

Metallurgical thermodynamics simulation & analysis

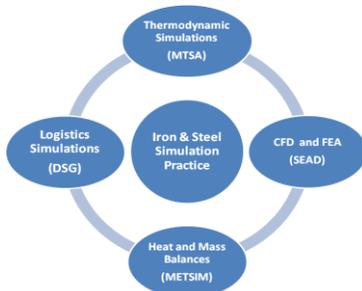
Iron & Steel

Complex metallurgical reactions occur in ironmaking and steelmaking processes.

Thermodynamic simulation can help improve process design and engineering, enhance operational practices, and improve product quality.

Without thermodynamic simulations, reliance solely on experiments and plant trials can be costly, time-consuming, and prone to error.

Thermodynamic analyses offer a good starting point for operations, and are useful to improve and optimize processes through desktop studies. These allow for lowering of operating costs and increase in product quality, while mitigating risks associated with running plant trials.



Our simulation practice.



Combustion in a rotary kiln.

Services

Our thermodynamic simulation group has expertise in modeling the following for a variety of ironmaking and steelmaking applications:

- Chemical reactions over a wide range of temperatures and pressures
- Oxide slag systems and slag or metal reactions, slag viscosity
- Liquids temperature calculations
- Alloy design
- Solidification and cooling
- Liquid metal treatment (desulfurization, and dephosphorization of liquid metals)
- Inclusion modification and control
- Slag or refractory interactions
- Combustion and flame temperature prediction for different fuel mixes
- Multi-component phase diagrams (oxides, metals, molten salts, mattes, slags)
- E-Ph diagrams, predominance diagrams and Ellingham diagrams
- Process simulation and analysis (involving thermodynamics and kinetics using Visual Basic programming).

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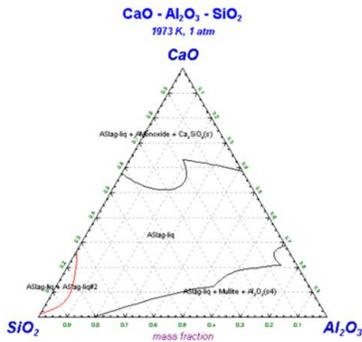
Quality assurance and control

Our process engineering specialists can determine conditions under which a process is running below the optimum and affects productivity and quality, and can develop strategies to mitigate those unfavorable conditions.

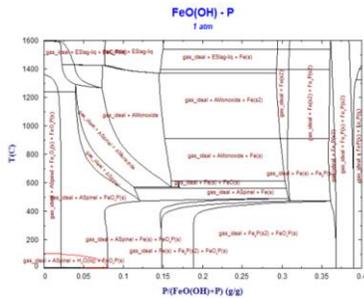
We have strong process engineering expertise coupled with world-class simulation capabilities, thus offering the complete package to better design and optimize a metallurgical operation. Simulations are based on first principles and are validated with operational data and/or published literature to make analysis robust and deliver value-added solutions.

Allied to our strong process capability, thermodynamic simulations can help improve a variety of processes. Some applications to projects include:

- Total process simulation of blast furnace, BOF, ladle metallurgy furnace, rotary kilns
- Direct reduced iron smelting
- Ilmenite smelting
- Combustion in rotary kiln or burner systems (flame temperature with different fuel mixes and products of combustion)
- Hot metal and liquid steel desulfurization
- Basic oxygen furnace refining
- Refractory and slag interactions
- Inclusion and slag interactions
- Liquid steel reactions and deoxidation
- Inclusion formation in the ladle and tundish
- Liquid steel calcium treatment
- Calculate slag and metal liquids temperatures in metallurgical reactors
- Formation of precipitates during cooling of steel
- Multi-component phase diagrams of slags and mould fluxes
- Formation of metal vapors over electric arc furnaces and basic oxygen furnaces (BOF).



Slag phase diagram.



Phase diagram of iron ore and phosphorous showing various phosphates that are formed under different temperatures and phosphorous content.