
Boliden Garpenberg

Welcome to a world class operation

Boliden Garpenberg in Hedemora municipality is now one of the world's most modern mines. At the same time, it is Sweden's oldest mining area that is still in operation. Zinc, lead, copper, silver and gold are extracted from the ore that is mined.

The operation is conducted with very strict goals when it comes to health, safety and environment. Nobody should be injured at work and our impact on the surrounding environment should be minimal.

Boliden has owned the Garpenberg mine since 1957, at that time around 300,000 tonnes of ore were mined each year. Since then the production has increased steadily. In 2011 it was decided to invest SEK 3.9 billion in an expansion of the operation in Garpenberg, with the aim of increasing production to 2.5 million tonnes of ore annually. Boliden Garpenberg currently has around 400 employees.

This is Boliden Garpenberg

Tailings Management Facility

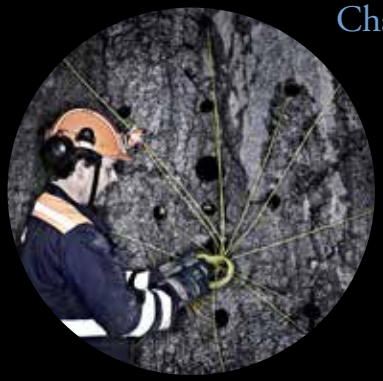
The Tailings Management Facility (TMF), Ryllshyttemagasinet, has been in operation since the mid-1960s and has a lifetime that will cover the operation's needs for the next 20 years. The tailings from the concentrator that is not back filled in the underground mine is deposited in the TMF. By optimising the management of the TMF, the discharges of metals from the operation will be minimised.

1 Mine office
2 Headframe – personnel hoist
3 Headframe – ore hoist
4 Mine ventilation
5 Water treatment plant
6 LPG plant
7 Ore storage
8 Paste fill plant
9 Concentrator
10 Concentrator office
11 Electrical substation

The process

The mining and concentrating process

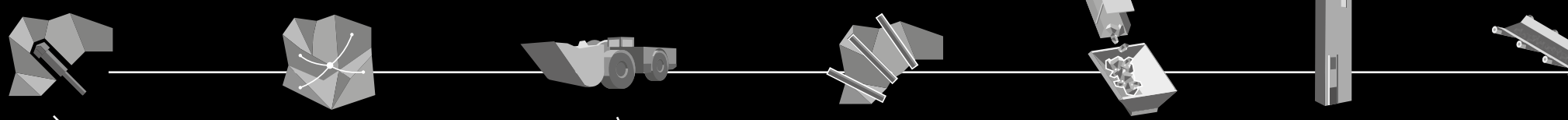
In Garpenberg, the ore is mined and crushed underground. The ore is transported to the concentrator above ground where the valuable minerals are extracted. Mineral concentrates are produced and transported to the customers.

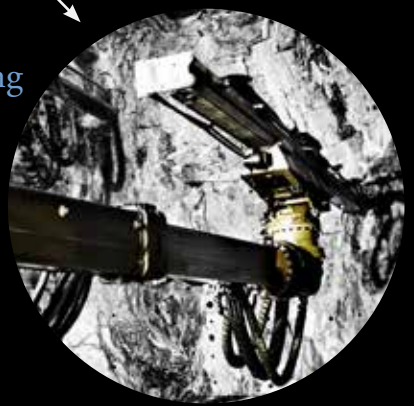


Charging and blasting

Rock reinforcement

Crushing





Drilling

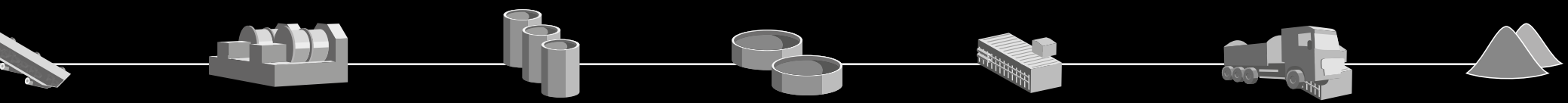
Loading and transport

Ore hoisting

Grinding

Dewatering – thickening

Dewatering – filtering



Flotation

Ore feed

Concentrate transport

Tailings

From mining to delivery

Ore is mined and processed in Boliden Garpenberg 365 days a year. Follow the journey from mining below ground to the transport of concentrate.

Underground mine

The Garpenberg mine is an underground mine where the ore is mined from between 500 to more than 1,200 metres below ground level. The main mining method is known as sublevel stoping. This means that the ore is mined in layers between two drifts (tunnels), which are driven through the ore body. Other mining methods include cut-and-fill mining, rill mining and residual mining of sill pillars.

Drilling

In the case of sublevel stoping, holes for the explosives are drilled using vertical drilling rigs. The drill holes can be up to 28 metres in length with a diameter of 76 millimetres. For cut-and-fill stoping and drifting, tunnel rigs with two booms are used.

Blasting

A liquid emulsion explosive is used for blasting. The emulsion is mixed mechanically when charging. During sublevel stoping, a normal round produces approximately 10,000–20,000 tonnes of loose ore.

Loading and transport

Loading ore from the sublevel stoping area takes place using remote-controlled LHD loaders. These can either be controlled entirely by an operator or controlled automatically, where loading and unloading are performed remote by an operator a CCTV camera system is used and the transport between is conducted automatically via a local WLAN system. Loading when drifting and cut-and-fill mining is performed with a wheel loader. The ore is transported using trucks to one of the two underground crushing plants. Ore and waste rock are transported by a contractor.

Reinforcement

At any place in the mine where people are working, systematic safety work is performed through scaling, shotcreting and bolting. During scaling, loose rock is removed from the ceiling and walls using mechanical scalers. The rock surfaces are then sprayed with a layer of steel fibre-reinforced concrete. Finally, rock bolts are drilled and cast in place in a systematic pattern. All of this is done to minimise the risk of rock falls from the ceiling and walls. In certain cases, a different type of reinforcement is required using e.g. cable bolts or mesh.

Crushing and hoisting

There are two underground crushing plants where the ore is crushed in jaw crushers. The crushing plants are situated 700 metres and 1,087 metres below ground level. After crushing, the ore is hoisted to surface in a shaft.
The machinery for the ore hoist is situated above the shaft installed in the headframe. The ore is unloaded into a bin in the headframe and then transported by a belt conveyor to an intermediate ore storage, which can hold approximately two days' of production.

Grinding

The ore is transported on belt conveyors from the ore storage to the grinding circuit. Water is added during grinding and the ore is ground in two stages, with autogenous grinding in the primary stage and pebble mill grinding in the second. Autogenous grinding means that the ore grinds itself without the addition of external grinding media. In the pebble mill, pebbles are added that have been extracted from the autogenous mill. The grinded ore is classified using screens and hydrocyclones. The coarse particles, that have not been ground down sufficiently, are returned to the grinding circuit. The grinding process results in a slurry containing water and finely ground ore.

Flotation

In the flotation process, the ore is concentrated and valuable minerals are separated from the waste rock. The flotation process is a surface-chemical process, where small amounts of chemicals are used to affect the valuable minerals' surface characteristics, causing them to become hydrophobic. This means that when air is blown into the slurry, air bubbles are attached to the surface of the hydrophobic mineral particles and are transported up to the surface of the flotation cell, where they can be removed.

Dewatering

The mineral concentrates are dewatered using thickeners and air pressure filters. Three mineral concentrates are produced: zinc, lead and copper concentrates. The precious metals are reported primarily in the copper and lead concentrates.

Concentrate transport

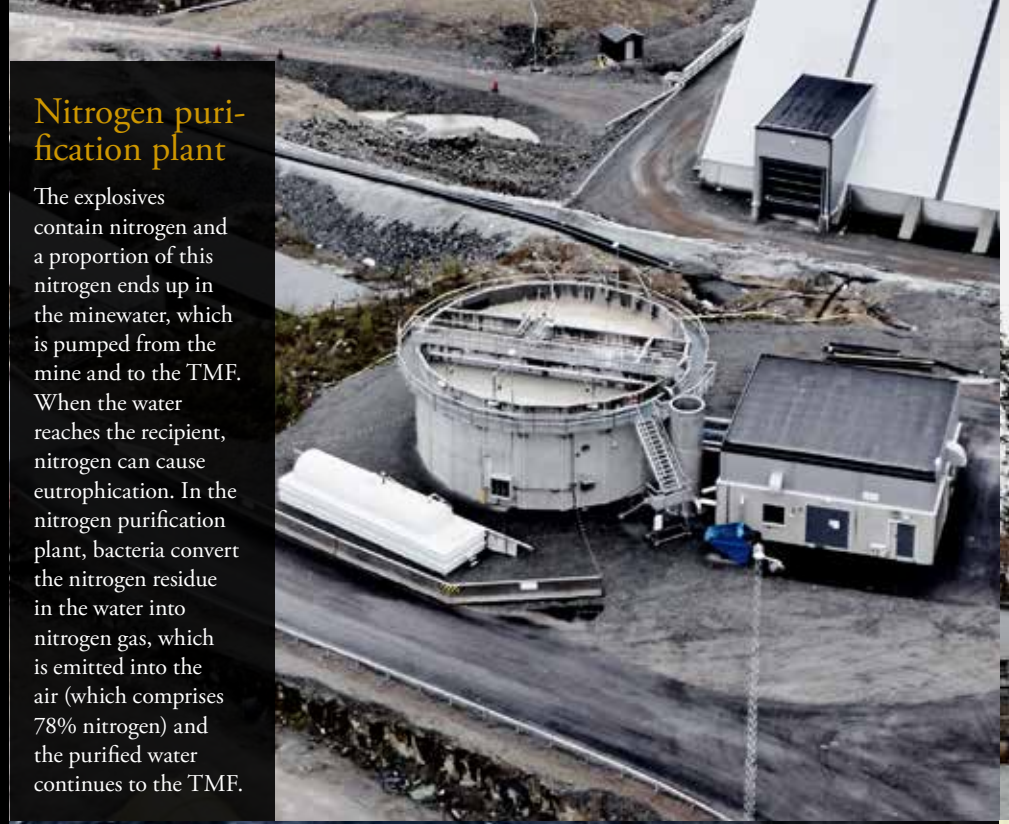
The zinc and lead concentrates are transported by truck to Gävle port for onward ship transport, mainly to our own smelters in Sweden (Rönnskär), Finland (Kokkola) and Norway (Odda). The copper concentrate is trucked and reloaded to railway for onward transport to the Rönnskär smelter in Skelleftehamn.

Tailings

Waste rock, which is mined and separated in the mine, are used for back filling in the mine. The portion of the finely ground waste rock that is separated in the concentrator is known as tailings. Some of the tailings are mixed with a binding agent and pumped back into the mine for back filling. Surplus tailings are deposited in a pond at the Tailings Management Facility (TMF) from where processed water is recovered.

Nitrogen purification plant

The explosives contain nitrogen and a proportion of this nitrogen ends up in the minewater, which is pumped from the mine and to the TMF. When the water reaches the recipient, nitrogen can cause eutrophication. In the nitrogen purification plant, bacteria convert the nitrogen residue in the water into nitrogen gas, which is emitted into the air (which comprises 78% nitrogen) and the purified water continues to the TMF.



Fenton plant

Oxygen-consuming substances, known as thiosulphates, are destroyed in the water treatment plant. If these substances reaches the recipient, they can cause oxygen deficiency in lakes further down in the aquatic system. The Fenton plant removes these substances through forced oxidation.

Mine geology

Mine geology provides the operation with important information about the ore and its surrounding geology, so that the mining engineers can plan the mining operations. It has to be decided how and where the ore is to be mined, and what infrastructure is needed.

Safety and the environment

In order to meet the strict EHS (environment, health and safety) goals for the Garpenberg operation a large number of measurements are performed by the operation with regard to both the external environment and the working environment. Noise levels and water quality in lakes and watercourses are controlled in the surrounding area. Within the operation, the health of our employees is examined regularly, as well as air quality and exposure to noise in their working areas.

Our mining equipment

A world class mine requires modern equipment
that is both productive and environmentally friendly.

DRIFTING
1 x Atlas Copco Boomer LC2
6 x Atlas Copco Boomer E2C

LONG HOLE (SUBLEVEL STOPING)
1 x Atlas Copco Simba M7
1 x Atlas Copco Simba ME7
2 x Atlas Copco Simba M6

ROCK BOLTING
6 x Sandvik Robolt DS-510

CABLE BOLTING
1 x Atlas Copco CableTec LC

SCALING
5 x Jama SB U 8000
2 x Atlas Copco ScaleTec LC

SHOTCRETING
1 x Jama CSU 800
2 x AMW 6400

LOADERS
3 x Sandvik LH 517D

Atlas Copco Boomer E2C

Jama SB U 8000

Sandvik LH 517D

Atlas Copco CableTec LC

Jama CSU 800

AMW 6400

Fixed assets

In Garpenberg, Boliden has invested in a number of fixed assets that are necessary for the operation.

ROCK SHAFT
6 m diameter, down to 1,175 m, loading takes place at a depth of 1,150 m

PERSONNEL SHAFT
4.5 m diameter goes down to 1,070 m, lowest disembarking level: 1,054 m

ORE HOIST
Capacity 28.5 tonnes per skip, speed 17 m/s, 416 t/h, installed power: 3 MW

PERSONNEL HOIST
Capacity 40 people (two levels), speed 8 m/s

HEADFRAME (ORE)
Height 68 m

VENTILATION
Total capacity: 750 m^3/s, heated via LPG, electricity and heat recovery

CRUSHING
Two crushing stations at depths of 700 and 1,087 m, jaw crushers with intake opening measuring 1.8 x 1.4 m, ore bins that hold 5,000 tonnes below the crushers

ORE STORAGE ABOVE GROUND
Approx. 60 ktonnes, of which approx. 16 ktonnes "live" volume (2 days)

CONCENTRATOR
Length: 208 m, width: 37 m, height: 40 m

PRIMARY MILL
6 m diameter, 12 m long, 5 MW installed power

FLOTATION
The largest flotation units have a volume of 70 m^3

THICKENERS
3 x 12 m diameter, 1 x 8 m diameter

FILTERS
5 x pressure air filters

ORE CONCENTRATE SILOS
Total capacity approx. 2,000 tonnes


Headframe – ore hoist


Ore hoist


Ore Storage above ground


Concentrator


Primary mill


Ventilation

NEW BOLIDEN

Metals for modern life