MINTEK has many years’ experience in developing techniques for the physical separation of metallic and non-metallic minerals. South Africa’s andalusite industry was founded on work done at Mintek. Dense-media separation (DMS) processes have shown promise as a pre-concentration stage and has been incorporated into platinum-group metals flowsheets, to separate barren waste rock from ore prior to milling. The beneficiation of chromite and iron ore using gravity and magnetic separation followed by flowsheet design have become important activities.

Services

Heavy Liquid Separation and Dense-Media Separation

Laboratories have been set up to carry out preliminary “sink-float” separations up to densities of 4 g/cm³. The HLS media comprises mainly of Tetra Bromo Ethane (TBE) mixed with atomised ferrosilicon or acetone to select the required relative density. Density classes with intervals of 0.05g/cm³ can be evaluated. The data is used to construct washability curves. For small-scale downstream processing such as milling and flotation, the separation is conducted in a specially designed “bucket” using only FeSi and water to avoid chemical contamination.

Pilot Dense-Medium Separation

Following from HLS tests, investigative projects are designed to treat bulk samples in the 2-5t/h DMS cyclone plant, which operates using either cyclones 250 mm or 350 mm in diameter. The plant is able to treat samples from 100 kg to 100 t in the larger pilot applications. HLS analyses on the sink and float fractions are used to confirm the separation efficiency of the DMS testwork. Projects on diamondiferous gravel, andalusite, iron, PGMs, gold, copper-nickel, and chromite ores have been run successfully.

Other Gravity Separation Technologies

MINTEK has a range of bench and pilot-scale equipment, including:

- Wilfley shaking tables (one-eighth and half-size);
- A variety of spiral concentrators, including a large diameter and high capacity spirals that can be run either in batch mode or continuously at solids feed rates from 1 t/h to 8 t/h;
- Fine and Ultra-fine separators such as the Falcon, 3 inch and 7 inch Knelson concentrators, Laboratory Mozley multigravity separator and Superpanner;
- Mineral Density Separator for characterising samples into closely spaced density fractions. The results are used to assist in plant performance, as well as to evaluate the amenability of using jigging as a processing option;
- Laboratory Teeter Bed Separator (6kg samples) and pilot Linatex T-type classifier treating up to 1 t/h solids; and,
- Kipp Kelly pilot air (pneumatic) table feed rate ±100-300 kg/h.

Classification

Wet and dry classification is carried out using a variety of equipment:

- Standard laboratory sieve shakers, Sweco and Rhologan screens;
- A variable linear screen with adjustable frequency, amplitude and inclination;
- Hydrocyclone pilot plant incorporating 25 mm, 65 mm, 100 mm, and 150 mm diameter cyclones; and,
- Air classifier used for dry classification down to 5 μm.
Electrostatic separation
Typically for mineral sand applications, evaluations are done on laboratory scale Ultrastat and Coronastat separators.

Magnetic separation
Permanent Roll Separator (dry)
• Laboratory rare-earth oxide permanent high-intensity roll separator for dry separation, with barium ferrite, samarium cobalt, and neodymium boron iron rolls;
• Pilot separator with two rolls treating a nominal 300 kg/h is also equipped with barium ferrite and neodymium magnets; and,
• Laboratory-induced roll separator.

Low-Intensity Magnetic Separation (LIMS)
• A wide range of laboratory and pilot scale LIMS units are available for testwork; and,
• A Davis tube is available for determining ferromagnetic content of ores.

Wet High-Intensity Magnetic Separation (WHIMS)
WHIMS is conducted at both laboratory (Eriez and Slon) and pilot scale (Jones and Magnapower). Mintek has a wide range of experience in the iron ore industry.

Sensor-based sorting
A variety of the latest sorters from Commodas/Ultrasort are available at pilot scale, including:
• A double camera optical sorter unit which has been successfully tested for the cost-effective upgrading of gold, platinum-group metal (UG2), base metal and industrial minerals ores. The unit on site is capable of handling up to 100 t/h at a feed size range of 20 mm to 80 mm, depending on the mineral composition;
• A dual X-Ray Transmission sorter which has been used for the upgrading of coal ores with a top size of up to 150mm; and,
• A wet diamond X-ray fluorescence sorter.

Coal preparation
Mintek undertakes bulk or laboratory scale testwork on the upgrading of coal to a saleable product using dense media, centrifugal separation, jiggling, spirals, and T-classifiers. Other services include process simulation and plant audits.

Recent Projects
• Tati Nickel – Bankable feasibility study with a focus on DMS processing;
• Kumba Resources - characterisation of iron ores via gravity and magnetic separation;
• Tata Steel - characterisation of fines via gravity and teeter bed separation;
• VALE – characterisation and flowsheet development of manganese and coal ores; and,
• Saudi Arabia - pilot-scale testwork on phosphate ore upgrading in conjunction with Bateman.