Raising the issue of mines

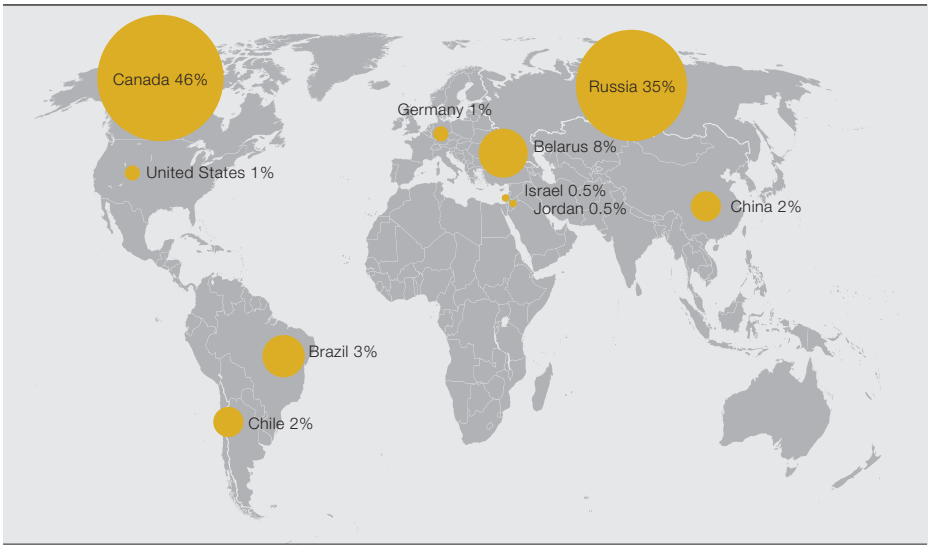
ABB hoists for mines

TIM GARTNER – A land area larger than the United States but a population about one-tenth the size endows Canada with huge acreages of pristine landscape. In this setting, industry has learned to minimize disturbance to the natural world. In mining, for example, great efforts are made by those who seek to develop natural resources to do so sustainably, with maximum energy efficiency and with minimal environmental impact. Raising mined product to the surface is one area in particular where technology can go a long way to accommodate Mother Nature. ABB has long supplied hoists to the mining industry and these can be not only installed in new mines, but also retrofitted to existing operations to equip them with the latest in hoist technology. Potash mining is one area where the benefits of ABB hoists are exploited.

Title picture
Energy efficiency, environmental impact and sustainability are important factors for mining operations when they come to choose a hoisting system for retrieving their produce to the surface. ABB's years of technology development in this area have resulted in a comprehensive range of hoisting products, including advanced friction hoists.


machinery

1 World potash reserves as reported by the United States Geological Survey. (Other countries make up 1 percent.)



As the world's population passes the 7 billion mark and as more of that population become more prosperous, the demand for food rises inexorably. Agriculture would have lost the ability to keep up with this demand long ago if it were not for the magical powers of fertilizer. The three primary crop nutrients are potash, nitrogen and phosphate, and, of these, potash is the one of most interest to miners. Dug from natural mineral deposits deep in the earth left by the evaporation of ancient oceans, bringing potash to the surface efficiently and safely, while minimizing environmental impact, requires the most advanced hoist technology available.

Potash is produced in only 12 countries, whereby Canada, Russia and Belarus together account for just over two-thirds of global capacity and, according to the United States Geological Service, almost 90 percent of estimated reserves → 1. The Canadian province of Saskatchewan is home to almost half of world reserves and 35 percent of global capacity.

Friction hoists and drum hoists

While there are two main types of mine hoist systems – drum hoists and friction hoists – recent ABB hoist projects in the Canadian potash arena have involved friction hoists.

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The main purpose of any type of hoist (friction or drum) is to raise or lower a load within the mine shaft using steel wire rope attached to a load. The load can be a skip (large metal container carrying mine ore), a cage (conveyance used to carry people, tools and mining machinery or supplies) or counterweights (used for certain types of hoists). One side of the rope is directly attached to the conveyance (skip, cage or counterweight). On a friction hoist, the other side of the rope is attached to another suspended conveyance on the other side of the friction hoist, while for a drum hoist, the other side of the rope is directly attached to the hoist drum. When the mine hoist drum rotates, it raises or lowers this steel wire rope, thereby raising or lowering the attached conveyance → 2.

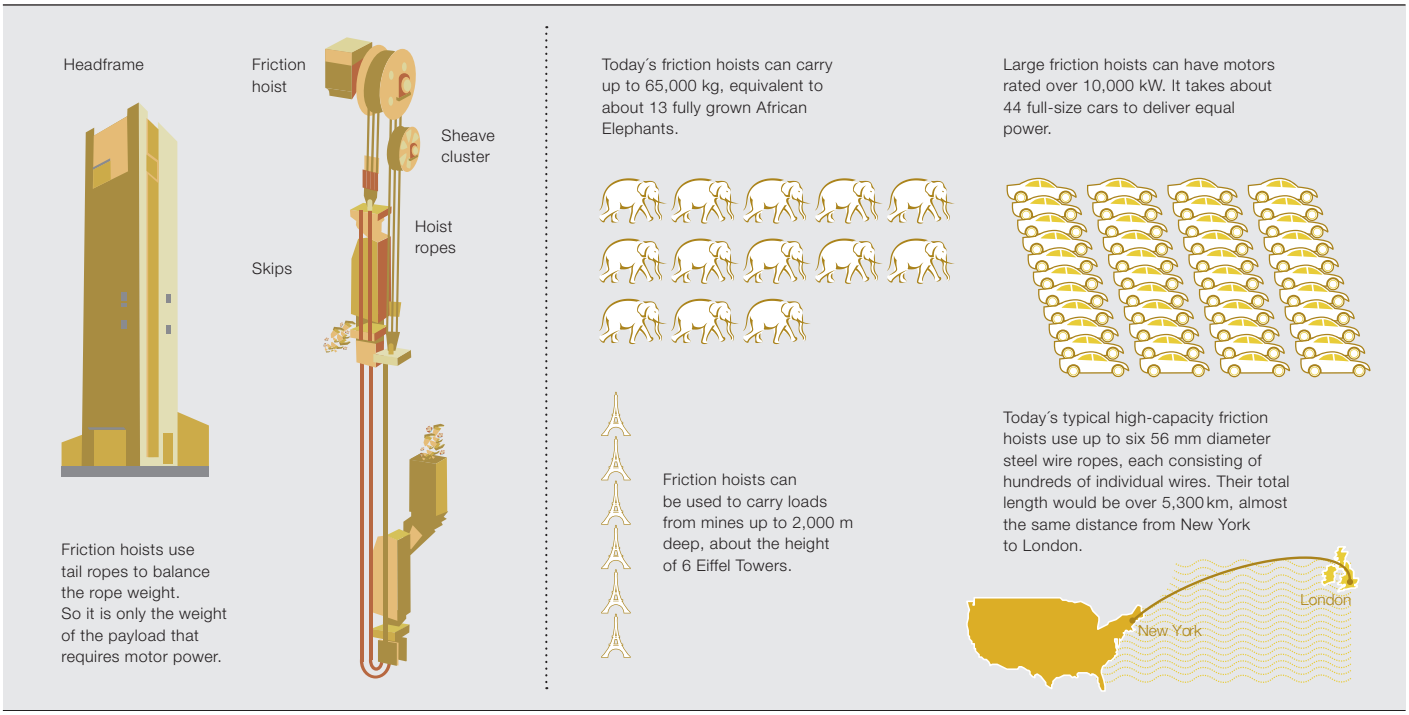
Unlike a drum hoist, the steel wire rope does not directly wind onto the friction hoist drum. Instead, it only passes over the friction hoist drum as the drum is rotated. The principle is the same as any pulley/belt driving mechanism and is used on most building elevators. Motor power/torque is transmitted from the hoist motor/drum assembly to the steel wire rope via the principle of mechanical friction between the rope and hoist drum. Since the rope is not wound onto the friction hoist drum, a friction hoist can use multiple ropes to support the mine payload. While four-rope and six-rope friction hoists are the most common, ABB has designed friction hoists using up to 10 ropes → 3. Drum hoists normally have only one rope for each drum and occasionally two ropes per drum in very deep mines or special circumstances.

ABB designs and supplies friction hoists, drum hoists, sheaves (wheels or pulleys), skips and other equipment used with mine hoist systems.

Friction hoists have proven to be the ideal solution for the Canadian potash mining industry due to their high energy efficiency and high payload capacity.

Mine hoist upgrades

Miners often upgrade hoisting capacity at their production shafts, especially if production rates increase. Sometimes this involves replacing the original hoist. Obviously, since the hoist enables the product to be removed from the mine, any interruption for upgrading work will stop production, so upgrades have to be performed in the shortest time possible. In some cases, this is no trivial task as extensive structural modifications may be required to the existing headframe



infrastructure in order to accommodate new, larger capacity hoists.

Two in one

In one case, in Saskatchewan, the production shaft contained two production hoists within the same shaft. ABB was contracted to upgrade both of the existing production hoists, but to do so within the same headframe and hoist foundations. This meant that the electrical and mechanical components of the upgraded production hoists had to fit precisely within the same hoist foundations. Since the new mine hoist could only be installed when the old mine hoist was removed, a tightly coordinated installation schedule was worked out between ABB and the customer.

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The upgrade project occurred over two consecutive summer shutdown periods. In the first, one of the existing production hoists was upgraded with a new friction hoist and AC synchronous motor and drive, as well as a new hoist control and operator system. While this upgrade was underway, ABB provided upgrades to the other production hoist, including a digital front-end upgrade to a competitor's DC thyristor drive system as well as a new hoist control and operator system. The second production hoist was mechanically upgraded in the next summer shutdown and later a new AC synchronous motor and drive system replaced the DC motor and thyristor drive system.

Over the top

In a second case, the customer asked ABB to repeat an earlier project at a different mine where a completely new hoist house was designed and fabricated on top of the existing headframe. Executing this required significant construction activity, but delivered advantages including:

- The size and capacity of the new hoist was not limited by the existing hoist foundations, allowing the customer to select the hoist most suitable for the shaft infrastructure.
- Construction of the new hoist house as well as installation of the new hoist would occur without interrupting mine production. During normal mine production with the old hoist, the new hoist could be installed and commissioned without ropes – ensuring a short changeover.

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3 Characteristics of friction hoists versus drum hoists

	Friction hoist	Drum hoist
Load-carrying ropes	Normally 4 or 6	Normally 1 but occasionally 2
Suitability for multilevel mines	Good with use of counterweight	Very good
Maximum hoisting depth	2,000 m (limited by hoist rope fatigue life)	3,000 m is deepest using two ropes
Motor power	Lower than equivalent-rated drum hoist	Higher than equivalent-rated friction hoist
Typical payload (potash industry)	45 t (higher and lower payloads exist)	30 t (higher and lower exist)
Relative cost	Lower than equivalent-rated drum hoist	Higher than equivalent-rated friction hoist
Hoist location	Can be mounted on ground or tower	Almost always surface-mounted
Headframe	Heavier structure than drum hoist	Lighter structure than equivalent friction hoist

The hoist selected was a four-rope by 5.95 m friction hoist outfitted with two AC synchronous motors and an ABB ACS 6000 AC drive system. A new hoist control and operator system was also installed and commissioned at the same time.

Surface-mounted hoists

Upgrades need not involve building a new hoist house on top of the existing production hoist headframe: ground-mounted hoists are also possible. In one recent case, a new ground-mounted hoist house was fabricated on the surface, near the existing headframe and production shaft. An extension was added to the top of the existing headframe where two sheave cluster assemblies (with four sheaves in each cluster) were installed. A completely enclosed rope travelway connected the new ground-mounted hoist house with the headframe extension. A new hoist control and operator system was also installed and commissioned at the same time.

Again, construction of the upgraded hoisting facilities did not interrupt production from the existing hoisting system.

Greenfield projects

Greenfield projects are generally the least complex as the new hoisting systems do not need to interface with any existing production or service infrastructure. In one recent project, slipform concrete headframes were constructed over the newly-completed shafts, after which ABB installed and commissioned complete new mine hoisting systems including mechanical equipment, AC synchronous motors and ACS 6000 drive systems as well as hoist control and operator systems.

The hoists were four-rope (5 m diameter) hoists, each powered by a single 7 MW AC synchronous motor and ACS 6000 drive system. The service hoist was commissioned in late 2013 and is in commercial operation. The production hoist will be put into commercial operation in 2015.

ABB as hoist supplier

ABB works closely with potash customers to select, plan and install production and service hoist upgrades in the fastest and most economical manner possible using the most modern and energy-efficient mine hoist equipment. In doing so, the customer can:

- Significantly improve potash ore hoisting capacity.
- Rationalize spares and capital spare parts inventory since major mine hoist components are, in most cases, identical (drives, motors, transformers, bearings, etc.).
- Gain operational benefits: For example, functionally identical hoists support common maintenance practices and procedures.

ABB hoists are, of course, used in many more operations that those that mine potash – coal, various ores, etc. ABB will continue to further advance its mine hoisting technology over the coming years and work together with customers to improve their hoisting operations in the most sustainable manner possible.

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