CANADIAN PROCESS TECHNOLOGIES INC.
Unit 1 - 7168 Honeyman St.
Delta, British Columbia
Canada V4G 1G1
Office Tel: +1 604 • 952 • 2300
Office Fax: +1 604 • 952 • 2312
Email: cpt@cpti.bc.ca

FINE AND ULTRA-FINE PARTICLE COLUMN FLOTATION

Ultra-Fine Phosphate Column Flotation

Column flotation has been applied to a wide variety of phosphate ore types ranging from volcanic to sedimentary. Although benefits are seen across the entire particle size range, column cells are particularly well suited to the production of fine and ultra-fine concentrates.

One representative application of the CPT flotation column to fine and ultra-fine flotation is the Barreiro carbonatite complex located in Araxá, MG. The main components of the rock formation are carbonatitic and glimmeritic rocks while the main source of phosphate is derived from apatite, which comprises approximately 30% of the minerals in the ore zones. The major impurities consist of iron oxides and silicate minerals. A simplified phosphate processing flow sheet is shown in Figure 4.

The ore is crushed, screened, and then fed to the concentrator, where it is subjected to grinding (rod and ball mills), classification in hydro-cyclones, low intensity magnetic separation, de-sliming in hydro-cyclones, flotation and dewatering etc.

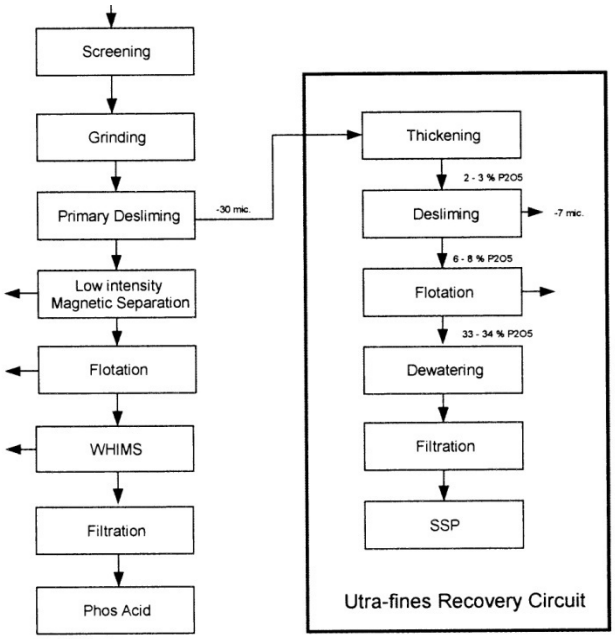

Figure 4 - Typical phosphate processing flow sheet

Traditionally, the de-sliming stage is designed to remove particles finer than about 25-30 micrometers. The high surface area and high impurity content associated with this particle size class make it difficult to treat by conventional flotation equipment. Removal of these slimes represents a major source of phosphate loss, which could represent 10% -15% of the total reserves.

The application of column flotation makes it possible to extend the size range of particles that can be treated by flotation to about 5-10 microns. Figure 5 shows a typical circuit arrangement for ultra-fine phosphate separation.

By re-processing the primary slimes (-30 micron) in a second stage of hydro-cyclones cutting at 5-10 microns, the cyclone underflow is fed to a series of conditioners where the pulp is treated with caustic soda, starch and a collector prior to introduction to the flotation columns.

The flotation columns are arranged in a conventional rougher-scavenger-cleaner configuration with intermediate products recycled internally.

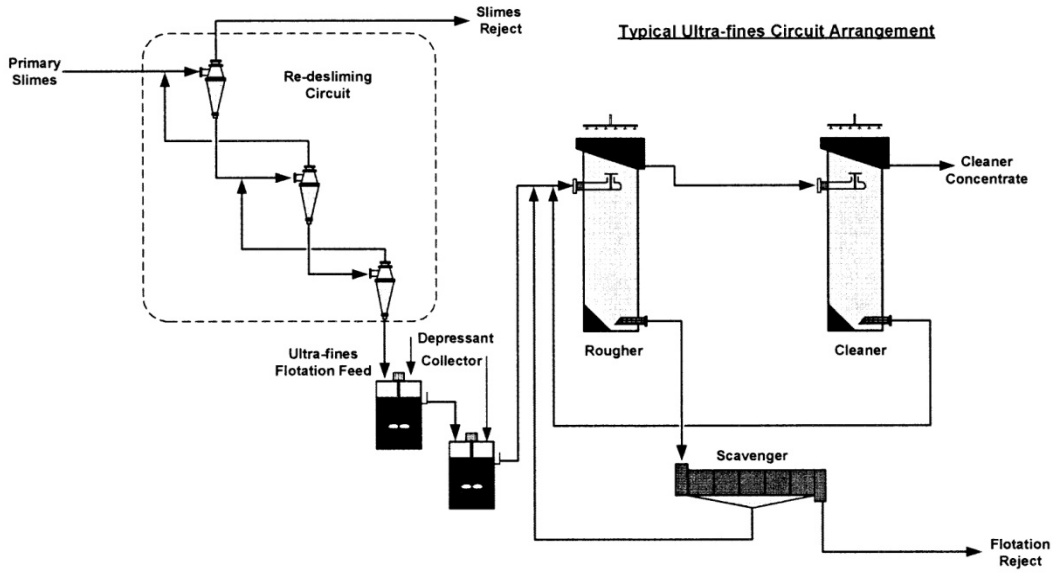

Figure 5 - Typical circuit arrangement for ultra-fine phosphate separation

A typical mass balance for an ultra-fines phosphate flotation circuit is shown in Table 1. Assuming that the chemical analysis of the slimes is essentially the same as the feed grade, the loss of phosphate in the slimes is equal to the mass rejection.

It can be seen, from Table 1, that the P_2O_5 grade of ultra-fine phosphate can be increased from 8.1% up to 33.5%. The flotation tailing P_2O_5 grade is only 2.7%.

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By treatment in flotation columns, it is possible to obtain an ultra-fine concentrate ideally suited for the production of Single Super Phosphate (SSP) fertilizers. The fine particle size minimizes the costs of concentrate regrinding at the fertilizer plant saving additional processing costs.

Table 1 - Typical mass balance for ultra-fines circuit

Stream	Mass (%)	P_2O_5 (%)
Primary slimes	100.0	6.0
Slimes reject	60.0	4.6
Ultrafine Flotation Feed	40.0	8.1
Cleaner concentrate	7.0	33.5
Flotation tailings	33.0	2.7

Faced with difficult ores, and low-grade deposits, the Brazilian phosphate producers have been world leaders in adapting this technology to enhance fine phosphate recovery. Most of the major producers are operating an ultra-fines recovery circuit in their concentrators.

For more information please contact:
Joe Querin
Business Development Manager