**Product separation and recycle**

In case of unconsumed reactants, we should define the conversion of reactants based on their conversion in the reactor chamber and also in overall.

Overall conversion =

Single-pass conversion =



Between points A and B, we can compute single pass conversion and C and D, we can compute overall conversion.

**Combustion Chemistry**

Incomplete combustion vs complete combustion

C4H10 + 13/2 O2 = 4CO2 + 5H2O ……. Complete combustion

C4H10 + 9/2 O2 = 4CO + 5H2O ……. Incomplete or partial combustion

***Composition of a gas on wet basis*** refers to the composition of a gas mixture in the presence of water.

***Composition of a gas on dry basis*** refers to the composition of a gas mixture in the absence of water.

**Theoretical and excess air**

In combustion reactions, it is necessary to feed the air and therefore, oxygen in theoretical or excess amounts to ensure complete combustion. So, oxygen supply in excess amounts is preferred to minimize the risk of an incomplete combustion and CO generation.

For these reason, general terms are used to define the conditions of input oxygen stream:

Theoretical air is the amount of air needed to convert all the hydrocarbon fuel into CO2 and H2O.

Theoretical oxygen is the oxygen amount corresponding to theoretical air.

Excess air is the amount of air fed to the process that exceeds the theoretical air.

Percent excess air (%) =

Example



Reference: Richard M. Felder, Ronald W. Rousseau, Elementary Principles of Chemical Processes, 3rdEdition.