# Tri-reforming equilibrium

The Gibbs free energy minimization helps to calculate the composition equilibrium for the components involved in the tri-reforming of methane. Equation depicts the total Gibbs free energy of the system



Where  is the Gibbs free energy of species  under standard conditions,  is the universal molar gas constant,  and  are fugacity of species  at standard and operating conditions, respectively,  is the number of moles of species , and  is the temperature. If carbon is formed in the overall reactions,  represents the number of solid carbon molecules, while  is the Gibbs free energy of solid carbon at the operating conditions. Given multiple phases coexisting under equilibrium conditions, for the gas phase, Equation represents the relation between gas fugacity and activity coefficient.



Where  is the molar fraction of the gaseous molecules and  is the fugacity coefficient for the th species.

The problem now is to find the set of  which minimizes  at a constant  and , subject to the constraints of elemental balances as in Equation .



Where  refers to the number of atoms of the th element present in each molecule of species  and  is the total number of atoms of the th element in the feed. The optimization formulation for this problem also includes the condition that all variables are not negative.