CO Mechanism

1 Dry CO Mechanism

Carbon Monoxide Oxidation is very important in hydrocarbon combustion. The chemical reaction is:

$$CO + \frac{1}{2}CO_2 \rightarrow CO_2 \tag{1}$$

This reaction has very high heating value and adiabatic flame temperature. It is also important intermediate in hydrocarbon combustion, CO_2 mostly produced by CO oxidation.

Dry CO explosion means there is no H species during the reaction, only C, O diluent. However, dry reactions are very slow at combustion temperatures. It is extremely difficult to ignite/propagate combustion in pure CO/O_2 systems, and also hard to produce very dry mixtures.

2 Wet CO Mechanism

Presence of H-containing species vastly increases CO oxidation rates. Overall mechanism:

Initiation:

$$CO + O_2 \xrightarrow{CO.1} CO_2 + O \tag{2}$$

Chain Branching/Propagating:

$$CO_2 + O_2 \xrightarrow{CO.2} CO_2 + O + O \tag{3}$$

$$O + H_2O \xrightarrow{H.15} OH + OH \tag{4}$$

$$CO + OH \xrightarrow{CO.3} CO_2 + H \tag{5}$$

$$H + O_2 \xrightarrow{H.3} OH + O \tag{6}$$

$$O + H_2 \xrightarrow{H.4} OH + H \tag{7}$$

$$OH + H_2 \xrightarrow{CO.2} H_2O + H \tag{8}$$

The most dominant steps in wet CO oxidation are (H.3) and (CO.3). (CO.3) is the **most exothermic step** in combustion of most hydrocarbon fuel.

Temperature can affect (CO.3) significantly. At low temperature, $CO+OH$ is slow, mechanism shifts to HO_2:

$$CO + HO_2 \xrightarrow{CO.4} CO_2 + OH \tag{9}$$

3 Combustion Process Analysis

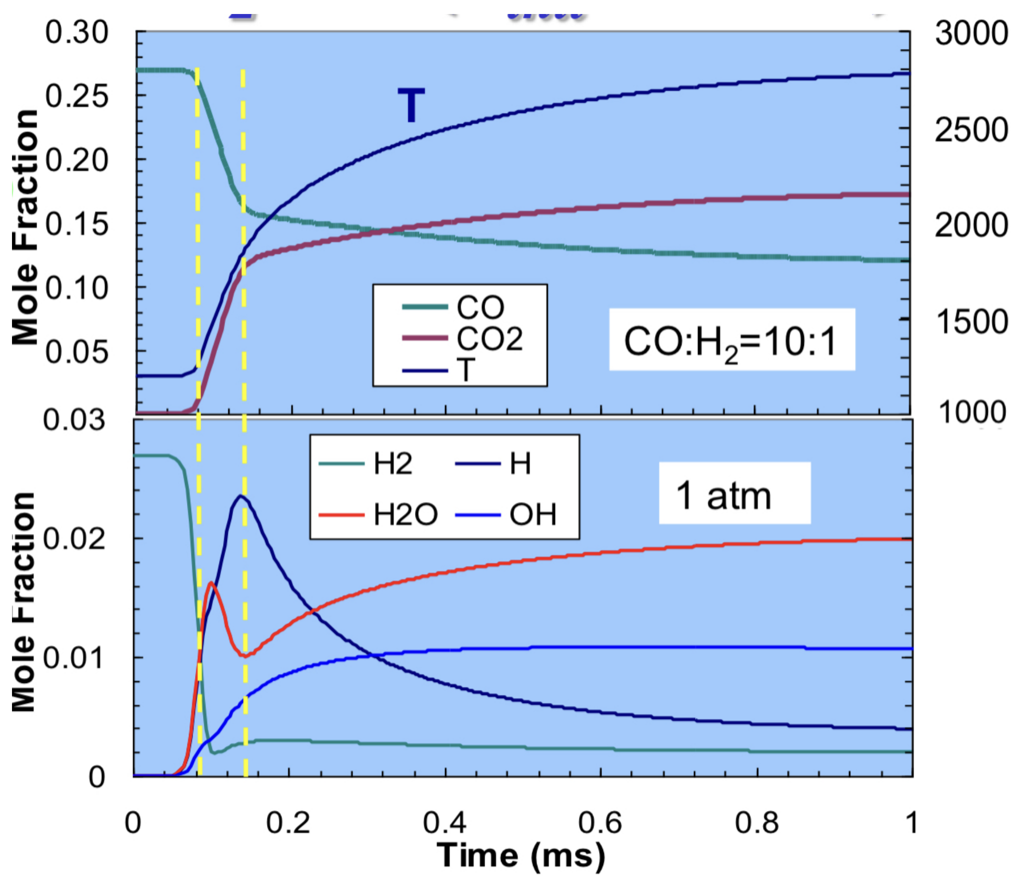

Figure 1: CO Reaction Process.

From the graph, we can observe that H_2 chemistry is faster than CO. H_2 makes enough OH so that CO can react.