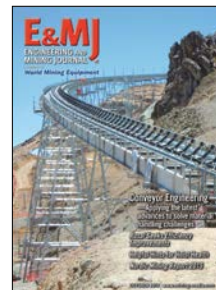


Advanced Braking Technologies for Mining Conveyors



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Mine conveyors pose several hazards to the safety of equipment, particularly on long inclined and declined conveyors, where the operation is mostly unmanned due to its distance, terrain and profile. With an increase in tonnages on declined conveyors with several hundred meters of drop, it is imperative to install an intelligent soft-braking system to address the starting and stopping requirements under various load conditions.



In order to improve efficiencies and handle larger loads, mining conveyors and their belts have grown in size. As the larger capacity of inclined and declined conveyors with higher torques became more common, it became critical to engage the conveyor brakes in a gentler, controlled manner. Also, mine operators wanted the ability to stop conveyors at a specific time, regardless of the load, to improve optimization throughout the mine. A more sophisticated braking control was required.

Very high levels of tension are applied to the conveyor structure and the belt when trying to stop a high-speed, high-load conveyor. These conveyors need to be stopped in a gradual, controlled way since conveyor structures are not designed to support the kind of tension caused by simply slamming on the brakes.

Competitive forces constantly challenge conveyor OEMs to reduce costs. All conveyor system components including structure, belts and rollers are scrutinized for maximum efficiency and performance. It is important that braking systems are selected to meet the specifications of each conveyor. This will ensure that the most cost-effective brakes and controls are optimized to precisely match the performance requirements.

In response to industry needs, Svendborg Brakes introduced the first generation of the popular SOBO® (SOft Braking Option) controller in 1998. The revolutionary control provided smooth, controlled braking on mining conveyors around the world. Over the years, PWM (Pulse Width Modulation), PFM (Pulse Frequency Modulation), and a combination of both methods, of the SOBO controller were introduced. These models provided improved control for low-torque/low-volume hydraulic brakes and reduced oil flow, an important feature to achieve long controlled braking in case of power failure.

The Next Generation

Today, mining conveyor OEMs are building even larger, more complex conveyors that combine greater strength and capacity for increased productivity. Mine operators are demanding braking systems that are more intelligent, quicker and more user-friendly.

While some competitors are still offering controls based on older technology, Svendborg Brakes recently introduced the new SOBO iQ at the SME show in February 2015 to meet the latest market demands. The innovative SOBO iQ system represents the latest technology in braking, which includes brakes, hydraulics and the SOBO iQ controller.

“The first version of SOBO was basically a black box that the customer didn’t have to think about,” said Soren Holm, Svendborg Area Sales Manager (Chile & Peru). “But today, mine operators need and want to know what’s going on in every area of their facility.

The SOBO iQ empowers mine operators as it provides all conveyor braking data online for easy access.”

The unique SOBO iQ soft-braking controller provides a range of safety and durability benefits in mining conveyor applications. Start up, deceleration, and the stopping of heavy conveyor loads is critical, and controlled start up and braking is essential for a significant reduction of torque peaks, preventing damage to the belt and mechanical components.

SOBO controls braking torque based on preset speed ramps and actual speed and system pressure feedback. Different braking profiles are provided for different scenarios. Advanced functions including independent overspeed monitoring, rollback and gear monitoring are integrated into the control box.

The SOBO soft-braking controller benefits and features include:

- Controlled braking independent of load and load position
- Braking on time or distance
- Adjustable brake ramp/curves
- Compensating for variable friction factors
- Controlled start-up
- Real-time monitoring of brake sequence time
- BUS communication with customer PLC

SOBO iQ Braking System Functions the Same as a VFD in Drives

SOBO iQ features a revolutionary dual-loop PI control (pressure/speed) and an internal pressure control loop. Pressure control is not only based on speed but also on deceleration. The control provides only the torque needed for a safe, controlled stop. Units have three-state digital modulation – never used in a braking system before. Each controller can accommodate up to 4 HPU's with defined torque sharing. Other features include full BUS-based communication with the master control system. Remote access and touchscreen for setup and monitoring are also available.

“The SOBO iQ controller offers customers enhanced functional flexibility,” according to Robin Schmidt, Svendborg Application Specialist (North America). “It can be used as a backstop, a dynamic brake and a parking brake all incorporated in the same system. Users can get signal feedback for all the braking system functions.” The control utilizes different communication ties plus different communication protocols. Users can easily access and change the parameters inside the control, such as defining a parking sequence or pre-setting a stop time.

Jan Mikyska, a Svendborg engineer who helped develop the SOBO iQ explained, “Control flexibility also means we can stop the conveyor – no matter if it’s fully loaded or empty – in the same time or distance, depending on what the customer needs. We simply add ‘S’ curves with specific desired braking profiles.”

“For example,” he said. “When you want to stop your car, you apply hard pressure to the brake pedal. When the car is almost stopped, you begin lifting your foot. We can apply the same kind of curve to the SOBO system.”



The unique SOBO iQ soft-braking controller provides a range of safety and durability benefits in mining conveyor applications.



SOBO iQ units have three-state digital modulation – never used in a braking system before. Each controller can accommodate up to 4 HPU's with defined torque sharing. Other features include full BUS-based communication with the master control system.

So when the conveyor is almost stopped, less braking force is utilized. Or, a two-stage mode can be inserted to put the same pressure onto the stops. It depends on the situation, whether its a normal stop or an emergency, but in all cases the conveyor can be stopped in a smooth, controlled fashion.”

The SOBO system is also capable of providing additional dynamic braking functionality. For example, in a situation where the motor VFD loses control of the conveyor due to material overload, causing the conveyor to accelerate beyond its normal running speed, the SOBO can be setup to send an overspeed alarm to the main PLC. The main PLC then decides whether a full SOBO stopping ramp should be initiated or if it is preferred to just bring the conveyor speed back to normal running speed again (in this case, the brakes will be programmed to automatically release when normal speed is reached and let the conveyor continue to run).

SOBO Control vs. Proportional Control

Proportional controls utilize proportional valves which generally work fine but are typically more expensive. The biggest disadvantage of proportional valves, however, is they require quite a bit of oil volume as the braking system needs constant motor and pump feeds in an emergency situation. Or, very large accumulators are required to keep feeding oil into the proportional valve during an emergency braking event. A very large UPS system and battery back-up system is required to power the pumps and the motors in order to maintain the large oil flow.

In contrast, the more cost-effective SOBO controller requires much less oil, eliminating the need for extra pumps and/or accumulators. A very small power source (the size of a motorcycle battery) is all that's needed to support the stand-alone, maintenance-free SOBO system. Minimal energy and oil requirements, combined with extensive electronic features provide solid advantages to SOBO users.

Experience and Service Makes the Difference

Svendborg has a very large number of SOBO systems installed on mine conveyors around the world which provides a huge database of how mining conveyors should work in different situations. All this data is used when a new control system is installed. Similar competitor control manufacturers don't have the level of experience and performance data to guide the design and setup of new conveyor braking systems.

Svendborg's technology leadership with control braking systems plus their teams of on-staff dedicated service technicians located in all the major mining centers are unmatched in the industry.

SOBO control and braking systems are installed on most of the world's largest incline and decline mining conveyors in Europe, Chile, Peru, Mexico, North America, South Africa and Australia. Svendborg's SOBO brand is known for outstanding performance in the field and is well recognized and trusted by all global mine conveyor OEMs and consultants.



Remote access and touchscreen for setup and monitoring. The control utilizes different communication ties plus different communication protocols. Users can easily access and change the parameters inside the control, such as defining a parking sequence or pre-setting a stop time.

A full line of Svendborg hydraulic brakes are offered to meet the specific motor size and torque requirements of all types of mine conveyor applications. A series of smaller calipers is available for use on the high-speed (low-torque) side of the conveyor drive shaft, while a full selection of larger caliper models is available for mounting to the low-speed side.

Svendborg also offers a broad range of specialized hydraulic power units, custom-engineered to meet any mining conveyor requirement. Unlike many competitors, all Svendborg power units are designed and manufactured in-house to ensure compatibility with other Svendborg braking system components. In order to minimize downtime, the units are equipped to monitor oil level and temperature, motor and pump function, and system pressure to immediately identify any failure and, thereby, prevent further damage.

Custom-designed Svendborg hydraulic power unit features include fast braking and retraction time, brake on/off indicator, redundant motor/pumps and valve blocks, accumulator monitoring, and smooth operation in cold climatic conditions – as low as $-40^{\circ}\text{C}/-40^{\circ}\text{F}$.

Svendborg's ability to design complete packaged braking solutions including the state-of-the-art SOBO iQ controller, a wide range of long-lasting brakes, custom hydraulic power units, and other quality components makes them a leading expert in the mine conveyor industry. Extensive support provided by an unmatched global network of local service centers makes Svendborg a preferred choice for mine operators worldwide.

Conveyor OEMs and consultants have grown to trust Svendborg as a true engineering partner. When called in early on a project, the Svendborg team can provide useful information and recommendations. For example, instead of positioning a brake disc between the gearbox and the pulley, which would require a coupling, it might be suggested that the disc be installed on the other side of the pulley, using a hub instead of a coupling, which would save two-thirds of the cost.

While initial system costs are scrutinized, end users continue to focus on the total cost of ownership when considering their conveyor braking systems. Svendborg systems might cost slightly more for the initial installation. However, downtime will be eliminated or significantly reduced because Svendborg technicians can typically be on-site within five to ten hours, whereas a competitive vendor may take three times as long and they may not speak the local language.

Svendborg application specialists utilize heat calculators when reviewing a conveyor braking application. The economical aspect of how much heat the discs and pads can handle is analyzed. For example, if a customer has specified a single brake disc but the calculator shows that too much heat will be generated, he will be advised that two discs likely will be required.

One other money-saving recommendation that may be considered is brake type standardization. While it might cost slightly more initially to specify the same brake models on two different conveyors within a facility, there may be significant savings achieved through standardization of parts and by making it easier for maintenance teams to become familiar with only one brake type.



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CASE STUDY

Braking Systems with SOBO® Controllers Installed on Copper Mine Conveyors in Chile

Svendborg was recently selected by a major mine conveyor OEM to supply complete braking systems for use on a series of three downhill in-line conveyors at a large copper mine in Chile. Two of the conveyors are 1600 m (1 mile) long and another is 700 m (.4 mile) long.

While this particular conveyor application may be considered challenging by competitors, providing a custom packaged solution to meet the unique requirements was fairly routine for the Svendborg team.

The copper mine conveyors can transport 5,000 tonnes/hour with a belt speed of 5.5 m/s (12.3 mph). The braking systems provide emergency stopping and parking functions. Each conveyor braking system consists of two model BSFH 520 caliper disc brakes, a SOBO controller, a hydraulic power unit and disc.

The spring-applied, hydraulically-released BSFH 520 brakes act on a 1.6 m (5.2 ft.) diameter disc mounted on the low-speed side of the drive shaft. The brake system provides up to 134,354 ft.lbs. (182,160 Nm) nominal braking torque to stop the conveyor in a controlled manner over a 50-second time period.

Svendborg's unique SOBO soft-braking controllers provide a range of safety and durability benefits in mine conveyor applications. Deceleration and the stopping of heavy conveyor loads is critical, and controlled braking is essential for a significant reduction of torque peaks, preventing damage to the belt and mechanical components. Manufactured in-house, Svendborg's custom hydraulic power units are engineered to meet any mining requirement. In order to minimize downtime, the braking systems are equipped to monitor oil level and temperature, motor and pump function, and operational pressure.

The three SOBO controllers allow the customer to give a brake command to each conveyor brake system at the same time, or they can program a delay if desired. In this case, they give the same brake command at the same time for the three conveyors.

The brake control can be set up with three to four different stopping ramp programs.

In many bigger mines the energy generated by a large downhill conveyor (easily 2,000 kilowatts per hour) can power the entire mine with electricity. Most mines are in remote locations, and they require electricity to run the conveyor VFDs. If power is cut at the mine, the VFD stops running and the braking system has to stop the conveyor. So, in the event of a power loss, brake Ramp 1 will automatically be applied. Brake Ramp 1 is always defined as an emergency, worst case scenario. A power loss stopping Ramp 1 might be set for 40 seconds.

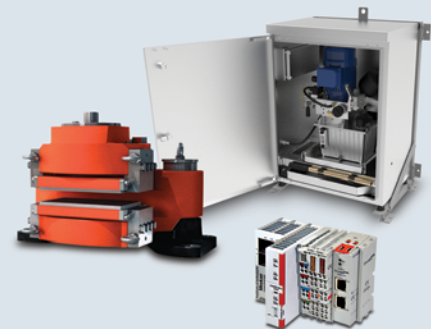
Brake Ramp 2 is for normal braking and might be programmed for 60 seconds. Typically, the motor VFD can slow the conveyor to a couple RPMs. At that point, the braking sequence will be applied at approximately 5% to take over the final stop, and then the parking brakes will be applied to hold the conveyor in the locked, secured position when the conveyor is completely stopped.



A large copper mine in Chile utilizes a series of three downhill in-line conveyors. Two of the conveyors are 1600 m (1 mile) long and the third is 700 m (.4 mile) long. The conveyors can transport 5,000 tonnes/hour with a belt speed of 5.5 m/s (12.3 mph).



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Braking Systems with SOBO® iQ Controllers Installed on Coal Mine Conveyor in Czech Republic

Svendborg supplied a complete braking system for use on an overland conveyor at a large coal mine in Tusimice, Czech Republic. The 1800 mm (71 in.) belt conveyor is 900 m (.55 mile) long and powered by three 500kW drives.

The opencast coal mine conveyor transports overburden at a rate of 3,000 tonnes/hour with a belt speed of 4.5 m/s. The braking system, consisting of eight model BSFI 320 caliper disc brakes, a SOBO iQ controller and two hydraulic power units, provides emergency stopping and parking functions.

The spring-applied, hydraulically-released BSFI 320 brakes act on a 0.8 m (2.6 ft.) diameter disc mounted on the high-speed side of the drive. The brake system can provide 60 kNm of torque max. and allow for controlled braking up to 50-seconds in case of a power failure.



A 900 m (.55 mile) long overland conveyor, powered by three 500kW drives, installed at a large coal mine in Tusimice, Czech Republic.



The braking system, consisting of eight model BSFI 320 caliper disc brakes, a SOBO iQ controller and two hydraulic power units.



Spring-applied, hydraulically-released BSFI 320 brakes act on a 0.8 m (2.6 ft.) diameter disc mounted between the electric drive motor and the gearbox on the high-speed side of the drive. The brake system can provide 60 kNm of torque max. and allow for controlled braking up to 50-seconds in case of a power failure.



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