FLOWSHEET DEVELOPMENT

METALLURGICAL OPERATIONS

SGS' experienced team of metallurgical professionals develops and demonstrates bankable flowsheets and processes for environmentally sustainable metal and mineral extraction processing. These flowsheets are confirmed on-site through bench and pilot plant testing programs that are internationally recognized by the mining, engineering and financial communities.

With SGS, your metallurgical testing program will:

- Result in a practical, cost effective, environmentally sound flowsheet.
- Provide data for capital and operating cost estimates.
- Generate higher value through improved recovery or cost savings.
- Provide bankable milestones to maximize financing options.

THE PROCESS

Flowsheet development is typically performed at the laboratory "bench". Based on the initial determination of specific ore parameters (e.g. grain size, mineralogy), the various options that might be applicable are evaluated. A conceptual flowsheet is developed which is further tested and optimized. Clearly, an independent facility with a wide range of expertise such as SGS is well suited for this type of work.

Developing and testing the most effective processing flowsheet reduces the technical risk associated with metal recovery. SGS' metallurgical groups' flowsheets are recognized by the global financial community for their quality and the integrity of their recommendations.

For new projects, flowsheet development precedes much more costly activities such as feasibility-stage pilot plant testing. It provides the flexibility to assess a wide variety of reagents, dosages, residence times etc to ensure optimal grade and recovery.

Existing plants must, at times, reevaluate their processing strategies. Changes in ore-type, technology or environmental regulations can mean that existing flowsheets must be fine tuned or even significantly revised. Compared to the cost of evaluating such operational parameters at the pilot stage or operational stage (after capital acquisition), comprehensive testing at the conceptual or flowsheet development stage can be exceedingly inexpensive.

TYPICAL TEST WORK ACTIVITIES THAT CAN BE UNDERTAKEN DURING FLOWSHEET DEVELOPMENT:

- Conceptual or scoping studies.
- Metallurgical mapping.
- Evaluation of processing options.
- Determine optimal operational parameters.
- Development of new processing technologies when warranted.
- Evaluation of processing options that are environmentally sustainable and meet legislated requirements in any jurisdiction

FLOWSHEET DEVELOPMENT IS THE BEST WAY TO:

- Develop a practical, cost effective environmentally sound flowsheet.
- Quantify and minimize the effect of ore variability.
- Generate higher value through energy optimization improved recovery or cost savings.
- Minimize risk associated with pilot testing or process changes.
- Reduce environmental costs with proper integrated design rather than expensive end-of-pipe retrofit.
- Provide bankable milestones to maximize financing options.

WHAT TO EXPECT WHEN YOU BEGIN A METALLURGICAL TESTING PROGRAM

Tips and rules of thumb for flowsheet development and pilot plant testing...

WHAT IS THE PROCESS?

With you and your consultants, SGS professionals will custom design your project team, then develop a realistic scope of work that suits your objectives. Processing options will be evaluated fairly and objectively, without bias or special interests to ensure the best technology is used. Many of our project managers have had plant experience, so they favor practical solutions and reject unrealistic options.

YOUR INPUT

At SGS, we think effective management of metallurgical projects is best achieved by encouraging your participation (or that of your representatives) from flowsheet development to pilot plant testing. This creates a continuous flow of information and ideas and insures that your requirements are met in timely and satisfactory manner.

Early in the planning and proposal preparation stages, we encourage you to discuss your timing, anticipated project scope and financial requirements. This allows us to develop the best program for you, be it a phased program with a number of bankable milestones that will help you maximize your financing options, or perhaps an intensive program that quickly resolves bottleneck problems.

Discussion and consultation continues throughout the test program. During critical periods or intensive testing, such as complex pilot plant campaigns, many of our clients elect to stay in the immediate vicinity and "work the shifts" with our staff (see below, "logistics"). The project insights and expertise sharing that arises can be very valuable at start-up. In these circumstances, SGS can offer office and meeting spaces for your use.

HOW IS YOUR PROJECT MANAGED?

Depending on the scope of work, flowsheet development projects are managed by a project or senior metallurgist. Interim results are forwarded in a timely manner. A written report will be issued at the completion of the project or at the end of each phase.

All project managers have access to SGS' technical experts. These world-class leaders provide technical consultation in their respective disciplines and are always available to solve difficult problems.

For some projects, it makes sense to run the project at one SGS site and build an integrated team consisting of SGS staff from across our international offices. In this way, your project can benefit from the best expertise and equipment available.

HOW MUCH SAMPLE IS NEEDED?

While each case has to be evaluated individually, typical samples volumes required are below.

HOW LONG WILL IT TAKE?

It is obviously difficult to say how long a project will take due to sample availability, ore complexity, etc, but minimum time lines are below.

During flowsheet development, it can make sense to phase projects, creating a series of milestones that are useful for financial purposes. If this seems right for your project, please let us know.

WHERE CAN I GET SERVICES?

SGS offers a global footprint to help meet your testing needs. For logistical and staffing reasons, we have nodes of expertise situated throughout our operations. Depending on your needs, we will work with you to meet your timing and project requirements.

SAMPLE OWNERSHIP

You retain ownership of all samples and rejects or test products sent to SGS for testing. This also means that you have the ultimate responsibility for their return or disposal.

The Project Manager will provide you with a list of all your materials (samples, assay and test rejects) that remain at the end of the project. Please let us have your instructions for these samples within 30 days. If we do not hear from you, we will store the samples for 3 months and then dispose of them for you.

FLOWSHEET DEVELOPMENT	PILOT PLANT TESTING
40-50 kg (composites preferred)	200 kg – 2 tonnes (4-6 composites)

	FLOWSHEET DEVELOPMENT	PILOT PLANT TESTING
Typical Minimum	6 Weeks – 3 Months	3 Months
Planning		2 Weeks
Set-up and Tear-down		1 – 2 Weeks
Piloting		3 – 5 Weeks
Reporting		4 – 8 Weeks

SAMPLE STORAGE

SGS has a variety of ways to store your samples before, during and after your testing program:

- Ambient temperature storage (varies from -20°C to 35°C with variable humidity) is suitable for most samples
- Freezer storage is appropriate for sulphide rich samples that might oxidize readily
- Heated storage is needed for laterites

Sample storage is based on type of storage needed (frozen, ambient or heated), length of time stored and the storage media (pails, drums etc).

ON-SITE OPERATIONS: HEALTH AND SAFETY

Health and Safety is an important consideration for SGS. All visitors to our site are bound by our health and safety policies, including clients or their representatives such as consultants or engineering firms and suppliers and contractors.

In addition, we operate a variety of operational activities such as employee health monitoring programs (hearing, blood lead, silica, others as needed), designated substance monitoring programs, dust collection systems, MSDS-based worker information data bases to ensure health and safety in our workplace. These protocols will operational during any anticipated operations. We appreciate any involvement or contributions other parties might make in this area but we, SGS, are committed to this, our corporate responsibility.

ON-SITE OPERATIONS: ENVIRONMENTAL ASPECTS

SGS' internal environmental policy insists that sustainable environmental practices are given top priority. As well, SGS is a co-signee to the CIM Environmental Policy Statement, which promotes environmentally sustainable operations in the mining and exploration industries.

At SGS, waste is directed to a fully permitted tailings pond. Our other facilities have waste disposal systems that comply fully with local regulations.

On-site environmental conditions are carefully monitored. Responsibilities are clearly outlined for management and employees. Participation is mandatory. Standards and operating procedures are documented and followed, so that our Policy is maintained. While we appreciate any involvement or contributions that other parties might make in this area, SGS knows that this is our responsibility.

CONTACT INFORMATION

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