Density Tracers for Minerals and Diamond (high RD range) applications

DIAMOND Non-RFID Density Tracers

To monitor the performances of DMCs and other density separators

Compliant with
Australian Standard AS5213: 2019
ISO Standard ISO5146:2022

- Added to and removed from the circuit manually
- 18 precise densities: 2.50 to 3.53 (colour coded)
- 11 sizes available 1mm to 20mm

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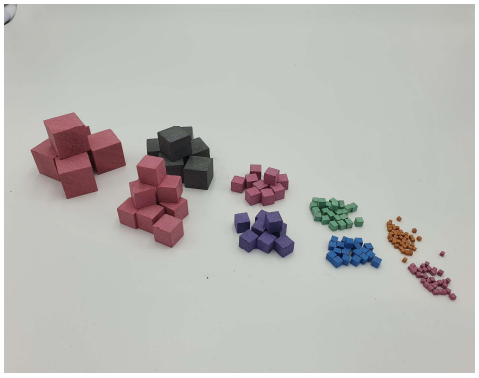
Cubic density tracers with densities spanning the range of interest are added to the circuit feed and retrieved from the product and rejects streams, manually or with the assistance of magnets or X-ray sorters. Guidance may be found in AS5213:2019 and ISO5146:2022.



For statistical confidence, a test may utilise some thousands of tracers in selected sizes and densities. After retrieval they are sorted into their various densities, and the resulting data are used to plot one or more partition curves.

The form of the curves can indicate whether the metallurgist should take actions such as adjust medium density, replace a worn circuit component, or correct an overload or medium instability situation.

Procedure

The following procedures focus on Dense Medium Cyclone circuits (DMC) but are adaptable to other units.
For a DMC circuit which has not previously been tested in this way:

1. Select appropriate sizes of density tracers, ensuring they can be retrieved
2. Determine appropriate tracer densities to be employed
3. Determine the number of tracers to be used at each density interval
4. Assemble the required personnel and conduct the test
5. Interpret the partition curves and assess the data

Select appropriate sizes of density tracers

To ensure relevance of the data to be generated, it is strongly recommended that tests be conducted with feed on. If using magnets for retrieval, one is usually free to select tracer sizes from 2mm up. If the nominal feed size range is, for example, -25+1mm, one may select tracers of 16, 8, 4 and 2mm. To check that retrieval rates are adequate, one may position the magnets at the discharge lips of the drain-and-rinse screens, then insert tracers of the relevant sizes at the feed ends of the screens. Retrieval rates commonly approach 100%, but reliable partition curves can be generated with retrieval rates as low as 70% (Wood, 2004).

If tracers are to be retrieved manually, it is usually feasible to employ only one size of tracer, which must be large enough to be reliably seen in the load on drain-and-rinse screens. For installations with a feed topsize in the 20-70mm range, 32mm tracers are most often used. For circuits with smaller feed, it is sometimes possible to use 16mm tracers. At least one person must be positioned to retrieve tracers from each drain-and-rinse screen in the circuit, for the duration of the test.

Determine appropriate tracer densities to be employed

Diamonds & Other Minerals:
Density Tracers for diamond applications are offered in 18 densities ranging from 2.5 g/cc to 3.53 g/cc. The density intervals are 0.1 g/cc, or 0.05 g/cc in the region of the commonly-targeted cutpoint of about 3.1 g/cc. Metallurgists typically select from these about 10 densities which they find to be important to their operations. Cutpoints for nickel, lithium, manganese and iron ore processing are usually similar to those for diamonds.

Determine the number of tracers to be used at each density interval

Diamonds:
With the larger density intervals in diamond circuit tests, it is common to use 100 tracers at each selected size and density. For a test using 3 sizes and 12 densities, the total number of tracers would be 3,600.

Conduct of the Test

If magnets are used, they should be positioned in the drain-and–rinse launders, but just out of the ore streams. After conducting any preliminary observations such as determinations of the densities of feed, overflow and underflow media, drop the selected tracers into the circuit feed, typically into a deslime screen oversize launder. Slide the magnets into their respective floats and sinks streams before arrival of the first tracers. 5 minutes after addition of the tracers, slide the magnets out of their streams. Any tracers not retrieved are considered as lost, or retained in the separator. If necessary, gently hose ore particles off the magnet, then pick off the tracers for washing, sorting into size and density fractions and counting. In cases where products from individual cyclones in a module are drained on separate screens, it can be helpful to separately record the tracers which report to those screens. A separate sheet may be used for each tracer size. Enter the numbers in the floats and sinks columns of appropriate test sheets (Test Data Sheet) If tracers are to be retrieved manually, they should be inserted at a rate suitable for manual retrieval, around one tracer every two-three seconds.

Interpretation of DMC Partition Curves

The figures below illustrate the common forms of density tracer partition curves for dense medium cyclones. A module of one or more well-operated and well maintained dense medium cyclones should show an efficient separation (Figure 1). By contrast with conventional float/sink techniques, density tracers provide the resolution which shows that large particles can be partitioned with an Ep of less than 0.01 RD units.

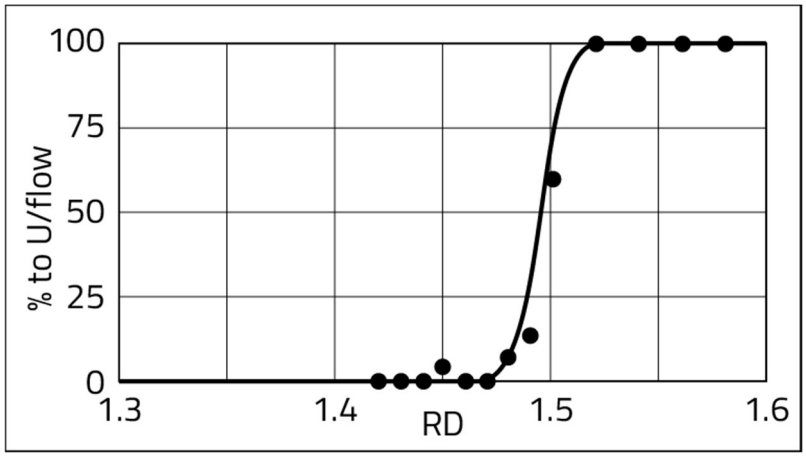


Fig. 1 Normal (efficient) Partition Curve

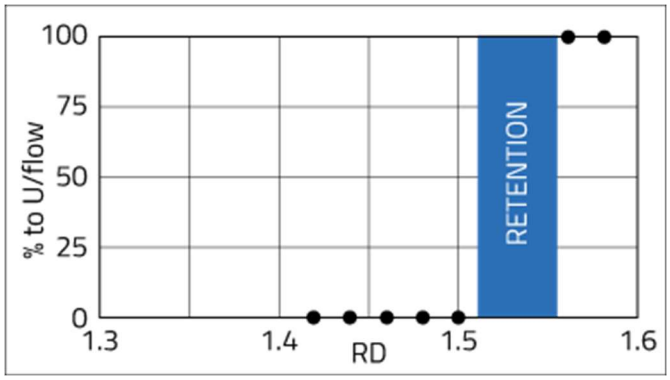


Fig. 2 Particle Retention

A small-to-moderate range of retention shows efficient partitioning, but there is a danger that a small change in operating conditions may increase the density range of retention. The cyclones then may rapidly become choked with "near-density" material and frequently clear themselves by ejecting surges of slurry, including low-density material, to underflow (Fig. 3). Retention is rare for particles (or tracers) smaller than about 20mm.

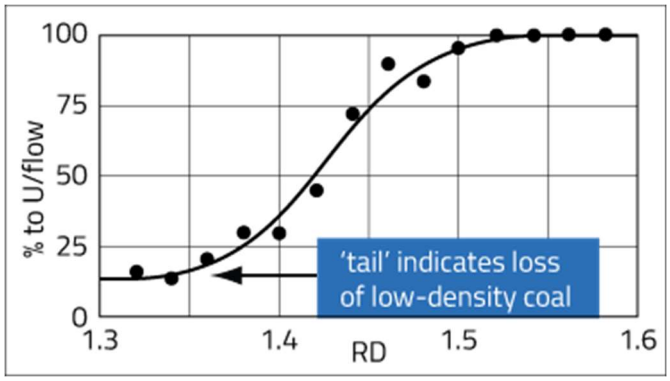


Fig. 3 Surging or Vortex Finder Overload

A large Ep, a low-density 'tail' and a low (sometimes negative) offset between feed medium density and cutpoint may arise from surging (see above) or from vortex finder overload when the medium flow from the vortex finder is insufficient to carry out all the particles which should report to the low-density product. As with surging, the yield loss can be very significant.

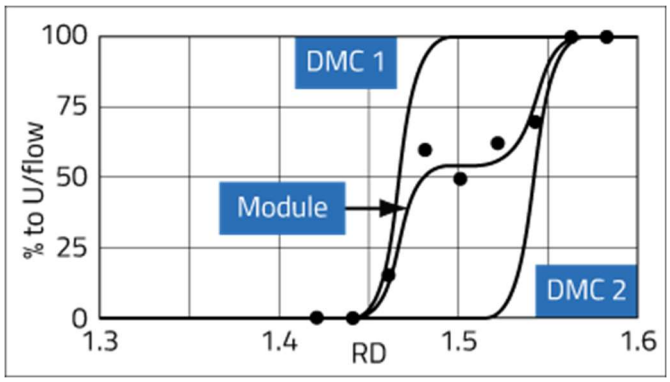


Fig. 4 Separators with Differing Cut Points

A partition curve with a plateau is indicative of differing cutpoints between separators operating in parallel. Examination of the data for individual product screens may suggest which units are separating at high, and which at low cut point.

Means for the correction of these separating inefficiencies may be found in the references listed or by contacting Partition Enterprises Pty Ltd.

References

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