REFLUX® Flotation Cell Test Information

FLSmidth

WE DISCOVER POTENTIAL

REFLUX®
Flotation Cell (RFC™)
Test Information

The University of Newcastle in collaboration with FLSmidth has developed a novel flotation technology utilising an inverted fluidised bed arranged above a system of inclined channels to enhance the hydrodynamics of flotation. The froth-less system allows for stable flotation, enhanced gangue rejection, and quicker kinetics – pushing the boundaries on concentrate grade, recovery, and throughput well beyond what is possible with conventional open tank systems. FLSmidth's global laboratories and equipment offerings can provide batch and pilot testing of the RFC technology to determine the optimum flowsheet and expected grade and recovery of a new flotation circuit.

The following information is intended for use as general guidelines only. Please contact FLSmidth for custom test program development and pricing.

RFC Batch Test Cost and Sample Requirements

Test	Unit Cost	Sample Weight Requirements / Test	
Sample Preparation • Grinding costs to specified P_{80} require quote	$100 per 10 kg		
Chemical & Mineralogical Head Characterization	$1,000 per sample	1 kg	Includes standard analytical
Batch RFC (8 operating conditions) • Feed flow • Air flow • Wash water and bias	$14,000	100 kg	Includes standard analytical
Comparison Lab Scale Conventional Flotation	$1,000	2 kg	Includes standard analytical
Project Management & Reporting • Testing data sheets including conditions and detailed assay results • Comparison to conventional results • RFC flow scheme recommendations	20%		

Additional sample preparation charges (primary grinding) and non-standard analytical tests are additional and will be proposed per project.

Minerals Testing & Research Center
FLSmidth, Inc
7158 S FLSmidth Drive
Midvale, Utah, USA 84047-5559
Tel +1 801 871 7000
Email Lab.SLC@flsmidth.com

www.flsmidth.com

REFLUX® Flotation Cells

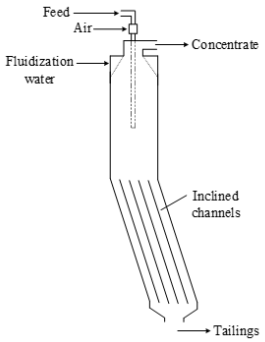
REFLUX Flotation Cells (RFC™) have demonstrated several hydrodynamic advantages over conventional flotation cells including:

- Ehanced bubble-liquid segregation capacity through the application of the Boycott Effect achieving a 5 to 10 fold increase in throughput rate
- Application of inverted fluidization water for effective counter-current washing and gangue rejection producing high grade product at elevated recovery
- Utilization of a high shear rate contacting sparger system for improved flotation kinetics
- Robust process control under "flooding" conditions with a unified gas holdup throughout the vertical section of the cell

The RFC consists of the main vertical vessel positioned above a system of inclined channels. The inclined channels enhance the segregation between the bubbles and downward flowing liquid, thus preventing the bubbles from entreating out the base of the cell, even at high tailings rates. Feed and air enter the cell via a central sparging system to expedite the flotation kinetics. The overflow product emerges through an annulus surrounding the sparger system, while the tailings discharge via the zone below the inclined channels. A plenum chamber encloses the top of the cell, supplying clean fluidisation water for counter-current washing of the rising bubbles with a positive bias flux to promote effective gangue rejection.

The RFC can be used as a first stage fast flotation technology. This single stage rougher approach aims at maximizing throughput and particle recovery using up to a 10-fold increase in conventional volumetric feed flux. The RFC can also be used in a second stage desliming or cleaning application. The cleaning stage utilizes the inverted fluidized bed approach to apply fluidization wash water to deslime the flotation concentrate free of entrained gangue particles.

Schematic



Laboratory Testing

The recommended approach to determine RFC performance is by conducting a laboratory scoping test campaign prior to in-plant pilot trialing. FLSmidth's Minerals Testing & Research Center works directly with clients to understand their objectives and develop a testing plan to meet those.

Eight batch tests in single-stage orientation are recommended for initial RFC™ projects to determine the operating parameters for optimum grade, recovery, and throughput. Adjustments to feed rate, bias flux, wash water flux and air flux are expected. Samples are taken from the RFC in kinetic format and analysed for key element recovery. A comparative lab-scale conventional flotation test is also conducted to determine the variation to the kinetic profile and grade/recovery curves. Laboratory testing provides results that are used to determine an optimum flow scheme and equipment sizing.

Multi-stage orientation can then be conducted to evaluate scavenging or cleaning applications. Please contact FLSmidth for custom test program development and pricing.

RFC Pilot Skid

Pilot Testing

A mobile and mine compliant RFC has been developed specifically for site trial testing. The skid consists of two RFCs offering several modes of operation including batch or continuous, single stage in series or parallel, or multiple stage to combine rougher, scavenger, cleaner operations. The self-contained unit requires an electrical connection, water, and air and has provisions to sample across all streams and is equipped with a local PLC for process control and data storage.

- Feed: 100 L/m, 2" Camlock
- Electricity: 480V, 100A, 60Hz Appleton Pin & Sleeve
- Water: 50 psi, 20 L/min, 3/4" Chicago Fitting
- Air: 90 psi, 100 L/min, 3/4" Chicago Fitting

Minerals Testing & Research Center
FLSmidth, Inc
7158 S FLSmidth Drive
Midvale, Utah, USA 84047-5559
Tel +1 801 871 7000
Email Lab.SLC@flsmidth.com

www.flsmidth.com

The best way to determine RFC performance is by conducting a laboratory testing campaign prior to in-plant pilot trialing. FLSmidth's Minerals Testing & Research Center works directly with clients to understand their objectives and develop a testing plan to meet those.

Production scale REFLUX Flotation Cell Performance

The REFLUX Flotation Cell laboratory and pilot trials have demonstrated improved flotation performance in the coal and minerals industries. A standalone production scale system can be implemented to validate laboratory and pilot scale performance. Please contact FLSmidth for custom test program development and pricing.

Production Scale Demonstration RFC

Basic Mineralogy

Basic mineralogy analyses are necessary in order to determine the mineralogical composition and liberation of the samples. The mineralogy of the sample is useful in order to help explain how the ore variability affects the flotation results and it provides guidance on how to better process troublesome ores.

Basic mineralogy consists of several tests:

- Bulk Mineralogy is accomplished by X-Ray Diffraction (XRD). This results in the bulk mineralogy of the sample, such as the percentage of quartz, feldspars, micas, clay, pyrite, etc.
- Clay Analysis is accomplished by Cation-Exchange Capacity (CEC). This results in quantifing the swelling clay content in the sample.
- Ore Texture Analysis is accomplished by Optical Microscopy. This results in an understanding of the particle size of the ore along with a qualitative assessment of any liberation issues.

Sample Receipt

FLSmidth's receiving policy requires that FLSmidth be provided with an SDS prior to or at the time of sample arrival in order for any sample to be received, in accordance with U.S. law. Samples without an SDS may be rejected. Samples should be shipped to the Minerals Testing & Research Center at 7068 S FLSmidth Drive. Your technical point-of-contact will provide all required shipping information.

Sample Quality

While FLSmidth goes to great lengths to produce quality testwork, the results will only be as relevant as the sample received. Representative sample acquisition is a client responsibility.

Testing Program

A purchase order is due prior to commencing the test program and should be sent directly to your technical point-of-contact. By issuing a purchase order to FLSmidth for the supply of laboratory services, you certify and represent that any material or samples supplied by you did not originate in a country against with the US or the EU has issued sanctions.

Sample Disposal

After the project report is completed, 3 months' of sample storage is included. After this time, the remaining sample will be shipped back to the client at the client's cost or disposed of in a safe a safe and suitable manner at the client's cost. FLSmidth firmly supports cradle-to-grave responsibility. If disposal is required, a Toxicity Characteristic Leaching Procedure (TCLP) will be performed on the sample to determine if it is hazardous. If the sample is hazardous, a Proof of Destruction certificate will be provided to the client.

Minerals Testing & Research Center
FLSmidth, Inc
7158 S FLSmidth Drive
Midvale, Utah, USA 84047-5559
Tel +1 801 871 7000
Email Lab.SLC@flsmidth.com

www.flsmidth.com