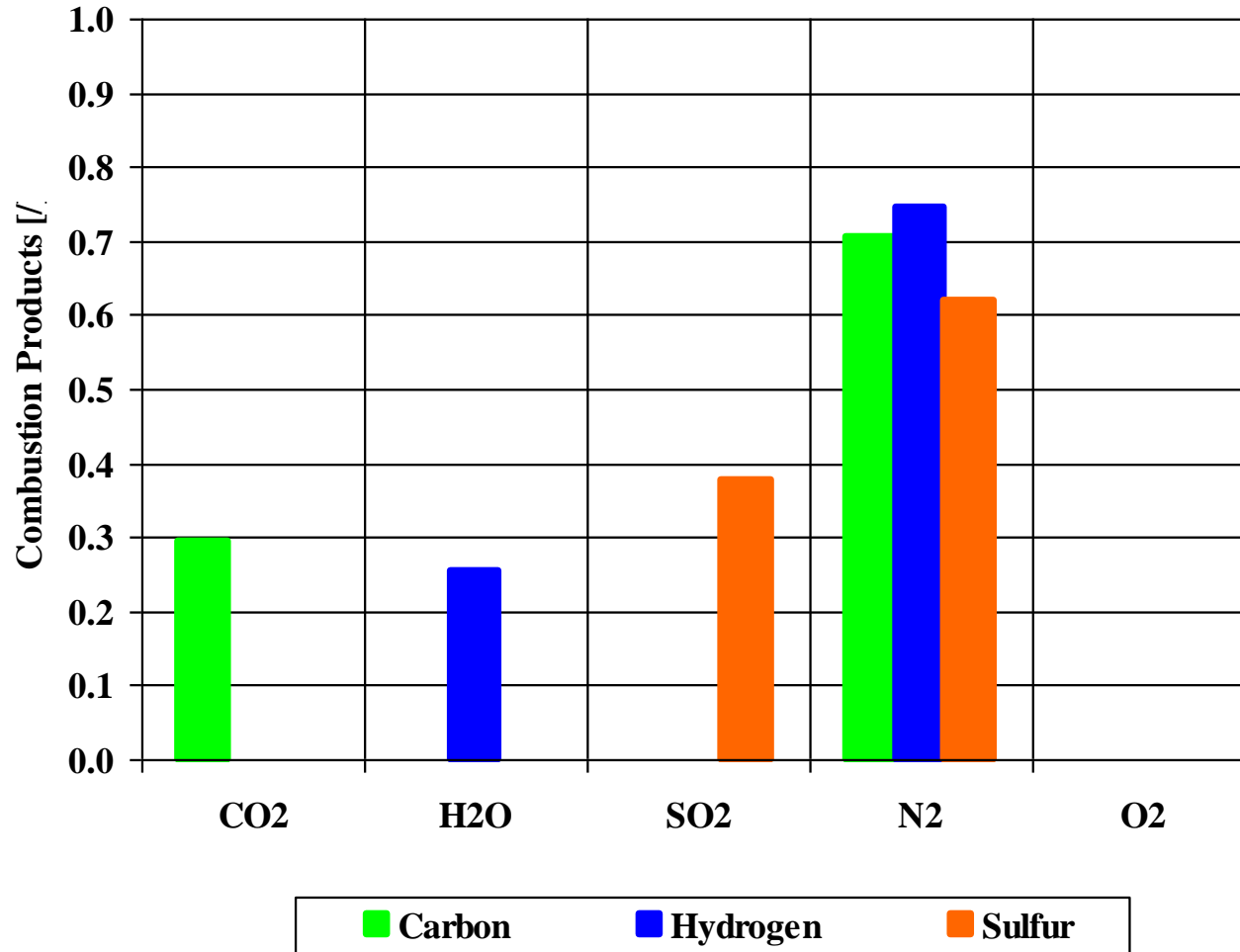
**Flame Temperature**

**1,972 [K]**

**Oxidant To Fuel Ratio**

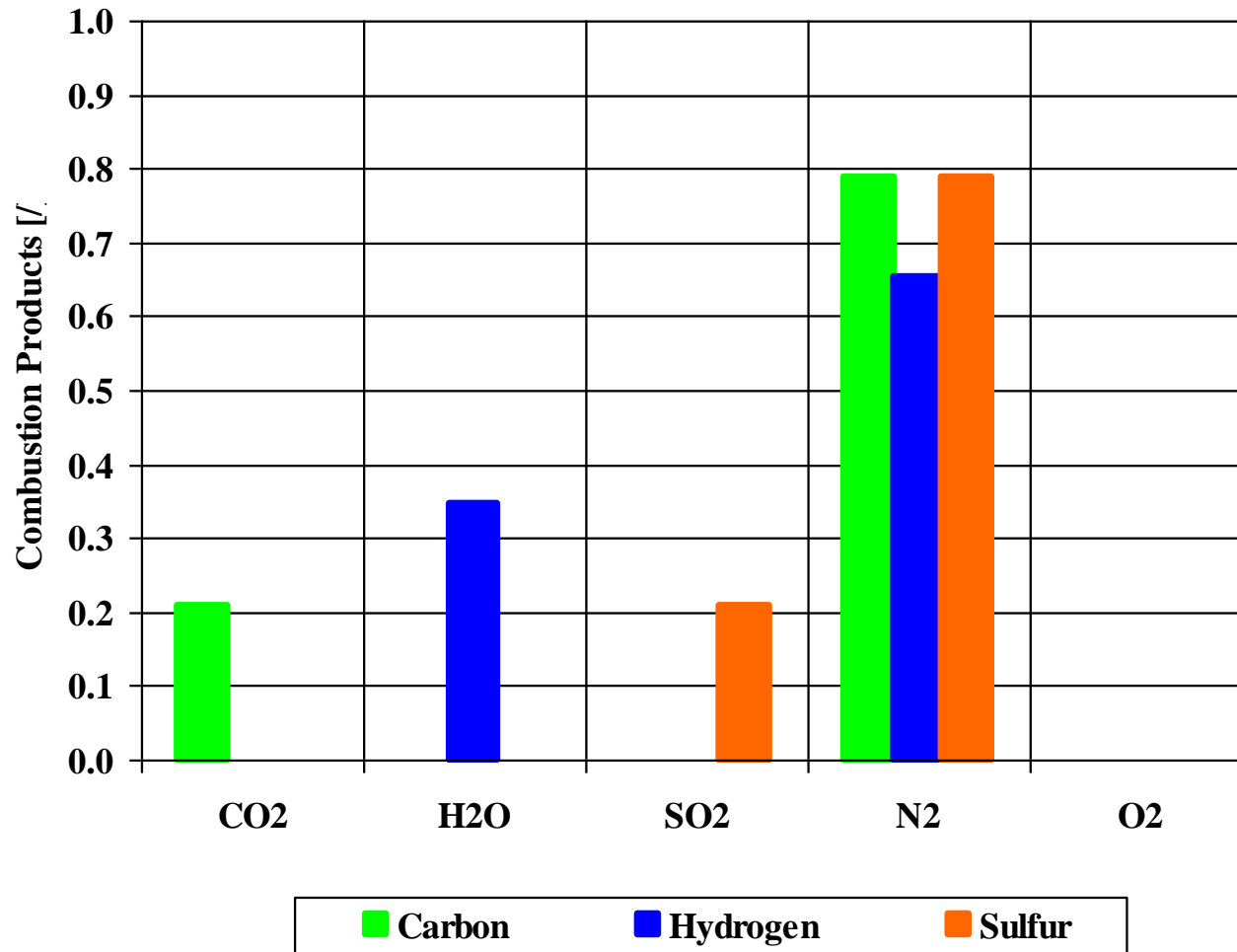
**4.292 [/]**

## Combustion Products -- Weight Basis



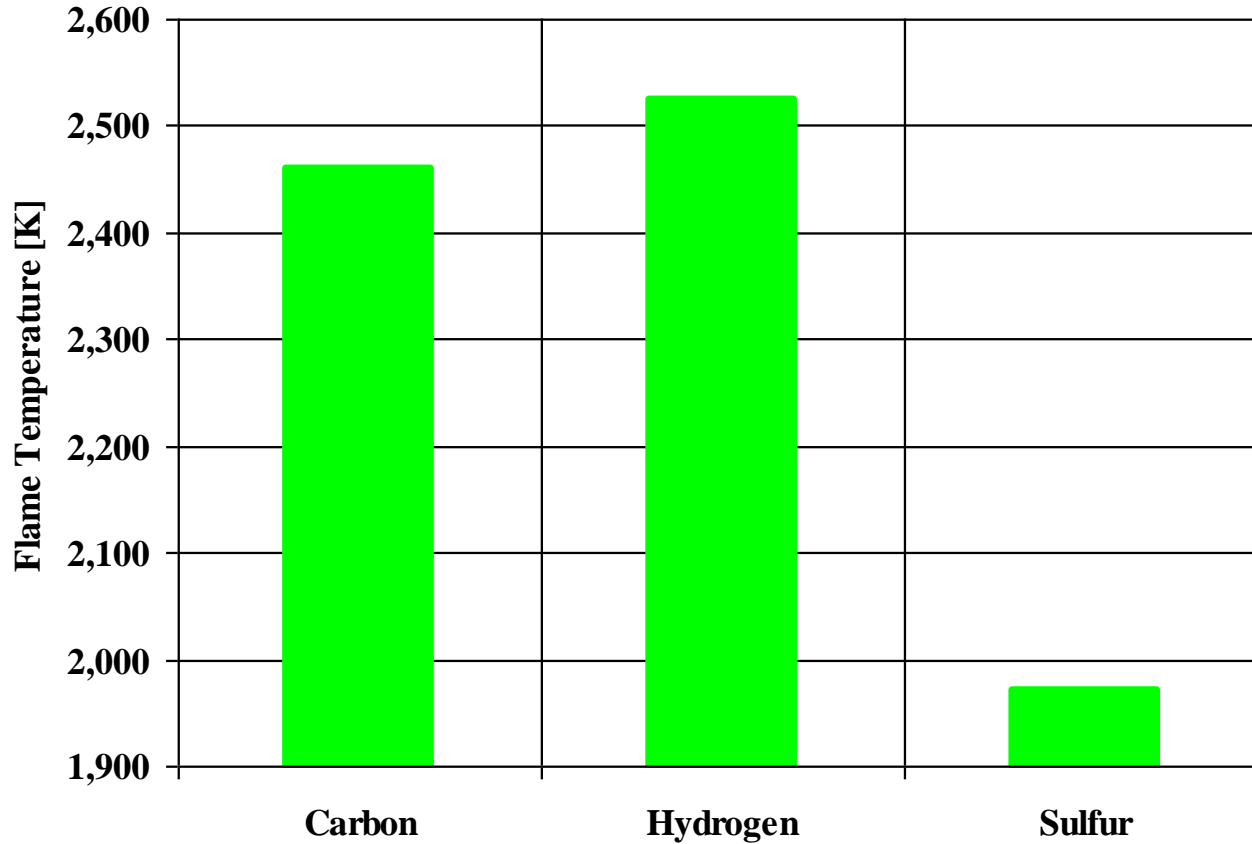
Fuel and Oxidant Inlet Temperature: 298 [K]

## Combustion Products -- Mole Basis



Fuel and Oxidant Inlet Temperature: 298 [K]

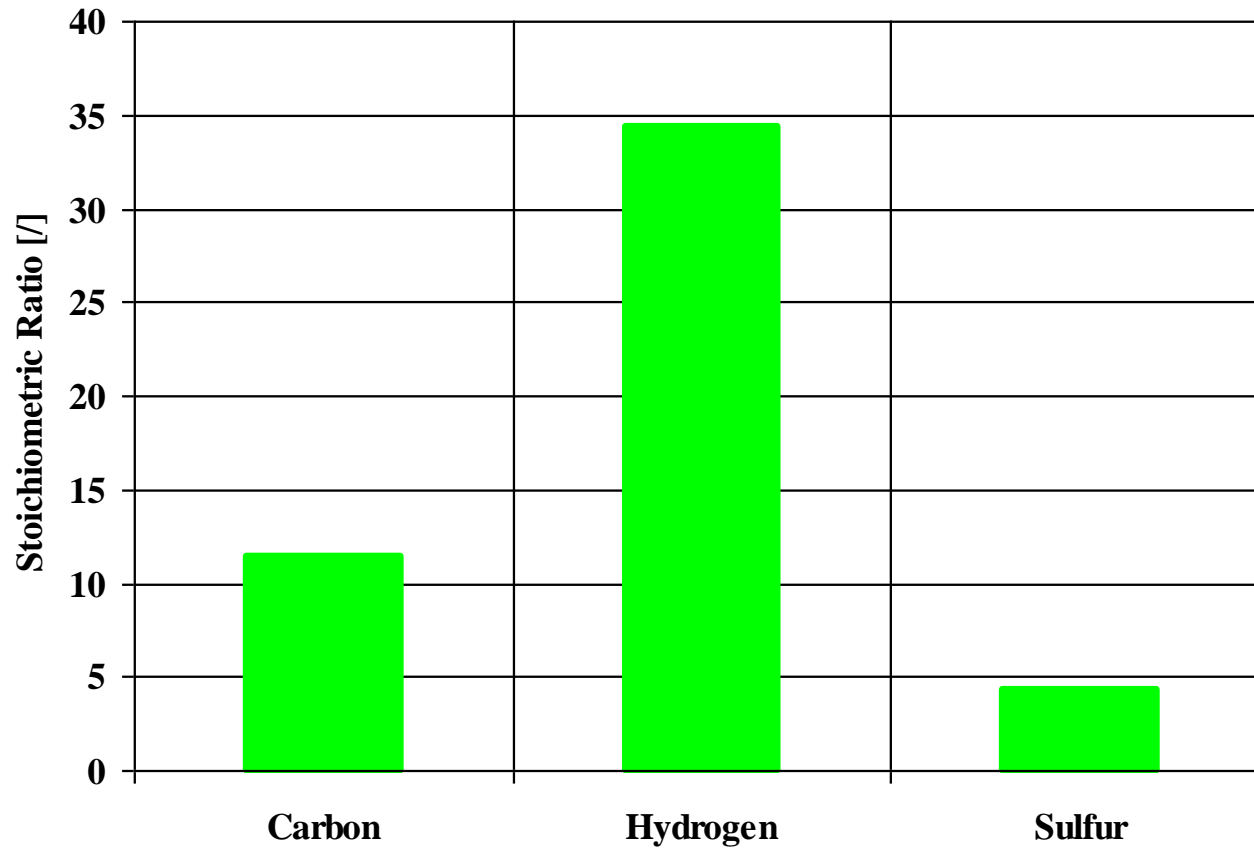
# Combustion Products Flame Temperature



■ Flame Temperature

Fuel and Oxidant Inlet Temperature: 298 [K]

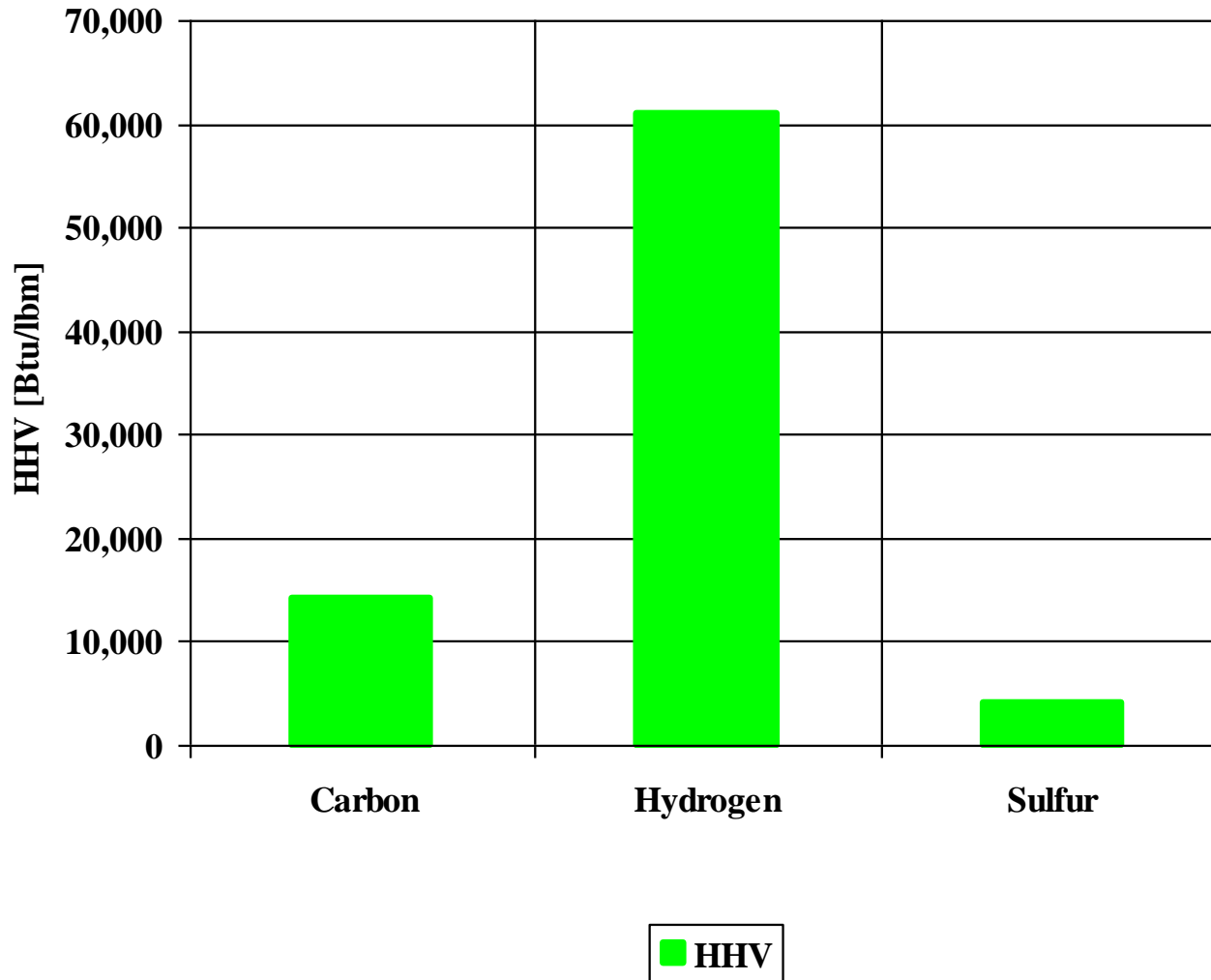
# Combustion Stoichiometric Ratio



■ Stoichiometric Ratio (Oxidant to Fuel)

Fuel and Oxidant Inlet Temperature: 298 [K]

# Higher Heating Value (HHV)



Fuel and Oxidant Inlet Temperature: 298 [K]

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