Extracting premium-grade productivity at Syncrude

While the words “oil production” usually conjure up images of drilling rigs dotted throughout a desert landscape or offshore rigs in stormy seas, a company in northern Alberta produces crude oil by chemical/mechanical extraction from oil sands. This yields 20 percent of the conventional light and medium crude produced in Canada, and 13 percent of Canada’s total oil requirements.

Syncrude is the world’s largest producer of light, sweet crude oil from oil sand; and the largest single source of oil in Canada. Headquartered in Fort McMurray, Alberta, Syncrude operates a large oil sand mine, utilities plant, bitumen extraction plant and upgrading facility that processes bitumen and produces value-added light, sweet crude oil for domestic consumption and export. Syncrude calls its product Syncrude Sweet Blend (SSB). It takes about 2 tonnes of oil sand to make one barrel of SSB. Syncrude mines 74 million banked cubic metres (BCM) or 155 million tonnes per year of oil sand to produce an average of 225,000 barrels per day of high quality SSB.

Mining the oil sand
Oil sand is composed of sand, bitumen, mineral rich clays and water. In its raw state, bitumen is a black, asphalt-like oil, as thick as molasses. The oil is mined from a surface mine, and the bitumen is extracted from the sand using steam and hot water. It is upgraded from a viscous, tar-like oil into crude oil by fluid coking, hydroprocessing, hydrotreating and reblanding. The upgraded bitumen product consists of naphtha and light and heavy gas oils that are combined to produce SSB, a straw-colored liquid which is low in sulphur and has excellent low temperature pour qualities. SSB is transported via pipeline to three Edmonton, Alberta refineries and to pipeline terminals which ship it to refineries in Canada and the United States.

Extracting the bitumen from the oil sand
Bitumen is extracted from the oil sand in the extraction plant at Mildred Lake (located 40 km North of Fort McMurray, Alberta). One of Syncrude’s three oil sand production streams is fed by a team of massive draglines, bucketwheel reclaimers and conveyor belts, technologies that are being phased out in favor of more cost-effective methods (see below). This feed enters the plant’s tumblers (large, horizontal, rotating drums). The oil sand is slurried with steam, hot water and caustic soda to condition it for bitumen separation. The rotary action also aerates the slurry. The slurry from the tumblers is discharged onto vibrating screens where large materials such as rocks and lumps of clay are rejected. The oil sand slurry is diluted in pump boxes and pumped to the primary separation vessels (PSVs).
The majority of Syncrude's oil sand is excavated by high-technology mobile trucks and shovels. It is conveyed to the extraction plant by pipelines from the North Mine site (located near Mildred Lake) and Aurora site (located 35 km Northeast of Mildred Lake). Trucks and shovels scoop the oil sand from these sites and deliver it to double roll crushers (whose capacity is 8,500 tons per hour) which size the feed. The crushers feed conveyors, which deposit the oil sand in a surge pile. The sized feed is then conveyed to a cyclofeeder at North Mine or to a mixing box at Aurora, where it is mixed with warm water and caustic. The resulting slurry is screened and the oversized material is rejected before entering a pump box. Slurry from the North Mine's hydrotransport line enters the base plant PSVs, where bitumen floats to the surface as primary froth. Slurry from Aurora's hydrotransport line enters a PSV at the Aurora site, where bitumen froth is extracted. It is then pumped via a 35 km pipeline to the Froth Treatment Plant located at the main plant site. These hydrotransport systems have a capacity of 8,000 tons per hour.

The sand settles out and the middlings and underflow streams are pumped to the Tailings Oil Recovery (TOR) vessels. These deep cone vessels recover most of the remaining bitumen using a technology developed by Syncrude. Froth from the TOR vessels is recycled to the PSVs to improve its quality. Bitumen recovery is further improved by the secondary flotation plant which processes middlings from the TOR vessels. Froth from the secondary flotation plant is combined with the primary froth stream from the PSVs, deaerated and heated, and fed to the froth treatment plant.

Froth treatment minimizes the water and solids going to the upgrader. Froth is diluted with naphtha and this product of diluted bitumen is either put through inclined plate settlers or through two stages of centrifuges. The combined product from the inclined plate settlers and is put through another set of centrifuges before going to the upgrader. A Naphtha Recovery Unit (NRU), developed by Syncrude, recovers naphtha from all froth treatment tailings. The extraction facility processes approximately 500,000 tonnes of oil sand per day to produce 92,000 m³ or 580,000 barrels per day of diluted bitumen.

**Leading-edge communication system facilitates centralized control of North Mine and Aurora sites**

At North Mine, the primary and secondary crushers, surge pile, conveyors and secondary hydrotransport pumps are controlled by eleven Quantum programmable logic controllers (PLCs). The PLCs run on Concept software and use three separate, dual Modbus Plus and fibre optic cable networks to communicate to the distributed control system (DCS) / supervisory control and data acquisition (SCADA) system.

At Aurora, the PLC control system is subdivided into three Modbus Plus networks. The first network—dedicated to the material handling operation—uses 6 Quantum PLCs to control the primary crushers; surge pile; hydrotransport pumps; conveyors; and a mobile equipment service center. The second network—for the utilities area—employs 5 Quantum PLCs to control the water and sewage treatment plants; the Once Through Steam Generator (OTSG); the duct burner; and the natural gas letdown station. The third network—dedicated to the Tailings operation—consists of 4 Quantum PLCs and uses Ethernet Spread Spectrum Radios. Inter-site communications from Aurora to the Base plant located at Mildred Lake and from two River Crossing sites—equipped with Momentum Ethernet I/O—use microwave technology. All PLCs run on Concept software and communicate via Modbus Plus and fibre optic cable in a “self healing ring” configuration to the central DCS/SCADA system.

At both sites, Bridge Plus units enable the Concept Engineering station to reach the PLCs on all networks.

**Syncrude is a world-class leader through investment in leading-edge technology**

Once again, Canada demonstrates its position as a world leader in the application of technology to the extraction and development of its natural resources. Syncrude is proof that Canada's greatest resources lie not in our forests, mines and oceans, but in the minds of the scientists and engineers who enable us to realize the potential of these national treasures.

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