Pyrometallurgy Division

High Temperature Laboratory

Overview

The High Temperature Laboratory in Mintek's Pyrometallurgy Division focuses on laboratory-scale studies for the minerals industry. A multidisciplinary team of metallurgists, mineralogists, earth scientists, engineers, and chemists is able to address most metallurgical aspects of pyrometallurgical processes. The scope of work includes materials characterisation and process development, which complement the larger-scale activities of pyrometallurgical process development and piloting.

Laboratory-scale activities

Evaluation of metallurgical products and related materials

Investigations include the physical and phase-chemical characterisation of metallurgical products and related materials. Examples include the analysis of failed refractories, the determination of liquidus temperatures, and the characterisation of reaction products.

Phase equilibrium studies

These deal with liquid-gas interactions at high temperature (*i.e.* the interactions between slags, glasses, oxide melts, alloys, mattes, etc.). Investigations are generally conducted on samples prepared in the division's laboratories using equipment that is able to accurately control both temperature and atmosphere (in order to control the oxygen partial pressure). A recent project involved a study of the partitioning and solubility of chromium in silicate liquids.

Solid-state studies

Solid-state reactions (solid-solid or solid-gas interactions) at high temperature are involved in processes such as roasting, calcining, oxidation, reduction, and the generation of volatiles. These reactions can be studied using materials prepared in the section's furnace facilities, or products submitted for analysis. Examples include the calcining behaviour of sulphide ores, the reduction mechanism of chromite, the generation of volatiles during the pyrometallurgical treatment of furnace dusts or leach residues, and the metallurgical performance (reactivity) of carbonaceous reductants.

Pyrometallurgical process development

An increasing amount of work is focused on the development of new or improved pyrometallurgical processes. Particular emphasis is placed on mass transfer aspects of process development up to small pilot-plant scale. Engineering aspects of the processes are covered elsewhere within the division, although we maintain involvement to monitor the metallurgical performance. Examples of recent projects include the distillation of PWG zinc, which resulted in a new, patented process, and fluidized bed chlorination of titania feedstock.

Other activities

Metallurgical monitoring and modelling

It is not easy to assess the performance of many pyrometallurgical processes based on normal plant data and mass balances. Mintek has special expertise in sample collection and the metallurgical monitoring of pyrometallurgical unit operations. In addition, the data can be used to model the performance of the operations. Examples include the deportment of elements between process streams, or the solubility of chromium in matte smelting furnaces.

Metal accounting

Research and development work is currently conducted by doing overall plant mass-balances, which includes various parameters and associated uncertainties. The problematic areas of uncertainty can be identified, researched, and improved, using both the laboratory-scale experimental facilities and the interdivisional support available.

Facilities

Mintek has a range of sophisticated laboratory-scale muffle, tube, quench, rotary kiln, and fluidized bed furnaces and peripheral equipment, all of which are equipped for operation under stringently controlled conditions. In addition, many of the larger projects that are undertaken result in the construction of pilot-plant facilities, and these are also available for commercially funded testwork. Thermodynamic calculations and phase-chemical predictions are undertaken using the FACT thermodynamic database and modelling software.