In the Name of God

Introduction

Copper is among the metals having been frequently used from millennia ago. About 85 to 90 percent of copper consumed globally is produced by mining activities. Generally, ore processing for extraction of metals is done through two methods of pyrometallurgy and hydrometallurgy. Pyrometallurgy processes have been used from the beginning of man›s history and, today, production of more than 95 percent of metals is increasingly done by means of these methods.

Different studies show that Iran is located on the world's copper belt lying in the direction of Northwest-Southeast of the country. According to the last study done in 1997, global copper reserves, except for China and former USSR, has been estimated 5700 million tons, of which 1900 million tons, or about 3 percent, belongs to Iran.

Persian copper vase

Iranian Copper Past

Copper objects and copper alloys found throughout the country and, also, the remains of old and primitive copper smelting furnaces indicate that ancient Iranians were acquainted with mining and smelting industry. Archaeological finds show that the Iranian people have been exploiting the mines from about fifth millennium B.C. to the present day. Bronze, gold and silver objects of the subsequent millennia evidence that exploitation of the mines and smelting industry had been advancing through. After the advent of Islam, particularly in Seljuk (12th century A.D.) and Safavid (17th century A.D.) eras, mines› extraction and melting industry had been remarkably flourished.

Copper Vase, From Susa-Iran, louvre museum

National Iranian Copper Industry Co

Kerman Sarcheshmeh Copper Corporation was established on 3th July 1972, and renamed as National Iranian Copper Industry Co. in 1976 to involve all the activities related to copper industry throughout the country. This company has duties of extraction and exploitation of copper mines and production of copper concentrate and copper products, including cathode, slab, billet, and 8mm wire rod. Sarcheshmeh and Miduk in Kerman province and Sungun in Eastern Azarbaiejan are among the country›s most remarkable copper mines.

Rafsanjan Sarcheshmeh Copper Complex

Sarcheshmeh copper mine lies in 160 km south-west Kerman and 50 km south Rafsanjan in an average altitude of 2600m, the highest point of which reaches 3000m. Sarcheshmeh ore bodies are located in the central part of Zagros Mountains range and have been formed of fault corrugated, sedimentary and volcanic rocks belonging to the early third geological period. Sarcheshmeh copper production units include mine, concentrator, smelter, refinery and foundries, leaching and bioleaching.

Rafsanjan Sarcheshmeh Copper Complex

Mine

The ore body of Sarcheshmeh copper mine is one of the most massive porphyry copper reserves of the world, and the mine itself is among the greatest copper mines globally.
According to the latest exploratory data, the mine involves about 1.6 billion tons ores, the average copper grade of which reaches 6/0 percent. Given this huge volume of reserves, a 30 years long-period plan for Sarcheshmeh mine with a capacity of producing 30 million tons per annum sulfide ores grading averagely 62/0 percent copper, and about 50 million tons waste materials have been provided.
Thus, based on this plan, averagely more than 80,000 tons of minerals with an average grade of 62/0 percent copper and 400,000 of waste materials per day are loaded into mine trucks, capacious of 135 and 230 tons, by electric shovels, with a capacity of 15 to 17 cubic meters, to be carried to primary crusher in order to be crushed to parts dimensionally under 8 inches and, therefrom, transported to concentrators.

Mine

Concentration

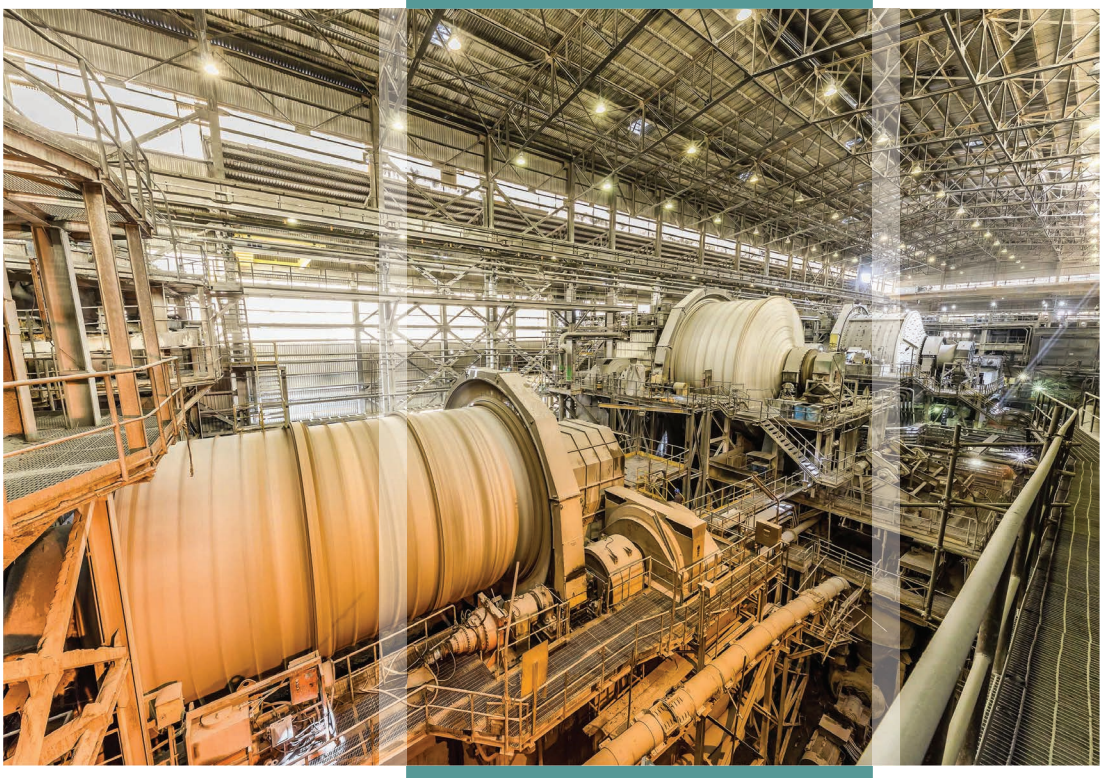
The concentration process of the Complex is done by two sections. The first section includes concentrators no.1 and no.2 and the second section is the molybdenum plant.

Concentrator no. 1

This plant involves secondary and tertiary crushers, thickeners, molybdenum plant, filtration unit, dryer and lime kiln. The feed required by concentrator is conveyed by conveyor belt from coarse ore stockpile to crushing section including secondary crusher (standard cone) and tertiary crusher (short head), and after being crushed is sent to milling section based on its grading. In the milling section, the soil resulted from this stage combined with some additive materials are finely pulverized by ball mills. Then, the pulverized material is sent to hydro cyclones to be sized and, therefrom, to rougher cells.

The valuable product of these cells is a concentrate which is taken to cleaner cells and, then, to re-cleaner ones. The copper-molybdenum concentrate is carried from there-cleaner cells to the copper-molybdenum thickener and, therefrom, to the molybdenum plant. The copper concentrate, separated from the molybdenite, is taken to the copper thickeners in the form of slurry and, then, being filtered and dried, is either stored in the concentrate depot or transported to the site of combination and preparation of the smelter's feed.

Consentrator



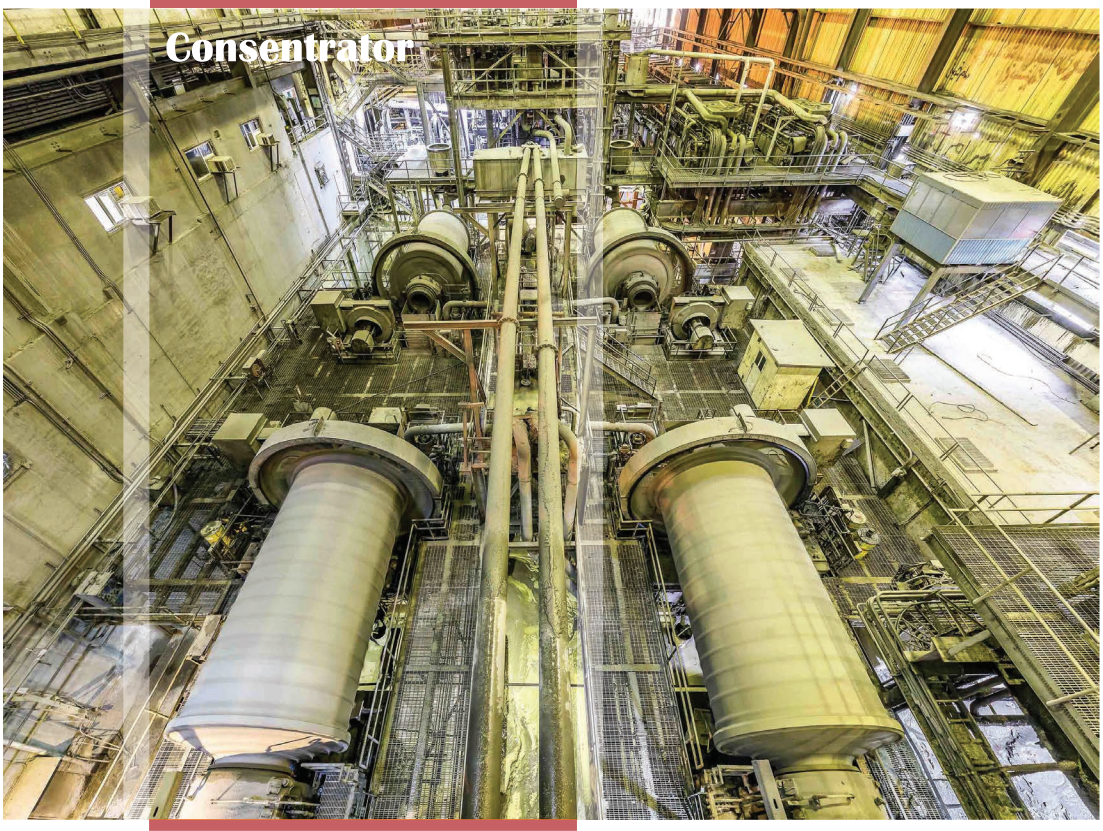
Concentrator no.2

In order to increase the output of Rafsanjan Sarcheshmeh Copper Complex›s concentrator plant, the expansion project of this plant initiated in May 1999, the first and second phases of which were completed in June 2004 and May 2015, respectively. Thus, 300,000 t copper concentrate with a grade of 23 percent and 2,400 t molybdenite concentrate grading 51 percent were added to the annual production capacity of Rafsanjan Sarcheshmeh Copper Complex.

The concentration process of the concentrator no.2 of Rafsanjan Sarcheshmeh Copper Complex includes material transfer unit (coarse material depot, chain feeders, conveyor belts, dust catchers and related equipment), material crushing and grading, floatation, dewatering and drying, providing and distributing system of lime milk and chemicals, dewatering and recycled water.

The concentrator›s feed is transported by conveyor belt from primary crusher to the coarse material depot. Then, these materials are carried to the crushing unit including two semi self crushing mills and two ball mills and after being crushed enter the rougher floatation cells by overflowing of the hydro cyclone and the resulted concentrate, after being re-crushed, is fed into the cleaner via the hydro cyclone.

The concentrate, produced in this phase, is transported to the column floatation cell and its tailings are carried to the scavenger cells. The output concentrate of the column floatation cells is conducted to the copper-molybdenum thickener and, then, to the molybdenum plant. Here, the molybdenum is extracted and the remaining copper concentrate enters the copper thickener and, therefrom, is transported to the pressure filter unit in order to be dried. Then, the dried concentrate is sent to the smelter.


Consentrator

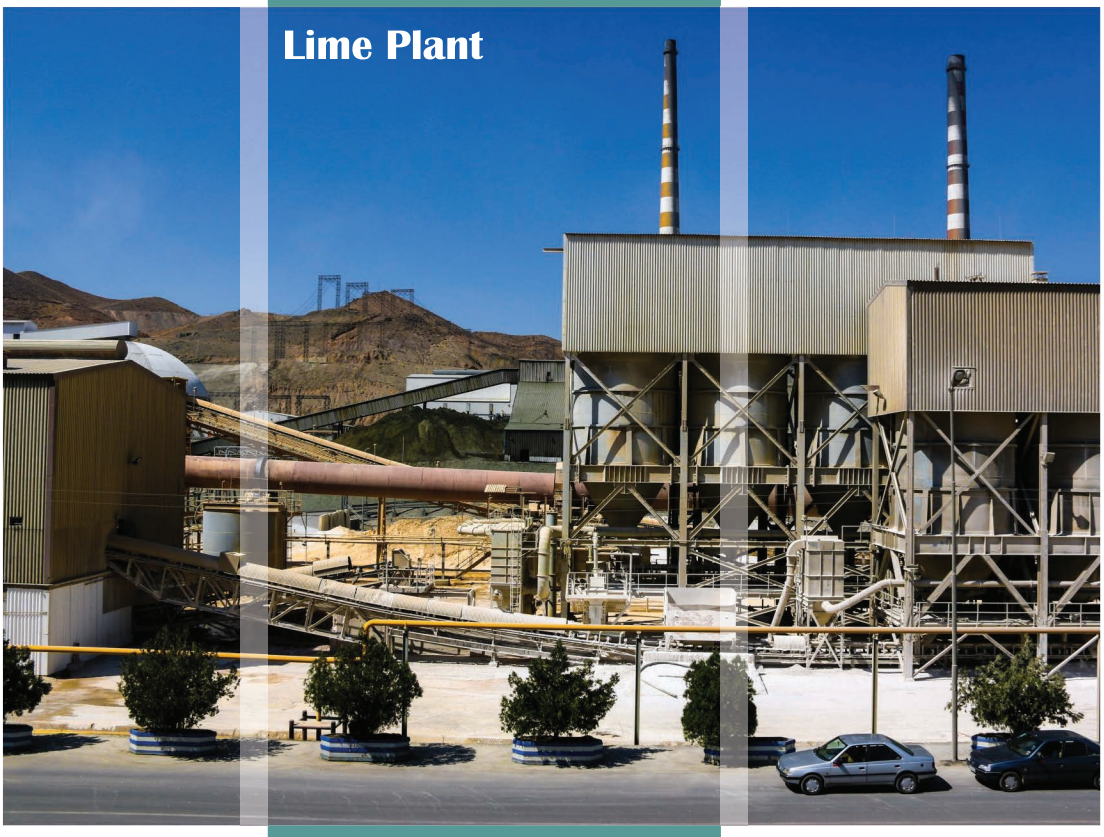
Molybdenum Plant

Copper-molybdenum concentrate having been dewatered in the copper-molybdenum thickeners is conveyed to the molybdenum plant.

In this stage, molybdenite ore, after passing floatation and re-milling, is separated from copper ores and transforms into molybdenum concentrate and, then, after being dried, is packed in some special barrels.

By implementation of the second phase of the concentrator, the production capacity has increased for the copper concentrate to 700,000 tons with an average grade of 23 percent, and for the molybdenum concentrate to 5,500 tons with an average grade of 51 percent.

Molybdenum Plant



Lime Plant

Smelter

The main units of Rafsanjan Sarcheshmeh Copper Complex›s smelter include concentrate warehouse and material transfer unit, dryer, flash furnace, thermal recycling boiler ,converters, anode furnaces and casting wheels.

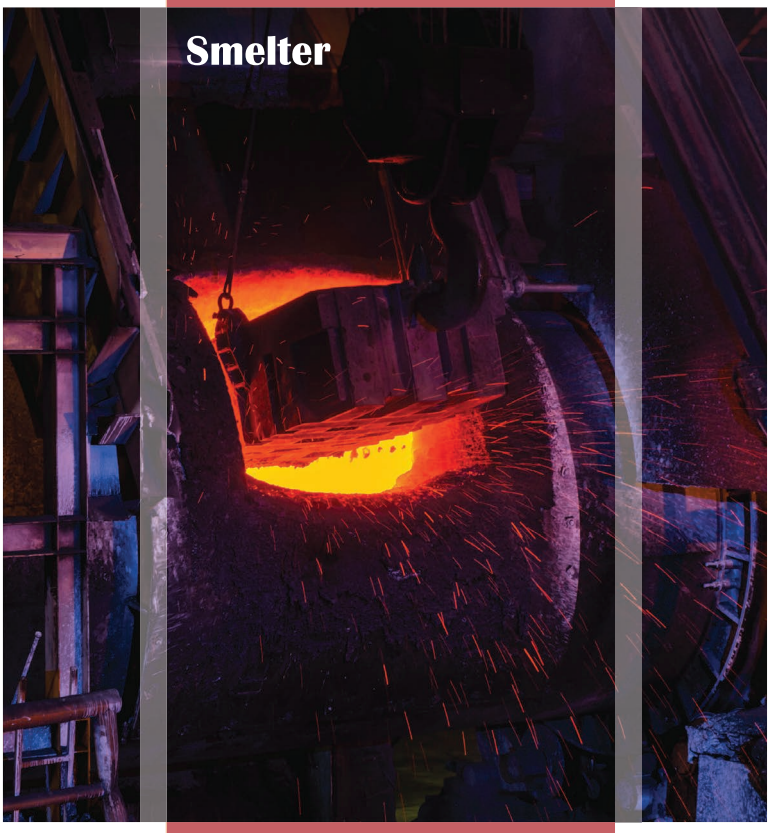
The product of the concentrator having been combined with some appropriate flux is transferred to the flash furnace.

Then, the resulted copper matte is carried into the converting unit to be more purified.

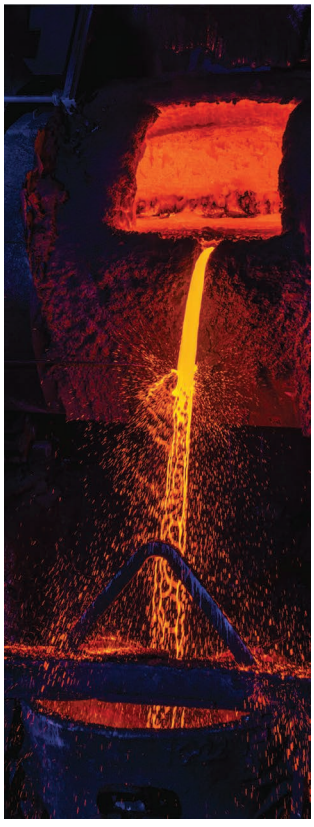
After doing the converting operation, copper blister is sent to the anode furnaces to be purified thermally. At the end, the smelter›s product is cast in the form of anode.

The weight of each anode is about 345 kg and its copper grade approximates 99.65 percent.

The product of Rafsanjan Sarcheshmeh Copper Complex›s smelter is a copper anode being sent to the refinery to be refined electrically.



Smelter



Sulfuric Acid Plants

In order to prevent the dissemination of the industrial pollutants, NICICO has erected two acid sulfuric plants of number one and number two with production capacities of 300,000 t and 600,000 t per year, respectively. They have been located adjacent to its copper smelter plant.

Acid Plant no. 1

The emissions of the smelter›s converters including 7.4 percent SO2 and some other impurities are directed to this plant and after passing the processes of cooling, refining, converting and absorbing, their SO2 content is separated and turned into a 93 percent sulfuric acid. The resulted acid is stored in 5000 t storage tanks to be either exported or used domestically.

Acid Plant no. 2

The output gasses of the flash furnace of the smelter consisting 21 percent SO2 and some other impurities are conducted to this plant and, as in the Sulfuric Acid Plant No.1, after passing the operations of cooling, refining, diluting, converting and absorbing, their SO2 content is separated. The produced sulfuric acid with purity grade of 98 percent is stored in some 12,000 t storage tanks in order to be either exported or domestically used.

Sulfuric Acid Plant

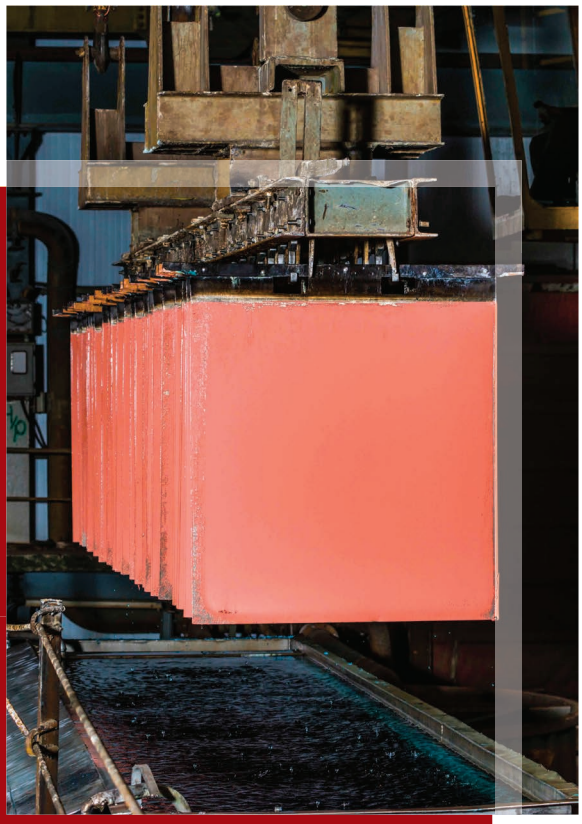
Refinary

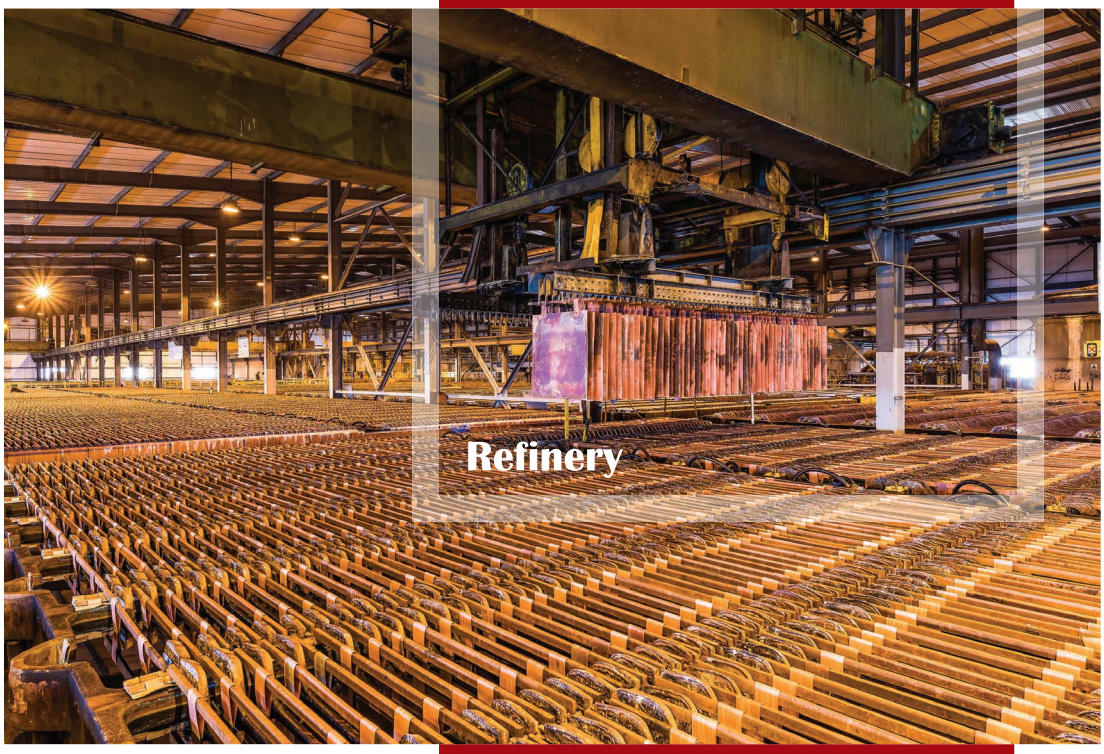
In Rafsanjan Sarcheshmeh copper Complex›s refinery the anode sent by the smelter goes through the electrolyte refining operation, using two methods of Starting Sheet and Permanent Cathode, and a copper cathode with a purity of 99.99 percent is produced in agreement with ASTM-B115 standard. Some of the produced cathode is sold in domestic and global markets and some is used by foundry unit (for producing 8 mm wire rod).

The refinery includes electrolysis hall with 960 electrolysis ponds and related equipment, water filtration unit, and the unit of purification and preparation of anode sludge (consisting precious metals such as gold, silver and so on).

The capacity of the electrolysis hall initially was 185,000 tons cathode per annum, but through the first stage of modifications, with optimizing the processes and increasing the current density from 210 A/m2 to 280 A/m2, it rose to more than 200,000 tons per year.

The second phase of modifications including complete installation of Permanent Cathode production method is being implemented in order to raise the capacity of the refinery to 240,000 tons per year.





Refinery

Continuous Casting

The continuous foundry is the greatest producer of 8 mm wire rod of the country and the only producer using the Contirod method with a nominal capacity of 32 tons per hour. Presently, the foundry with two work shifts per day meets all the needs of the domestic market and supplies a product which as in agreement with ASTM-B49 standard.

The continuous casting plant includes some units such as Asarco shaft furnace, holding furnace, Hazelett casting machine, rolling line and de-oxidation line.

The cathode imported into the foundry after being smelted and prepared enters the casting machine and the resulted continuous bar, having the dimensions of 50*120, goes directly through the rolling line and, after 15 successive stages of rolling, turns into 8 mm wire rod. The produced wire rod after being superficially de-oxidized finally is packed in the form of 5t coils and supplied in the market.

Continuous Casting

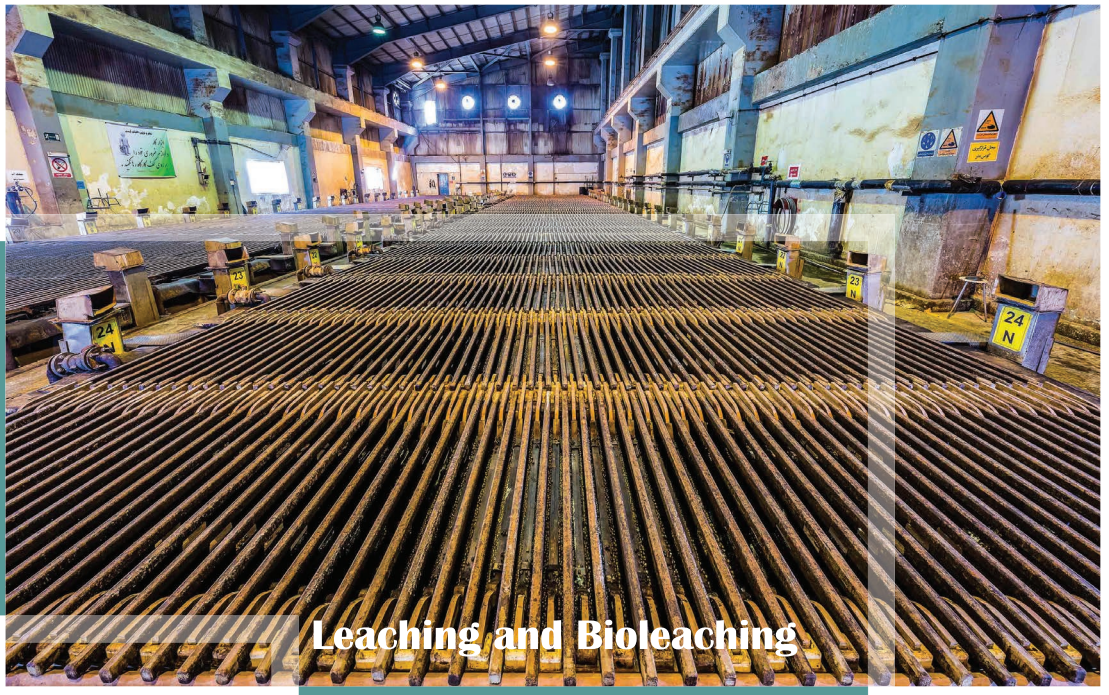
Leaching and Bioleaching

The heap leaching process has been planned on the basis of dissolution of oxide and carbonate ores using hydrometallurgical methods.

Leaching and bioleaching complex include heap, solvent extraction, electrical reduction, bioleaching and dust units and has a capacity to produce 10,000 tons copper cathode per annum.

In this method, the oxide ores, having been heaped, undergo an acidic irrigation in order that their copper content converts into a solution of copper sulfate. Then, the resulted solution from heap is carried into the solvent extraction unit.

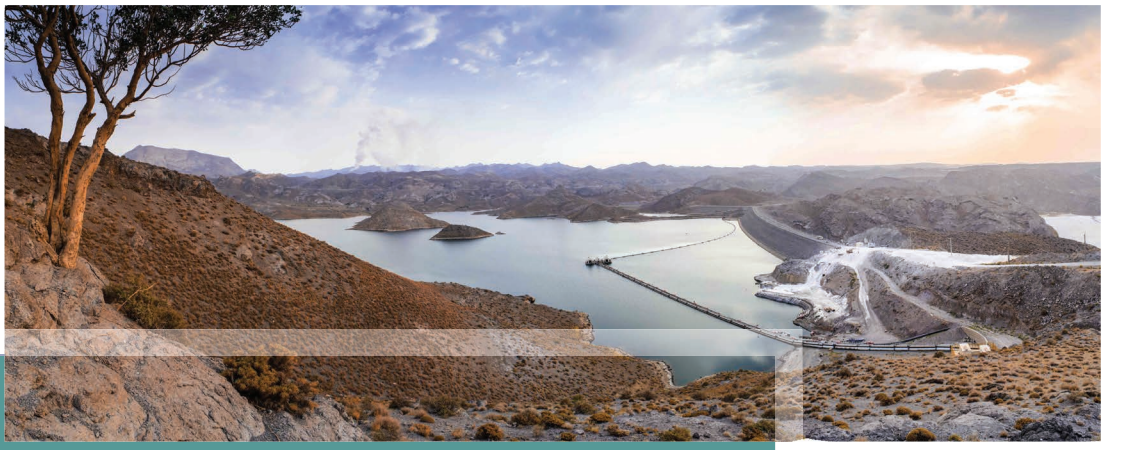
In this unit, copper is selectively extracted from the PLS and delivered to the electro-winning unit to be electrically reduced. Here, according to the ASTM-B115 Standard, a copper cathode with a purity of 99.99 percent is produced.



Leaching and Bioleaching

Integrated Water Master Plan

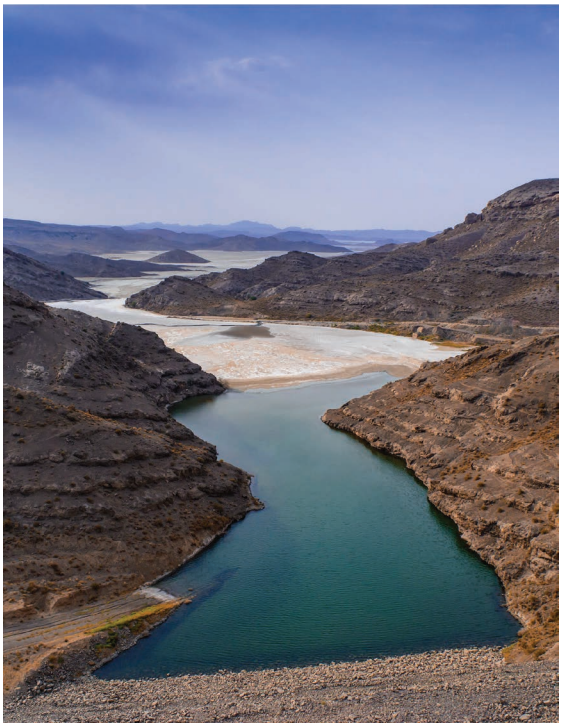
Increasing the production capacity in Rafsanjan Sarcheshmeh Copper Complex, as one of the expansion key plans of NICICO, requires proper planning for management of water supplies given that these supplies are limited in the region. Thus, the integrated water master plan was implemented from 2003 on to reduce the makeup water needed by the concentrator, supply the required water, pack down the concentrator›s tailings and accord to the international environmental standards.
This project has been planned for optimal use and maximal recovery of water from tailings by exploiting advanced technology of paste thickeners. The integrated water master plan includes elevating and strengthening the extant tailings dam, building a temporary tailings dam, a sedimentation dam, a deviational dam and a filtration house named as Rood-e-Shoor, renovating the extant thickeners and building a High Rate new thickener, erecting paste thickeners and establishing tailings and water transport lines.



Integrated Water Master Plan

Invironmental Actions

Though developing pyrometallurg technologies of copper production from sulfide ores accelerates achieving the target products, it increases the production and dissemination of environmental polluting factors, too.
After the implementation of Sarcheshmeh copper smelting project and changing its technology from reverberatory into flash and optimizing flash furnace of Khatoonabad smelter and, also, as environmental issues and clean and healthy air are rising in importance, NICICO is taking actions to control and decrease the polluting factors, of which the most significant are as follows Desulfurization of Sarcheshmeh copper smelter›s flue gasses through changing them into sulfuric acid by erecting a 600,000 t per year acid plant.
Controlling industrial waste waters through the integrated water master plan.



Environmental Actions

Observation of Internationally Acceptable Standards

All the end products of Rafsanjan Sarcheshmeh Copper Complex are produced according to ASTM International Standards having all qualitative specialities defined by these standards, so that they can compete with similar foreign products. Presently, Integrated Management System of ISO 14001 and Safety and Job Health Management of OHSAS 18001 have been established in NICICO and are under independent domestic and foreign care control.

Also, Control and Test Quality Management System of ISO/ IEC 17025 (in the units of quality control, and laboratories of production process and planning control of Rafsanjan Sarcheshmeh Copper Complex) has been established, and the primary stages of establishment and controllership of the validation of Inspection Management System of ISO/IEC 17020 have been completed in the Technical Inspection Unit.

Observation of Internationally Acceptable Standards