

# Multi-Phase Equilibrium (MPE) — Process modelling software

Multi-Phase Equilibrium (MPE) is a software developed by CSIRO using the CALPHAD method for the calculation of multiphase equilibrium in high temperature base metal production systems. It can be used for modelling ferrous and nonferrous smelting processes to improve understanding, diagnose problems and optimization.

## Overview

MPE is a powerful analytical tool for use in the high temperature processing of minerals and molten materials. It contains comprehensive molten solution databases relevant to metal production. The minor elements commonly found in nonferrous ores are included in the MPE package. Its comprehensive calculation capabilities can be used to investigate a wide range of technical problems. The package contains a number of modules which are focused on specific industries.

## Key modules

- Gas and solids
- Slags and refractories
- Copper and nickel smelting
- Lead and zinc smelting
- Ferroalloy Smelting
- Iron and steelmaking

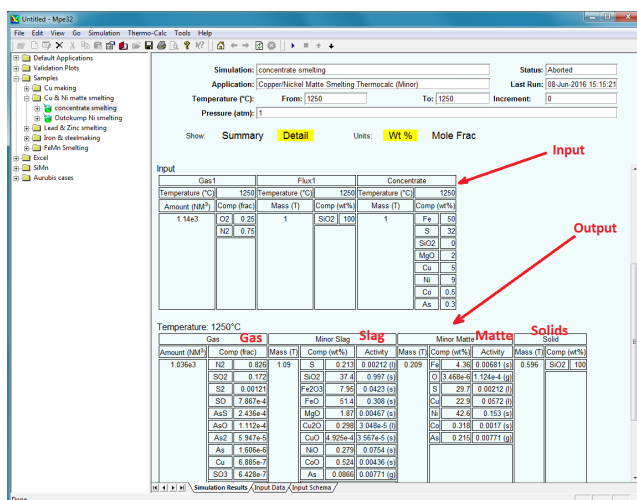
## Capabilities

- Modelling the heat and mass balance of base metal smelting
- Modelling the deportment of the minor elements (As, Sb, Bi, Pb, Se, Te, Sn, Co, Ni, Cr, Po and Ra..) among phases in nonferrous smelting
- Predict the melting point and viscosity of the slags
- Modelling the formation of speiss phase during smelting of high As/Sb materials
- Predict the electrical conductivity of smelter type of slags
- In addition to its standalone interface, MPE can also be driven through Excel worksheet, which is convenient for process flowsheet modelling
- In Excel mode, MPE can be used for batch calculation and analysis of large amount of industrial data

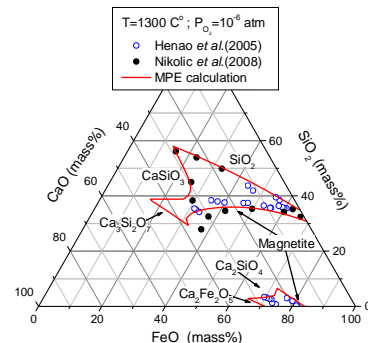
## Applications

### Liquidus

The liquidus of the slag can be calculated at given conditions which can help designing an appropriate fluxing strategy for smelting a specific concentrate.



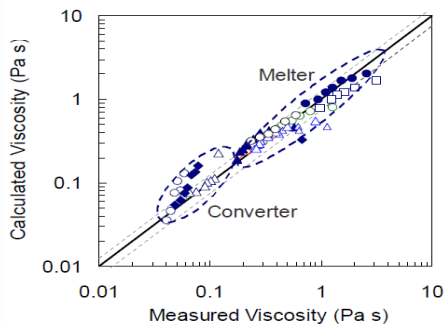
Illustrative display of MPE showing input and output data.



The calculated liquid region of the FeO<sub>x</sub>-CaO-SiO<sub>2</sub> slag system at 1300 °C and oxygen partial pressure of 10<sup>-6</sup> atm.

## Viscosity

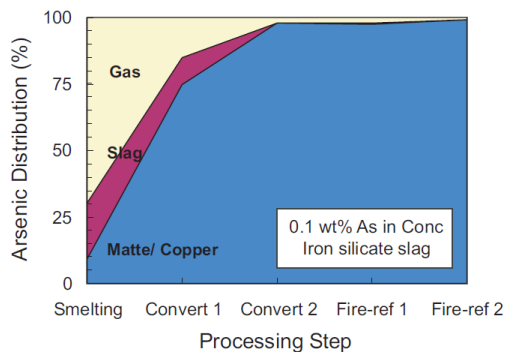
MPE is able to predict the viscosity of slags with or without solid phase suspension over broad composition and temperature ranges.



The comparison of the calculated viscosities of melter and converter type of slags against the plant measurements.

## Minor elements department

Toxic elements such as arsenic is often present in copper concentrates in low concentration. However, the minor elements can have a major influence on the quality of the products as well as an economic and environmental impact. Therefore, a high degree of control over their departments is a key step in reducing their dispersion in the biosphere.

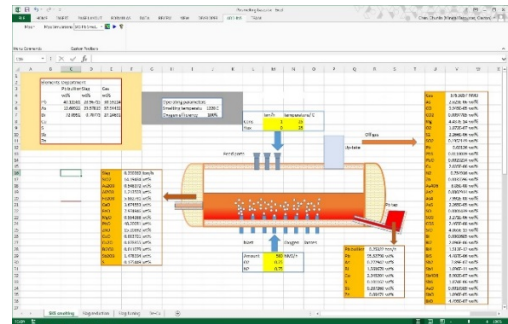


The calculated department of arsenic between matte/copper, slag and gas phases during smelting, converting and fire-refining steps.

## Flowsheet modelling

MPE can also be driven through Excel worksheet. This feature enables MPE for flowsheet modelling of a multistage process such as lead smelting by linking the output of previous stage (smelting) to the input of the

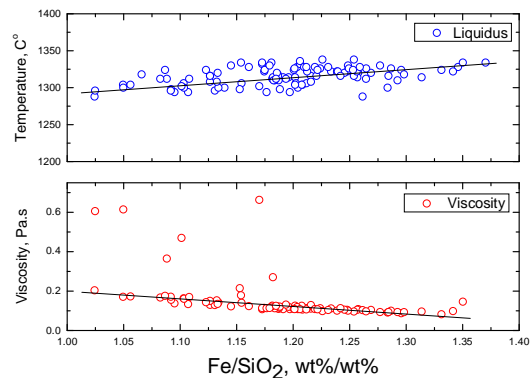
following stage (slag reduction) in Excel. The department of major and minor elements across the whole process (smelting, reduction, fuming etc.) can be modelled. This feature also allows MPE to exchange data with other software through the Excel worksheet.



Flowsheet modelling of the lead smelting process. The direct recovery of lead to bullion at smelting stage is around 40%, the slag with 48% Pb was produced.

## Analysis of plant data

Another important feature of MPE is its batch calculation mode in Excel. Large data sets, such as flash furnace operation data of which the slag composition was set up in Excel can be automatically processed batch wise by MPE. The results can then be statistically analysed and examined for significant trends. The plotting function in Excel also makes it convenient to visualize the variation trend of the results.



The calculated slag viscosities and liquidus of a commercial nickel flash smelter.

The team is able to facilitate the use of MPE for process optimization either through commercial project or direct sale of MPE license.

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### FOR FURTHER INFORMATION

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