

CODELCO - CHUQUICAMATA MINE

BIGGER IS BETTER



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The mineral wealth of Chuquicamata, now the world's largest open-pit mine, has been known since prehispanic times. Today a massive underground expansion project is taking the asset into a new era of future prosperity

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If you were to set out today from Chile's capital city, Santiago, and head 1,650 kilometres north you would eventually come to what is the world's largest open pit mine. Based 2,870 metres above sea level, the Chuquicamata Mine is without question one of the jewels in the crown of Codelco, the planet's largest producer of copper.

In its possession Codelco holds approximately ten percent of the world's total copper reserves, producing some 1.75 million tonnes of refined copper in 2012 alone. This massive amount of copper stems through the company's seven mining divisions, one of which is Chuquicamata, which itself is responsible for producing around 366,000 tonnes of fine copper per annum.

Although mining at Chuquicamata commenced in 1910, its mining properties had been known for centuries by the prehispanic cultures present in the region. Said properties continue to be exploited to this very day with Codelco currently embarking on a structural expansion of the site in order to mine the resources located under the last open pit at Chuquicamata.

This pit has successfully delivered wealth and prosperity to Chile for the better part of 100 years, and yet in its current state it will no longer be profitable by the end of this decade. It is with that in mind that the company embarked on its plan to transform the world's largest open-pit mine into an underground operation and one with a projected output rate of 140,000 tonnes per day.

"In recent years," explains Sergio Bustamante, Project Director for Chuquicamata, "further explorations have



Air extraction tunnel which is 11 meters in diameter



SIMINE gearless drive systems for conveyors

Overland conveyor with gearless drive system commissioned at copper mine in Peru

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For the first time, a large-scale belt conveyor system with gearless drives has been installed outside of Germany: For an order from the Australian mining company Xstrata Copper, ThyssenKrupp supplied the conveyor system and Siemens the gearless drive system for the Antapaccay copper mine in Peru. With a conveyor speed of 6.2 meters per second on a belt 1,370 millimeters wide, approximately 5,260 tons per hour of copper ore can be transported over a distance of about 6.5 kilometers from the mine to the processing plant. The only comparable conveyor drive system in the world was installed in 1986 – also by Siemens and ThyssenKrupp (previously O&K) – in the Prosper-Haniel coal mine of Deutsche Steinkohle AG in Germany and is still in operation.

The drive system consists of two low-speed synchronous motors, each with a power rating of 3,800 kilowatts, and the associated SINAMICS SL150 cycloconverters, converter transformers, a containerized E-house, and related electrical equipment. Compared to conventional high-speed motor and gear units, this gearless drive solution enables the installation of larger drives, increases reliability and efficiency, reduces maintenance effort – and delivers maximum availability.

Siemens' scope of supply also included the entire switchgear and gearless drive systems for a 40-foot SAG mill and two 26-foot ball mills with all associated power supply equipment.

been made which have confirmed that beneath the pit exist 4,200 million tonnes of resources.”

This figure translates into around 1,700 million tonnes of copper ore reserves and molybdenum (512 ppm), which represents over 60 percent of all mined resources in the last 100 years. It has subsequently been decided by the company that exploiting the reserves through the construction of an underground mine, which will be one of the largest and most modern and efficient in the world, is the most economical option going forward.

Such a large undertaking, especially one that is unprecedented anywhere in the industry, obviously throws out its own technical challenges, all of which have been taken into account by the mine operators. The material handling system for example will be unique in that it will run entirely through belts, with the main strap

SIEMENS

Direct drives equipped with synchronous motors are a proven drive solution. These gearless drive systems are often found in steel rolling mills, but also in mining applications, such as hoists and mills.

Direct drives are now being increasingly used for belt conveyors requiring high power.

Conveyor drives must be reliable and efficient – that's why ThyssenKrupp and Siemens partnered up to develop a simple drive solution with few components. The drive train consists only of the pulley, two bearings, the rotor and stator.

The availability of the drive increases as a result of the low number of components installed.

Direct drives are more efficient and represent the best choice for power ratings of several Megawatts.

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“THE MATERIAL HANDLING SYSTEM IS UNIQUE IN THAT IT WILL RUN ENTIRELY THROUGH BELTS”



The access tunnel is approximately 7.5km long

Answers for industry.



Entrance to tunnel number 12

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having two sections of approximately three kilometres of belt each.

Elsewhere, technical operations on the early stages of the mine's structural design, which comprises of four levels of production, include the construction of a main access tunnel measuring 7.5 kilometres, a similar tunnel system that will be used to transport ore, five clean air injection ramps, two air extraction shafts and numerous other works.

Despite the obvious scale of the task at hand Bustamante and the company have a clear target in mind when it comes to the timescale for the expansion project. "Underground operations are due to commence from 2019.

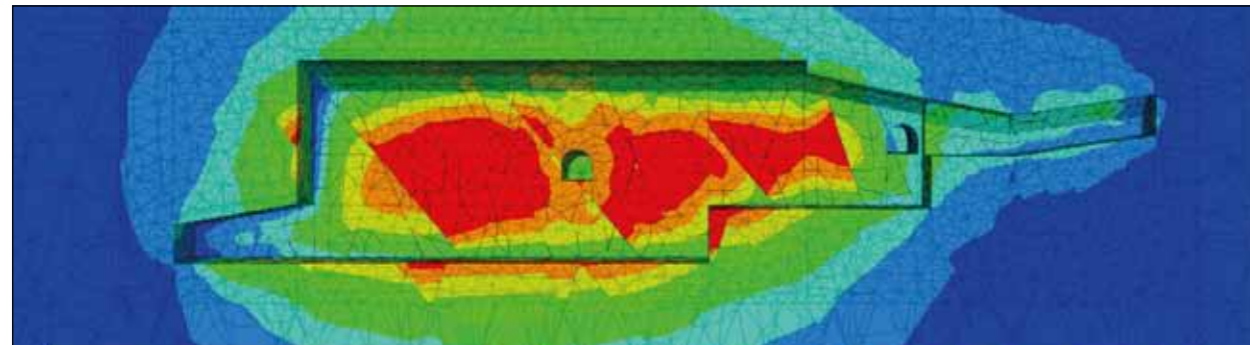
360,000

Tonnes of fine copper produced
 by the mine per annum




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ROCK MECHANICS SERVICES



The rock mechanics team of SRK Consulting Chile has been providing technical support to the Chuquicamata Underground Project, during the last 4 years. SRK group in Chile has worked on a wide range of topics in the project, from collection and interpretation of geotechnical data to design of underground excavations, including also more than 50 complex 3-dimensional continuum and discontinuum numerical models. To date, SRK work carried out for the Chuquicamata Underground Project is summarized in 25 technical reports and more than 90 construction drawings.



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After that will be a ramp up period that will take about seven years to reach a production level of 140,000 tonnes of ore per day which converts into 366,000 tonnes of fine copper a year.”

As the home of both the largest open pit mine and the biggest producer of copper in the world, it really goes without saying that Chile is a hugely important location when it comes to the health and future growth of the mining sector, not only

in South America but on a global scale. It therefore stands perfectly to reason that the State of Chile assigns a great deal of importance to the industry.

By breaking down the figure it becomes clear very quickly indeed how important Codelco’s operations are to the country and the wider region. In 2012 the state-owned company generated more than \$7,500 million in income and since it was created in 1971 it has generated wealth equivalent to more than \$100 billion. A sizeable percentage of this is in turn assigned by the state to areas such as health, education, public services and

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Work platform for air extraction

“IN RECENT YEARS FURTHER EXPLORATIONS HAVE BEEN MADE WHICH HAVE CONFIRMED THAT BENEATH THE PIT EXISTS 4,200 MILLION TONNES OF RESOURCES”



Astaldi is in Chile since 1987.

Today, Astaldi is building for CODELCO the tunnels of the Chuquicamata Mine new underground system (26 km of tunnels, 5 km of shafts) and has completed the Relaves Treatment Plant (built for CODELCO Andina) which is today producing 11 tons/day of Concentrated Copper Minerals.



ASTALDI GROUP

Astaldi is a leading Italian general contractor with over 90 years of global experience. Its expertise is in the construction of large infrastructure projects in transportation, water and energy and civil and industrial building as well as concessions. Listed on the Italian Stock Exchange since 2002, today Astaldi operates in 18 countries with close to 10,000 employees. Over the years Astaldi completed and delivered numerous iconic works in Europe, Central and South America, Africa and Asia. In 2012, Astaldi ranked among the first ten top global contractor in transportation and hydro-electric projects by Engineering News Record.

www.astaldi.com

infrastructure projects, all for the benefit of the Chilean people, particularly those classed as being the most deprived. This makes the fact that the industry is continuing to grow rapidly and robustly a hugely positive one, with a least five structural projects in different stages of development presently underway under the Codelco banner alone.

As well as supporting Chileans on a national scale,

Codelco's Chuquicamata mine has long been a vital source of support for the local Calama community. "Here," Bustamante states, "the company has led a very important program called Calama Plus. Together with the support of various private companies the program centred on a voluntary citizens' consultation, in which more than 20,000 residents participated, with the aim being to create a master plan to improve the standard of life in the community."

Looking at future of the mine and its underground expansion, the biggest challenges for Codelco when it comes to



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Jumbo rig working in the transport tunnel

2019

When underground operations at the mine are due to commence

Building personnel
separating different
areas of construction

“THE NEXT FIVE
TO TEN YEARS ARE
ARGUABLY GOING TO
BE THIS PROJECT’S
MOST VITAL PERIOD
OF TIME”

managing and constructing a mega-mining project valued at over \$4,000 million will be to ensure that it continues to capture the enormous potential of the Chuquicamata site for many years to come, something that must be done within time and cost limits, and without serious accidents. This last point is critically important to the company as it has long placed emphasis on the fact that safety is its top priority and that it believes that there is no target it could reach that would ever justify placing its employees at risk.

“The next five to ten years are arguably going to be this project’s most vital period of time,” Bustamante concludes. “This is the period in which we are going to be building the project, and then it will be put into operation and subsequently we will advance with the productive scaling (ramp up). Our primary goal throughout will be to materialise a good project to benefit Chile and all the people of Chile.” **BE**

For more information about
Codelco - Chuquicamata Mine visit:
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