



**SUPPORTING YOUR  
PYROMETALLURGY PROJECT  
DEVELOPMENT**



**MINTEK**

A global leader in mineral and metallurgical innovation

MINTEK'S PYROMETALLURGY DIVISION carries out high-temperature research and process development in the following fields:

- DC arc furnace smelting
- Pretreatment, prereduction, fluidized-bed technology
- Fuming
- Condensation
- Process design and simulation
- Metallurgical waste treatment
- Base metals
- Light and refractory metals
- Stainless steel and ferro-alloys
- Precious-metals concentrate smelting

## **DC-ARC FURNACE TECHNOLOGY**

Mintek is a world leader in the application of DC arc furnace technology. The Pyrometallurgy Division's greatest strength lies in its range of transferred DC arc furnaces (single graphite-electrode furnaces) that are available for testwork. The largest of these is rated at 5.6 MVA, and is usually operated continuously between



1 and 2 MW. Campaigns of many weeks/months can be undertaken. Three smaller furnaces, ranging from 30 to 500 kW, are used for smaller-scale tests.

Work has also been carried out using AC arc furnaces (40 to 200kW) in either slag-resistance or submerged-arc mode. Experience has been gained in treating sulphide concentrates, ferro-alloys, direct stainless steel, and fused-cast refractories.

The following commodities form part of the Pyrometallurgy Division's expertise:

- Chromite smelting
- Ilmenite smelting
- Recovery of cobalt from slags
- Steel-plant dust treatment
- Magnesium metal
- Platinum group metals



## **FUMING AND CONDENSING**

Mintek developed expertise in the mid 1980s in the fuming of magnesium in a tightly sealed DC arc furnace at the 60 kW scale but this has not yet been commercialised. Expertise has also been gained in the fuming of zinc (Enviroplas process) from both lead blast furnace slags (LBFS) and electric arc furnace dusts. The treatment of LBFS has been demonstrated at up to 2 t/h in a sealed furnace linked to a lead splash condenser. The continuous introduction of liquid slag at 1 t/h through an underflow weir has also been successfully accomplished.

## **HIGH TEMPERATURE LABORATORIES**

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.



## ***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).

## ***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.

## **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.





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***For further information contact***

Pyrometallurgy Division, Mintek  
200 Malibongwe Drive,  
Private Bag X3015, Randburg, 2125, South Africa  
Phone: +27 (11) 709-4622

Manager: Isabel Geldenhuys,  
Email: [IsabelG@mintek.co.za](mailto:IsabelG@mintek.co.za)

