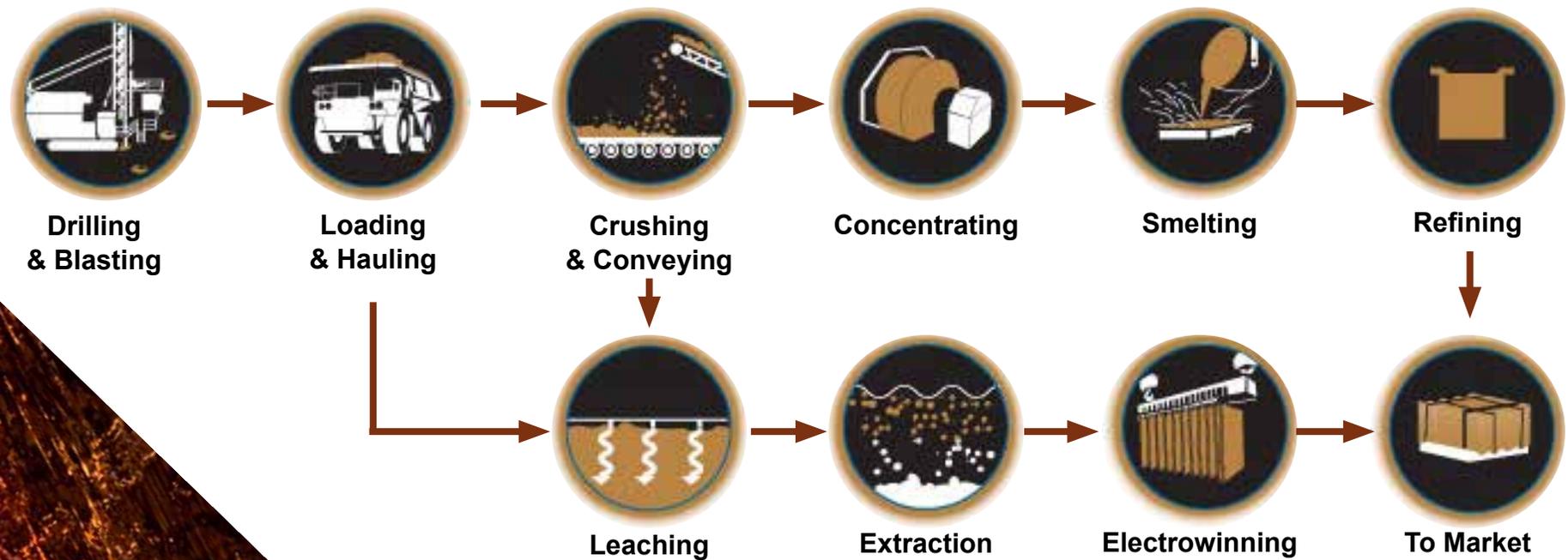


## OUR MINING PROCESS

Learn how Freeport-McMoRan Inc. carefully drills deep into the earth mining for copper ore. Follow the process each step of the way from Drilling to Electrowinning to Market. Take an inside look at how the raw ore is sifted, refining and manufactured into the copper products you depend on.

*Click on an icon to begin the tour.*



DRILLING & BLASTING

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DRILLING & BLASTING

Large drilling rigs bore a carefully designed pattern of holes approximately 12 inches in diameter and 60 feet deep into the rock. The holes are filled with an explosive compound of fuel oil and ammonium nitrate. Upon detonation, thousands of tons of ore are fragmented in a single blast.



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LOADING & HAULING

LOADING & HAULING

LOADING & HAULING

Large electric-powered shovels are capable of scooping up to 100 tons of ore in a single pass. Mammoth haul trucks are capable of carrying more than 300 tons of material per load. Computers and global positioning satellite systems assist dispatchers in directing full loads to leach stockpiles or crushing plants, and in directing empty trucks back to available shovels.



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CRUSHING & CONVEYING

CRUSHING & CONVEYING

CRUSHING & CONVEYING

Some loads of ore go directly to leach stockpiles, others are directed to primary crushers where the ore is crushed into small enough sizes to be placed on a conveyor belt. At this point the ore can be sent directly to leach stockpiles or it can be directed to concentrator facilities for further crushing and grinding.



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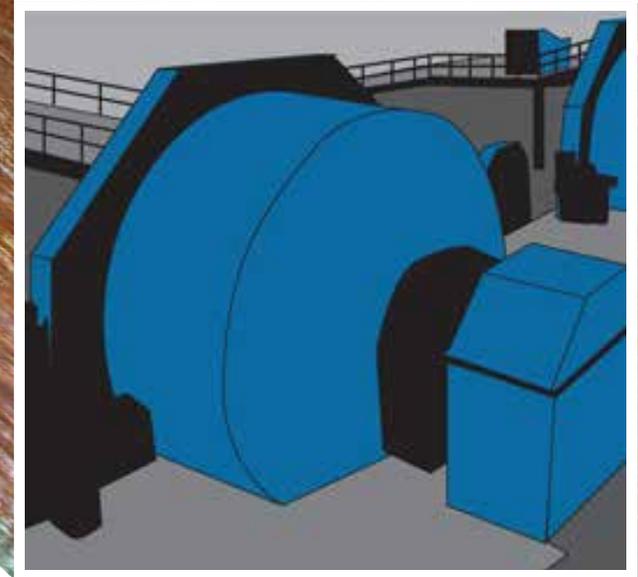
CONCENTRATING

CONCENTRATING

CONCENTRATING

CONCENTRATING

Using large grinding mills, ore is further crushed and ground to the consistency of beach sand. Because nature creates copper in low densities (typically less than 1 percent grade), copper levels must be increased or “concentrated” to be recovered economically. This is accomplished by the next step, called flotation. Finely ground ore is mixed with water and reagents creating a slurry. When agitated and injected with air, froth is created in the slurry and the copper is liberated or “floated” away from the host rock. The product of this process is dry, gray powder called copper concentrate, which contains about 30 percent copper.



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SMELTING

SMELTING

SMELTING

SMELTING

As a next step, copper-containing minerals in the concentrate are further separated from other elements (chiefly, naturally occurring iron and sulfur) using extreme heat. The molten copper is cast into anodes weighing 800 to 900 pounds each. These average about 99.6 percent purity.



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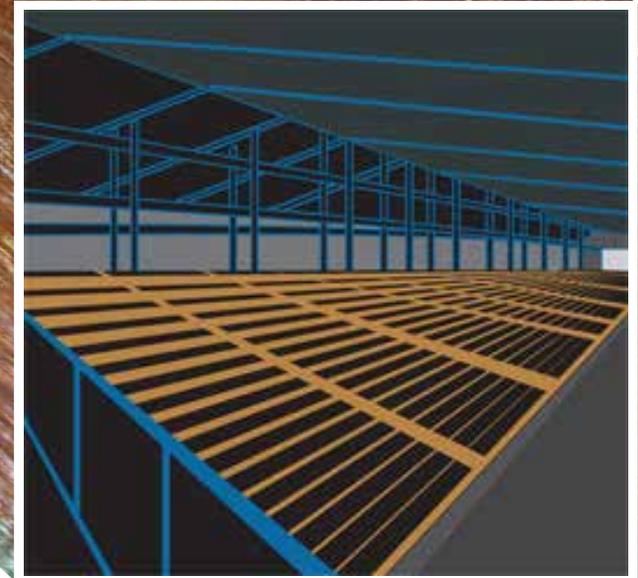
REFINING

REFINING

REFINING

REFINING

Anodes created in the smelting process are purified by electrolytic refining. The anodes hang vertically in cells in an electrolyte bath of copper sulfate and sulfuric acid. Thin starter sheets of pure copper are placed between the anodes and act as cathodes. Both the anode and cathode are in contact with a supply of direct, high-amperage electric power at low voltage that passes through the cells with the electrolyte acting as a conductor, much like a car battery. As copper in the anode is oxidized, it dissolves into the electrolyte solution and then plates onto the cathode. In this process, the impurities are removed, leaving a high-quality copper product (99.999 percent pure) ready for market.



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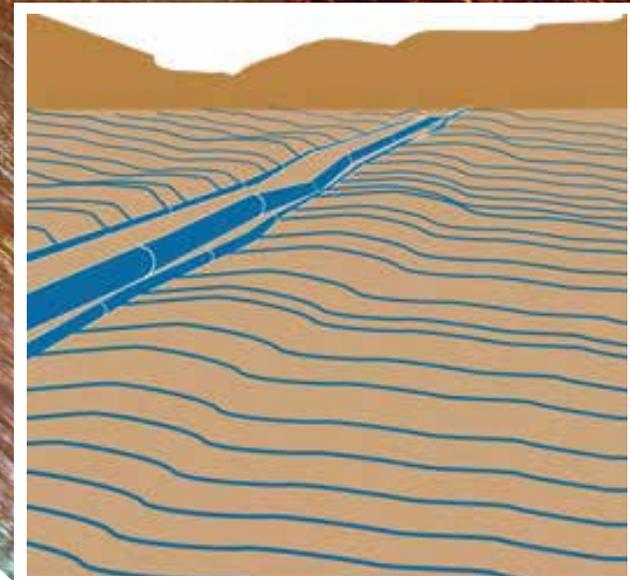
LEACHING

LEACHING

LEACHING

LEACHING

Smelting uses heat (in a process called pyrometallurgy), leaching uses fluids, called hydrometallurgy. In leaching, commonly referred to as solution extraction and electrowinning (SX/EW) copper is removed from rock using weak sulfuric acid solutions. (This process makes use of sulfuric acid produced as a byproduct of smelting.) In a first step: low-grade ore from the mine is either stockpiled for treatment or is crushed before stockpiling. The ore is placed in these large stockpiles or “pads” in 15- to 30-foot-high levels or “lifts.” As each level is built, a network of plastic tubing and drip systems or sprinklers is spread over the top of the pad to deliver “raffinate” to the stockpile. A slightly acidic solution, raffinate percolates through the stockpile, dissolving copper minerals contained in the rock surface. This copper-laden water, called pregnant leach solution, exits the bottom of the stockpile and flows into collection ponds. From there it is pumped to tanks at a solution extraction plant on the site.



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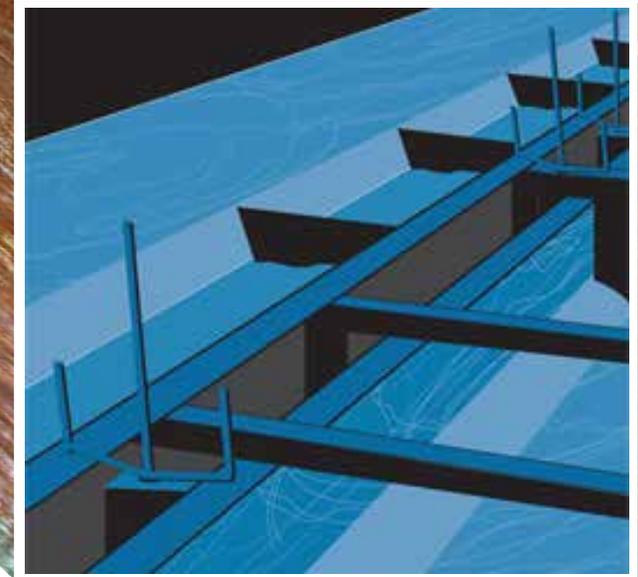
EXTRACTION

EXTRACTION

EXTRACTION

EXTRACTION

The pregnant leach solution is mixed with a diluent similar to kerosene that contains an organic compound specifically designed to extract the copper. After the solutions have been combined for about two minutes, the mixture is allowed to settle. The pregnant leach solution, which gives up its copper to the organic compound, is the heavier of the two solutions and settles to the bottom of the tank, becoming raffinate again, where it is pumped back to the top of the stockpile to begin the cycle all over. The diluent containing the copper-laden organic, now known as "loaded organic," floats to the top of the tank and is pumped to the next section of the solution extraction plant.



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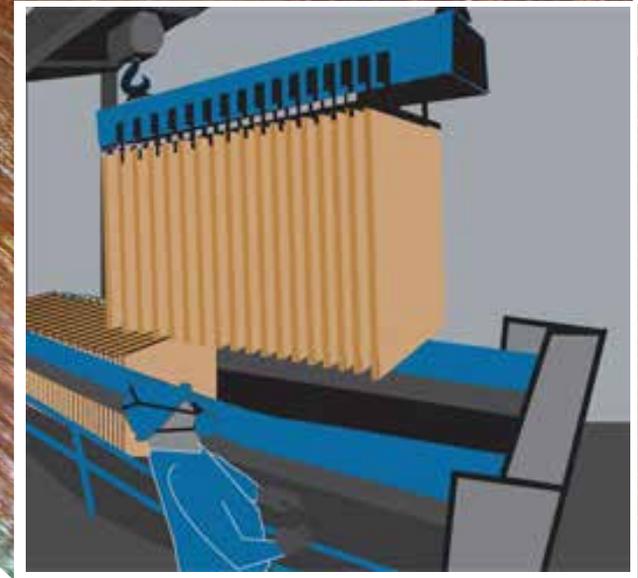
ELECTROWINNING

ELECTROWINNING

ELECTROWINNING

ELECTROWINNING

In this final step, the rich electrolyte is pumped through a series of tanks or “cells” in the electrowinning tankhouse. Hanging in the tanks are insoluble lead plates, alternating with sheets of thin copper or stainless steel. Each lead plate serves as the anode pole of an electric circuit. The thin copper sheets, called starter sheets, or the stainless steel sheets, called blanks, serve as the cathode pole. A direct current passes from the anode through the electrolyte to the starter sheet or blank, causing the copper ions in the electrolyte solution to plate (attach) onto the starter sheet or blank. After six to seven days in the tankhouse, 100- to 300-pound copper cathodes that are 99.999 percent pure and ready for market are harvested. The electrolyte that has passed through the tankhouse, now depleted of its copper, is returned as “lean electrolyte” to the stripping step of the process to begin that cycle again.



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TO MARKET

TO MARKET

TO MARKET

TO MARKET

Some cathodes both from the electrowinning and refining processes are shipped to company facilities to be used in making copper rod, the primary feedstock for the wire and cable industry. Some cathodes are shipped directly to customers for other manufacturing purposes.



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