

FLOTATION

Flotation is an incredibly robust and versatile process that works equally well on mixed sulphide, oxide, silicate and other ores. Using standardized equipment, cutting-edge mineralogy and experienced technical staff, SGS Minerals Services will provide laboratory test programs which are designed to achieve your objectives quickly and efficiently. Strong ties with equipment and reagent suppliers ensure the most effective, practical, and innovative (if necessary) methods for mineral separation are applied.

OUR PHILOSOPHY

SGS Minerals Services is the most experienced and trusted testing organization in the mineral processing industry. Our core philosophy is to understand the variability of the ore parameters that affect flotation performance and then design, optimize or forecast based on these parameters.

OUR QUALIFICATIONS

- Recognized bankable expertise in beneficiation, metal extraction, purification and recovery across our global network of metallurgy labs.
- Extensive bench and pilot scale facilities.
- Over 70 years of experience in developing practical and cost efficient processing routes.
- Quality mineralogical and analytical services.

PROGRAM DESIGN

We execute our philosophy in a stage-wise fashion that permit each phase of work to build on all that has gone before it. For example, flowsheet development is done on carefully selected drill core composites¹ that represent your major ore types. Following this, locked-cycle

tests are done to define the basic flotation circuit flowsheet. Variability is assessed using geometallurgical approaches. Advanced kinetic-based computer simulations based on a series of small scale tests are then used to fine-tune the flowsheet and provide you with circuit options that trade-off upfront capital expenditure and/or operating flexibility with grade-recovery performance.

SGS Minerals Services has all of the expertise and equipment necessary to complete the flotation flowsheet with thickening, filtering or leaching testwork as needed.

FLOTATION CELL HYDRODYNAMICS

SGS Minerals Services offers a scientifically proven technology to measure flotation cell hydrodynamic variables using high-end optical equipment and software. By visualizing and understanding the “hidden” factors of flotation cell hydrodynamics, SGS Minerals Services has the expertise to provide you with reliable data and solutions for more efficient flotation.



SULPHIDE FLOTATION

SGS Minerals Services has over 70 years of experience in the design and evaluation of sulphide base metal flotation regimes, with more than a thousand ores including the minerals

- argentite
- arsenopyrite
- bornite
- chalcopyrite
- covellite
- enargite
- galena
- molybdenite
- marmatite
- pentlandite
- pyrite
- pyrrhotite
- sphalerite
- tetrahedrite

Polymetallic ores, such as copper-lead-zinc-silver-bismuth ores, are some of the most complex and SGS Minerals Services has proven practical solutions to separate these minerals.

OXIDES AND SILICATE FLOTATION

Gravity, magnetic and electrostatic separation processes are the traditional treatment methods used for beneficiation of oxide minerals. Advances in flotation reagents can make the recovery of oxides by flotation a more effective and economic process. Grinding and surface chemistry are critical to the success of oxide flotation. Over-grinding of the brittle minerals is avoided by stage grinding and careful selection of equipment.

We have experience in diverse regimes for treatment of a wide range of oxide minerals such as

- barite
- cassiterite
- copper, lead, and zinc carbonates

¹ RC cuttings or lump samples can be used if core is not available

- fluorite
- ilmenite
- iron ore
- monazite and other rare earth oxides
- phosphates
- potash
- rutile
- scheelite
- silicates
- spodumene
- tantalite
- topaz
- wolframite
- zircon

OTHER MINERALS AND APPROACHES

Flotation is a robust process and new and innovative treatment processes have been developed by SGS Minerals Services. An example is the recovery of secondary minerals from oil sands. Other minerals that can be recovered by flotation include:

- coal
- metallic copper
- metallic silver
- platinum group elements (PGE)

Our experience in the PGE is particularly strong with process development, in-plant optimization and auditing of plants, for some of the world’s largest producers.



OIL SANDS

SGS Minerals Services performs froth flotation testing on oil sands materials, separating bitumen from sand. We have also developed methods to extract heavy minerals from oil sands tailings via flotation.

SGS Minerals Services provides columns and contact cells to the oil sands industry that are used in flotation and scavenging applications.



LABORATORY AND PILOT PLANT EQUIPMENT

Columns, mechanical cells, flash flotation, unit cells, and high capacity contact cells are regularly used in our evaluations. Other related equipment, such as stirred mills, ball mills, and high intensity conditioners, are also available. Techniques, such as new reagent development, control potential sulphidization (CPS), flotation kinetics, and computer modeling are also used.

LABORATORY EQUIPMENT

- a selection of rod mills, ball mills, and grinding media
- Denver and Agitair flotation cells
- extensive reagent selection
- Eh/pH capability

PILOT PLANT EQUIPMENT

- a wide selection of primary and regrind mills
- flotation banks suitable for 3kg/h to over 1000kg/h
- column cells from 2” to 12” diameter with DCS level control
- Contact Cell multi-stage plants of various sizes
- reagent pumps monitored and controlled through a DCS system
- standard and high-intensity conditioners
- thickeners, tailing pond, and recycle water capabilities
- pulp density and pH monitoring and control through a DCS system

COMPREHENSIVE SUPPORT SERVICES

MINERALOGY

Mineralogy plays an important role in quickly troubleshooting and resolving operational issues. In particular, QEMSCAN™ technology offers a quantum leap in the understanding of flotation processes. The QEMSCAN™ instrument rapidly and inexpensively analyzes hundreds of thousands of points in a polished section. This large dataset is the basis for liberation studies, grade- recovery prediction and diagnosis, with greatly improved speed, detail and confidence over manual grain counting methods.

In a recent project at SGS Minerals Services, over \$250,000 was saved by using QEMSCAN™ for prediction of grade-recovery variability in place of traditional locked-cycle flotation testing.



QEMSCAN Mineral Particle Map

CHEMICAL LABORATORIES

SGS Minerals Services’ full service analytical and environmental laboratories operate around the clock to provide key data to guide project decisions. Analytical instrumentation is linked to a networked data management system allowing speedy access by the project team worldwide.

CONTROL, PARTY UMPIRE ANALYSIS

Final locked cycle or pilot plant concentrates can be subjected to high-accuracy settlement analysis to determine if phases causing smelter penalties or precious metal credits are present.

ENVIRONMENTAL TESTING AND PROJECT WASTE DISPOSAL

SGS Minerals Services has unique environmental expertise, particularly in assessing potential environmental problems. Environmental studies supporting flotation studies can involve material characterization, acid base accounting, process water toxicity, leachate toxicity testing and effluent testing.

Project tailings can be disposed of by a third party contractor, following pertinent government regulations.

SOPHISTICATED DATA MANAGEMENT AND ANALYSIS

Distributed control systems and process control instrumentation are available to control and operate the pilot plant grinding and flotation circuits. Rapid feedback is provided to refine operating conditions. On-stream particle size analysis, and chemical analysis, is also available.

CONTACT INFORMATION

Email us at minerals@sgs.com
www.sgs.com/mining

EXPERIENCE

SGS Minerals Services has done bench and pilot-scale testing on literally thousands of flotation projects. Recent high profile projects include:

- Antamina
- Pogo
- Voisey's Bay
- San Nicolas
- Bulyanhulu
- Raglan
- Yackabindie
- Greenbushes
- Tenke Fungurume
- Southern Peru Copper
- Troilus
- Lac-des-Isles
- Tambo Grande
- Winnarshoek
- Montcalm
- Telfer
- Las Pelambres
- Batu Hijau
- Pallca
- Lady Loretta