**Dense Media Separation Laboratory**

In 2003, Mineral Services Canada Inc. commissioned North America's first laboratory scale micro-DMS plant at its North Vancouver facility (Fig. 1). The plant is designed to recover diamond indicator minerals and diamonds in the size range -6 to +0.3 millimetres from exploration samples (till, stream sediments etc.). Over ten years of research and development by Dowding, Reynard and Associates and others has perfected the technology to achieve the accuracy and repeatability required for batch mode laboratory applications. DMS technology is clean (non-toxic), fast, accurate and reliable. It is also less susceptible to sample contamination than conventional heavy mineral concentrating techniques currently in use in the exploration industry. In 5 years of operation, the facility has processed in excess of 10 000 samples.

*Figure 1. Micro DMS plant at the Mineral Services Vancouver Laboratory*
Calibration and Quality Control

Separation in the DMS plant is achieved in a gravity-fed high-pressure cyclone (Fig 2a). The sample is mixed with ferrosilicon slurry of controlled density and fed into the cyclone where separation of the heavy mineral fraction from the light minerals is effected. The efficiency and precision of the separation process is defined by a Tromp Curve (Fig 2b). The cut-point spans a density range of 0.2 g/cm$^3$ at ~3.1 g/cm$^3$ and has been carefully calibrated to quantitatively recover chrome diopside (SG ~3.25 g/cm$^3$) and forsteritic olivine (SG ~3.34 g/cm$^3$) along with pyrope garnet, chrome-spinel and ilmenite.

![Calibrated tromp curve](image)

In our North Vancouver laboratory, the Tromp curve is established each morning using synthetic density tracers prior to commencing with daily production. In addition, every fifth sample is spiked with synthetic diamonds in order to monitor and demonstrate plant performance. During the commissioning phase, numerous tests were undertaken in order to establish optimum performance.

Test Results

Natural kimberlite indicator minerals (-2 +0.3 mm) together with synthetic density tracers (0.8 mm) and synthetic diamonds (0.5 mm) have been used to calibrate and test plant performance over a wide range of sample background compositions and grain-size ranges. In terms of natural indicator mineral grains, standard tests involved the introduction of 100 grains of each of the common KIM mineral species (pyrope garnet, chrome diopside, picro-ilmenite and forsterite olivine). Results were beyond expectation in that not a single indicator mineral grain was lost during the entire testing process, which involved over twenty tests performed under a variety of conditions. Routine QC testing introduced since the laboratory commenced commercial production has been equally impressive.
Initial weights measured and recorded. Samples washed and screened into –2 +1 and –1 +0.3mm fractions (-2 +1mm fraction to storage or waste, - 0.3mm fraction to waste).

Unconsolidated exploration samples

Sweco wet screening

Dense Media Separation

Dry screening

Magnetic Separation (Permroll)

Heavy Liquid Separation

Magstream

Concentrate screening

Indicator mineral sorting and extraction

Optional Processes

Heavy mineral concentration of the –1 +0.3mm fraction using a micro-DMS plant with a calibrated cut point of 3.1g/cm³.

Removal of residual ferrosilicon fines using Ro-tap shaker.

Concentrate reduction by separation of non-magnetic minerals using Eriez RE5-1 rare earth roll permanent magnetic separator (non-mag fraction to storage).

Concentrates hand screened into –1 +0.5 and –0.5 +0.3mm fractions (only on samples >5g). Samples processed through Magstream will have both the ILM and PCD fractions hand screened into these size fractions.

Sorting of concentrates and mineral analyses are undertaken at Mineral Services Laboratories in Vancouver or Cape Town, South Africa which is accredited under ISO/IEC 17025.

Removal of ferromagnetic minerals using Carpcoc Model MOS (10) 111-15 separator (only on samples > 5g) (magnetic fraction to storage).

If excess almandine garnet is present, the para-magnetic fractions may be processed to separate almandine garnet and kimberlithic oxides (ILM fraction) from kimberlithic silicates (PCD fraction). Significantly enhances sorting efficiency and reliability.

Concentrate refinement with methylene iodine (MI) SG=3.32 (can be diluted to 3.20) (floats to storage).

Initial weights measured and recorded. Samples washed and screened into –2 +1 and –1 +0.3mm fractions (-2 +1mm fraction to storage or waste, - 0.3mm fraction to waste).

Optional Processes