

## SGS' OIL SANDS PILOT PLANT, FORT MCMURRAY

### PROCESS OPERATIONS AT THE APPLIED RESEARCH AND TRAINING FACILITY

Oil Sands – 80% sand, 10% bitumen and 10% water, one of the largest energy reserves in the world, but also among the most difficult and costly to process. They are abrasive, sticky, but a magnificent source of energy-especially when they are processed in a cost-effective and environmentally sustainable fashion.



### 1928 TO NOW

The present technologies used to extract bitumen from the oil sands were pioneered in 1928 by Albertan Karl Clarke's hot water extraction process. Since then, innovative enhancements have refined and improved this approach, resulting in the billion dollar processing operations characteristic of the oil sands projects today.



### INTO THE FUTURE

Over the next 5 to 10 years, oil sands producers will be challenged – to produce more oil from lower grade ore, more cost effectively, using less water and less energy and do all this in a timely, more sustainable fashion – all this to keep up with the increasing world energy demands. Technology and innovation will continue to be critical tools to help relieve these pressures.

### BIG CHALLENGES NEED BIG PARTNERS AND TECHNOLOGY OPTIONS

Big challenges like this need big partners and an arsenal of technology options. To make informed decisions, one must review the existing alternatives and evaluate the myriad new and promising technologies available to the oil sands.

Big decisions have big price tags and therefore big financial risks. Diligently assessing processing technologies under operating conditions before making epic billion-dollar decisions is only prudent.

SGS is a large independent multinational testing company that services many industrial sectors. For decades, we have helped the global mining and petrochemical industries evaluate process options, test process materials and meet sustainability requirements.



### OUR ROLE

SGS is an experienced, ethical partner with the proven industrial processing experience to help you with your technical due diligence and risk reduction. As an independent technology provider, SGS takes pride in our quality services and our professional ethics.

Our role in technological partnerships is three-fold:

- To provide you with the opportunity to mitigate technical and environmental risk by testing process technologies at the pilot scale.
- To offer a safe, flexible and cost-effective venue to demonstrate and optimize production and related environmental aspects.
- To give operators evaluating new technologies a venue for commercial viability prior to capital investment.



**WHAT WE BRING TO THE PARTNERSHIP**

- Proven experience in process development, benchmarking, separation technologies, process engineering and pilot testing.
- Purpose-built piloting facilities in Fort MacKay, the heart of the oil-sands area.
- ISO/IEC 17025 analytical and environmental testing laboratories in Fort McMurray to support to pilot operations.
- Familiarity with big-project engineering needs and the related global financial requirements.
- Ability to help you make the right choices, without upsetting existing production schedules or putting up large capital outlays.
- An excellent reputation for technical work unbiased by any commercial interests.

Pilot testing for SGS and you our client starts with safety. Our site health and safety policies and procedures have been developed to protect:

- Our staff, and you, our client.
- The environment that surrounds our facilities.
- Our reputation as well as your reputation.



**OUR SAFETY PROGRAM**

SGS is committed to operational safety in all our workplaces. The Safety and Loss Management Program includes:

- The required permits needed to ensure safe work for all parties involved.
- The isolation, lock-out and tag-out of equipment.
- The management of change policies.
- A joint health and safety committee to monitor health and safety and environmental issues on a daily basis.
- Full time safety management to ensure all health and safety issues are dealt with.
- A full HAZOP review of all our activities.

**COME, LET’S TOUR OUR OIL SANDS PILOT PLANT IN FORT MCKAY**

**SECURITY GATE PROTECTION AND SIGN IN**

Ore is delivered to our Fort McMurray pilot plant and taken to the Back Ore-pad. We can receive up to several hundred tons for each project.



**ORE STORAGE AND CONFIGURABLE STORAGE UNITS**

Once the sample arrives, it is immediately brought into our insulated Ore Storage Building and stored at about -10°C. Here, we can accept up to 25 hundred tones of ore in this 11 thousand square foot building. The sample is kept under insulated tarps to minimize oxidation and water loss. Concrete blocks are easily moved to accommodate several separate ore types.



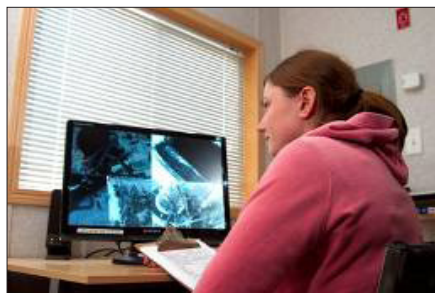
**CRUSHER**

Prior to conditioning or bitumen extraction, the ore is loaded into a crusher fed at a nominal rate of 2 tons per hour. The undersize is then transferred to the Bitumen Extraction Building by conveyor and apron feeder system.



### VIDEO CAMERA MONITORING IN THE CONTROL ROOM

The feed to the plant is monitored by a weight-o-meter and by video camera which is monitored in the Operations Control Room. This ensures a constant feed flow-rate.



### ORE FEED TO BITUMEN EXTRACTION BUILDING

Once the ore is in the Bitumen Extraction Building, it is feed into a digestion vessel. This can be a tumbler, tank, drum or hydrotransport loop, depending on your project needs. For this specific project, hot water and steam was added to the bitumen in a rotary tumbler to facilitate conditioning, or the separation of the bitumen from sand.



### SAMPLING THE DIGESTED BITUMEN SLURRY

The digested bitumen slurry is readily sampled according to the project schedule to provide data for plant control and process optimization data. This is only one of the many possible sampling points in our plant. All plant samples are analyzed in our full-service laboratory in Fort McMurray.

### SAMPLES RECEIVED AT SGS FOR ANALYTICAL TESTING

Our analytical facilities in Fort McMurray have 25 years of experience serving the oil sands community. They are well equipped for Dean and Stark analysis, particle size distribution as well as for ICP and gas chromatographic determinations. Here, your pilot plant testing needs get rapid turn-around times.



### CONTROL ROOM

Our entire facility is instrumented, monitored and run using the latest distributed control system or DCS. DCS cabling from our master control centre spans the facility and connects to all our equipment with about 1000 control points.

This high level of process control generates a permanent record of all operating conditions, flow rates, temperatures, and reagent dosages. These data are then reconciled with the final grade and recovery. This is the key to your evaluation and your overall process assessment. Of course the intellectual property involved remains confidentially yours – SGS is a testing company, not an operator.



### PRIMARY FROTH SEPARATION CELL (PSC)

The digested slurry, or lean froth, is handled in some fashion. In this project, it was introduced into a primary froth separation cell or PSC. In this case, this is a scaled-down piece of equipment that is otherwise identical to the technology in use at producing oil sands projects. Less traditional approaches can also be tested if desired.

During digestion and conditioning, the bitumen and sand separate. The bitumen engulfs air bubbles and forms slurry. Once in the PSC, impure bitumen froth floated to the top, passed over the edge and collected in the lauder. The coarse sand sinks to the bottom and is treated elsewhere- we'll come back to that.



## FLOTATION

Traditionally in the oil sands industry, the final product from bitumen extraction is simply the primary separation froth. However, flotation technologies serve three important purposes. They improve froth recovery, they generate higher-grade froth with less fine sand, thus minimizing maintenance, and they purify and polish process water for reuse within the plant or for discharge to tailings ponds.

Obviously these operational and environmental issues are important to many oil sands companies. We commonly test column and contact flotation cells to assess the value of these technology options.



## SECONDARY FLOTATION CELLS

To improve bitumen recovery and discharge-water quality, the middlings or “bitumen, sands, clay and water” from the middle of the primary separation cell can be sent for secondary separation. In this case, this was trialed in two contact column flotation units.

Columns can be connected in many different configurations. Ultimately, the column froth will flow to the short term froth storage tank, but this can be accomplished in various open and closed circuit configurations.

## VARIOUS CONFIGURATIONS POSSIBLE

Although not yet used extensively in the oil sands, flotation columns are well accepted traditional technologies that are commonly used in the mining industry. The flotation columns in our pilot plant are adaptable– they can be easily reconfigured from column cells to contact cells or even contact column cells.

SGS is a world leader in traditional mechanical cell and column flotation technologies. We are currently installing column-based circuits in oil sands processing operations today.



## SWAPPING IN OTHER FLOTATION EQUIPMENT

Our circuit is flexible enough we can even swap in mechanical cells if required. Thus we can test various flowsheet options and benchmark each of your ores or operating parameters.



## FROTH STORAGE

The froth from the PSC and/or the flotation columns is stored in large capacity tanks in the Bitumen Extraction Building until a sufficient volume is prepared for subsequent froth treatment.

## FROTH TREATMENT PLANT

The final froth is pumped from the storage tanks to SGS’ Froth Treatment Building. This building is expandable to 75 hundred square feet and can accommodate two clients. Now, the froth contains about 60% bitumen, 30% water and 10% mineral. It is heated to a defined temperature, then diluted with various hot solvents. This allows further phase separation. The lighter bitumen, now diluted with solvent, is removed as diluted bitumen or dilbit and the heavier tailings sink.

## PLUG AND PLAY FLEXIBILITY

Our Applied Research and Testing facility is dynamic. We have engineered in many “plug and play features” which make it easy to generate the specific process configuration that will meet your need.

All of our equipment is skid-mounted so it is easily moved by forklift. Usually, our water and compressed gas feed through quick connects and hoses to allow maximum flexibility. Finally, we are never more than 4 meters from an electrical or DCS connection.



### MIXING REAGENTS

We can readily mix re-agents prior to use. This mixing station is skid-mounted so it is readily moved into place when needed. This adaptability gives us the flexibility to test high recovery, but lower grade processing scenarios or lower recovery and higher grade scenarios. It gives you the confidence and security that your extraction plant design will be well suited for your future processing needs.



### THICKENING TO IMPROVE WATER QUALITY

Water accessibility, use and quality are all important issues to the oil sands. We have incorporated a thickener into our plant to improve our water-handling and water-quality capabilities. We use this technology to skim the last .5% of bitumen from the process water and remove fine suspended material.



### CLEAN WATER, LESS ENERGY USE

Every oil sands operator wants to minimize water usage, tailings volume, energy requirements and operational costs. Thickening recovers warm process water, minimizes water usage, lowers heating costs and thus lower energy needs. If appropriate for your project needs, we can divert samples from the thickener underflow for settling tests.



### FINAL WATER POLISHING IN CONTACT FLOTATION CELLS

We send the overflow from the thickener to an SGS Contact Cell to recover fugitive bitumen. Here, the process water is aerated again and low grade bitumen froth is generated. The underflow water now contains negligible bitumen. We have improved the water quality yet again and it is recycled in our plant as warm process water. Because the bitumen content is so low, there are few maintenance issues.

### HANDLING THE COARSE SAND TAILINGS

Let's catch up again with the tailings from the PSC. For every 2 tons of oil sand ore we condition, approximately 1.6 tons of coarse sand tailings are produced. These coarse tailings separate from the bitumen in the PSC. In operating projects, hydrocyclones are used to handle this material. Due to the small scale of our operations, we use a spiral classifier to separate the coarse sand from the fines. The water is then removed with a vacuum belt filter.

### PROCESS WATER FOR REUSE

The filtrate from the vacuum belt filter is recycled for plant use

### COARSE SAND DRIED AND DISCARDED

Coarse sand is carried to the top of the spiral classifier, and then deposited on a vacuum-belt filter to remove the water. The resulting filter cake or sand has about 10% moisture.

### TAILINGS PAD

The coarse sand is conveyed to the tailings pad. It is tested and then trucked to a local landfill site.

### CONTACT INFORMATION

Email us at [minerals@sgs.com](mailto:minerals@sgs.com)  
[www.sgs.com/mining](http://www.sgs.com/mining)