

Finite Element Modelling

Finite Element Modelling is a numerical method of finding a solution of partial differential equations. The physical phenomena of a complex engineering problem can be described in terms of partial differential equations. **COMSOL Multiphysics** is software that employs numerical methods to solve partial differential equations thereby calculating various physical quantities such as temperature, velocity, force, pressure, concentration, electrical current density, magnetic field density etc.

One of the main advantages of using a package such as COMSOL Multiphysics is that partial differential equations of different physical properties can be solved simultaneously in real time. This enables the user to develop a broader and deeper understanding of a complex engineering system.

In the approach adopted by XPS for Finite Element Modelling, the output from thermo-chemical models (based on FACTSAGE™) and the process models (based on METSIM™) are combined with COMSOL Multiphysics. For example, thermo-physical properties of the slag (heat capacity, density), heat of reactions etc. can be calculated from FACTSAGE™. Similarly, output from METSIM™ model can be used to define the boundary conditions of a COMSOL model.

Key Capabilities

Finite element modelling helps in answering key questions of plant operation, equipment design and materials selection.

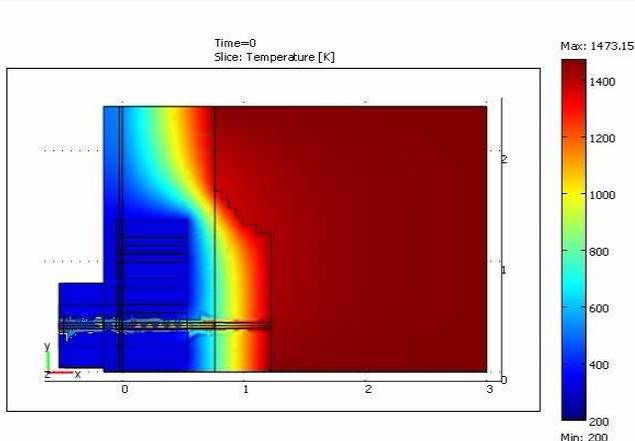
COMSOL Multiphysics has been applied in the following cases:

- Furnace freeboard study.
- Vessel integrity.
- Refractory capability study.
- AC/DC furnace design

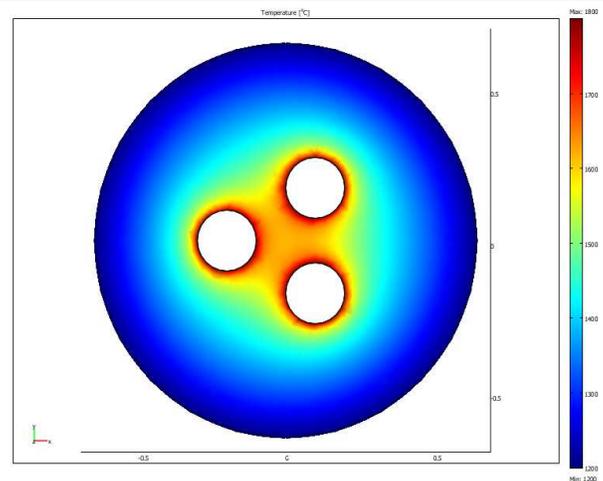
Recent projects successfully completed by XPS using COMSOL include:

- A study on heat and mass transfer in AC submerged circular furnace.
- A study on fluid flow in furnace freeboard of Noranda reactor using finite element method.
- A study on temperature profile in the refractory of Noranda reactor.
- Finite element study on tap hole of the electric furnace

Examples of Using Finite Element Model Using a COMSOL Platform



Finite Element study on a tap hole of an electric furnace



Temperature profile in the slag phase of AC submerged furnace