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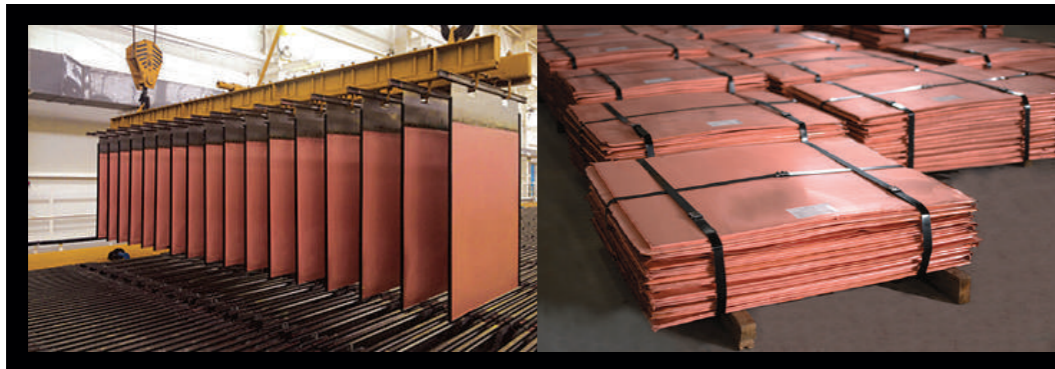
**Iranian Babak
Copper Company
IBCCO**

PIONEER IN GREEN INDUSTRY



TANK BIOLEACHING

The first cathode producer by the tank bioleaching in the world



CAST & DRAW (UPCAST)

The newest and most advanced copper tube line in the world



IBCCO

Iranian Copper Babak Company in a Glance

IBCCO, as one of subsidiaries of Middle East industries development holding company (MIDHCO), has initiated its activities in copper industries Since 2010.

Our main activities:

With focus on copper mining field, our main activities are categorized as:

1. Exploration, design, outfit and extraction of and from copper mines.
2. Establishment, development and improvement of copper processing plants and related subsidiaries.
3. Copper processing with different methods.
4. Execution of all activities, attributed to copper mining including consultancy, contract management, engineering services inside and outside Iran.
5. Commercial activities including buying and selling of legally exported and imported products, equipment related to mining industries.
6. Investment in other companies as a shareholder or in a form of partnership.

Our project:

Chah-Firouzeh copper concentration plant.

Our plant:

1. Copper tubes with namely capacity of 12,000 TPA.
2. Copper cathode (Tank Bioleaching) with namely capacity of 50,000 TPA, LME Grade A .

IBCCO Complex Location:

IBCCO complex with an area about 50 hectare, is located in 23th Km. of Shahr-e-Babak - Anar road in Kerman province, as one of the richest province in mining industries of Iran.

IBCCO now focuses on two plants including "The copper tube production plant" and "The LME grade A (ASTM B115) cathode project". The former is based on the cast and draw, as the newest technology in the world (fourth production line in the world), and the latter is the greatest tank bioleaching construction throughout the world.

By using these facilities, IBCCO produces wide range of semi-finished copper tube products (LWC, Pancake and Straight) with the highest international standards. Our conformity to all the quality, environmental and safety standards helps us to receive CE from TUV NORD Germany, ISO9001, ISO14001, ISO18001 Certificates as well as HSE-MS standards from SGS Iran.



Copper Cathode Plant

Greatest copper Cathode producing plant using tank bioleaching with the namely capacity of 50,000 metric ton per year was established and launched by Iranian Babak Copper Company at the north of Kerman province, Shahr-e-Babak city. Laboratory studies, pilot and process unit modeling had been done by Canadian companies. In this method copper cathode is produced through dissolution of copper sulfide concentrate inside acidic solution with the help of thermophile microorganism. Then with application of common solvent extraction and electrowinning procedures, copper with the quality same as LME grade A (purity minimum 99.99) in accordance with ASTM B115 (2016) is produced.

Copper Cathode Production Process:

Main production process consists of milling, dissolution and residue, neutralization, SX and EW.

Milling: Grinding of concentrate is performed through two vertical mills and reduces the size of particles from diameter 40 μm to 10-15 μm .

Dissolution: Copper sulfide concentrate is dissolved using bacteria in 50°C acidic environment. The main task of bacteria is oxidation of Iron and Sulfur, as well as acidic dissolution of oxidized Copper minerals and finally will lead to production of copper sulfate PLS.

Then and after precipitation, the residue of precious metal such as Gold, Silver and etc. will be separated through two thickeners and primary filters.

Neutralization Unit: primary produced PLS will be neutralized inside neutralization tanks using Lime in order to supply suitable PH and remove Iron impurities, and subsequently it will pass through thickeners and secondary filters before starting of SX process.





Copper Cathode Plant

Solvent Extraction: this unit includes two sections:

- 1- Extraction: separation of Cu Ion from aqueous phase to organic phase.
- 2- Stripping: transition of Cu Ion from organic phase to electrolyte solution and thereafter to electrowinning unit.

Electrowinning: deposition of copper Ion on stainless steel sheets with help of direct current and eventually the production of cathode with purity minimum 99.99 in accordance to grade A.

Advantages of tank bioleaching in comparison with pyrometallurgical process:

- Capable of using copper concentrate with different elemental composition and without restriction on Cu content of charging concentrate.
- It is more compatible with environment and has less pollution rate. In pyrometallurgical process large amount of SO₂ is produced which results in environmental pollution and

in order to eradicate this much pollution, launching a Sulfuric acid plant is necessary, whereas in tank bioleaching sulfuric acid is used as primary substance.

- In comparison with pyrometallurgical projects, investment cost is lower. (Currently the construction of smelting and refining plant wouldn't be economical for capacity less than 200.000 ton per year).
- Uncomplicated Operating control conditions as well as low Operating risk.
- Total energy consumption including electricity and fossil fuel will be decreased significantly in this method.
- Efficiency of pyrometallurgical operation would be 92% at optimum condition, whereas in tank bioleaching the modeling is based on 97%.
- Capability of recovery for Gold (150 kg per year) and Silver from the remaining residue.





Copper Cathode Plant

Cathode Chemical (Elemental) Analysis:

Standard	Cu (%)	Se (ppm)	Te (ppm)	Bi (ppm)	Sb (ppm)	Pb (ppm)	As (ppm)	Fe (ppm)	Ni (ppm)	Sn (ppm)	S (ppm)	Ag (ppm)
ASTM B115 (2016)	99.95	2	2	1	4	5	5	10	10	5	15	25
BS EN 1978:1998	99.90	2	2	2	4	5	5	10	-	-	15	25
IBCCO	≥99.996	0.6	1/1	0.7	2/1	2/5	1	4	1	1	9.1	3

Dimension:

Pcs / Bundle	Weight / Bundle (Kg)	Weight / Sheet (Kg)	Length (cm)	Width (cm)	Thickness (mm)
40	1800 to 2200	45 to 55	106	102	5 to 6

Packing:

Forty sheets of cathodes are packed using two parallel steel straps.



COPPER CATHODE

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Copper Tube Plant

Using cast and draw technology as one of the newest and advanced technology in the world, Copper tube plant has established on 2014.

Production line of plant is a combination of advanced Finnish and Austrian technology, respectively supplied by UPCAST and ASMAG companies.

Among all advantages of this technology, high quality and shortened production method are remarkable.

The plant has been launched on an area of 6 hectare and 10,000 square meters. Considering the existing technology, the plant can produce copper tubes with a premium quality that meets the current international standards, especially ASTM B280, B75, B68, B743, EN12735, EN1075, JIS H 3300, in order to supply all requirements to local and overseas markets.

Copper Production:

The production process of this factory is divided into three main sections: Production of mother tube through UPCAST, reducing the tube diameter to the desired size through drawing and shaping machines and eventually annealing the final product through bright annealing furnaces.

Melting and Casting:

In this method the tube production is started with UPCAST melting/casting furnace. First the cathode grade A is Charged into a 9 ton inductive furnace together with

phosphorous bronze and after obtaining the desired alloy, the melt is transferred to a 7 ton holding furnace. Then, through UPCAST, primary mother tubes with 38/33 and 52/47 (OD/ID) dimensions are drawn directly and transferred to the special baskets.

Primary Drawing:

The diameter and thickness of the primary tubes, produced in previous step, are now reduced by two 120 KN ASMAG drawing machines just according to the production process design.

Middle Annealing:

Since the drawing process has been done in cold temper, some residual tensions are formed in the tubes. In order to release these tensions and modification of metallurgical structure, tubes will be passed through an annealing furnace. This furnace is made by ASMAG, Austria.

Secondary Drawing (Spinner Block):

The tubes from the former section are transferred to two spinner block machines aiming the final sizes. The difference between this machine and the primary drawing machine lies in the number of drawing steps which enables us to produce tubes with diameters of 4-30 millimeters and the production speed of 1200 meter per minute. These machines are also made by ASMAG.



Copper Tube Plant

Level Winder:

After reaching the demanding sizes, the tubes are sent to level winder. In this step the whole surface of tube passes through "Eddy Current" to be inspected. The points with possible surface defect will be marked with a color and could be separated by customer. All these facilities and equipment have been bought from German company called "Foerster" which has international reputation in making non-destructive test devices. The inspection of tube in this machine takes place through two devices: "Defectomat" and "Rotating" which detect point and line defects respectively.

The number the faults are controlled in accordance with the standards.

Then tubes are wound in shape of 100-150 kg coils. This equipment is also made by ASMAG.

Finishing (For Pancake and Straight):

In finishing section the tubes are cut into straight or pancake according to customer's order. In this machine, tubes are inspected by "Foerster" equipment. In case any fault has been detected, the product will be omitted from production line completely. This machine can also cut straight tube up to 6 meters and pancakes from 15 to 50 meters. This machine is also made by ASMAG.

Final Annealing:

In this unit coil and pancake tubes are heated up to a suitable temperature in the final annealing furnace to regain their physical properties such as machining capability, electrical properties, cold working and also a shining surface. Then they will be held at the same temperature for a while and finally cooled down to the room temperature at suitable speed. To avoid the oxidation of the tubes, the oxygen is vacuumed and instead of it, Hydrogen and Nitrogen are blown into the furnace.

Final Products:

Eventually the tubes are produced in 3 different shapes of LWC (level wound coils), Pancake and Straights according to the customer order and supplied to the international and domestic market.

The industries using copper tubes:

- Cooling and heating industries
- Home utensils
- Water and gas piping
- Radiators
- Electrical industries
- Solar panels
- Automobile industry





Copper Tube Plant

Technical Properties:

Vickers	Grain Size µm	Min Elongation %	Min Tensile Strength MPa	Annealing Temper		Designation	Standard
-	Min40	40	205	Soft Anneal	O60	C12200 (Cu-DHP)	ASTM
-	Max40	40	205	Light Anneal	O50		
-	-	-	250	Hard (drawn)	H58		
(40to70)(HV5)	-	40	220	Anneal	R220	CW024A (Cu-DHP)	EN
(Min100)(HV5)	-	3	290	Hard	R290		
-	30 to 60	40	210	Soft Anneal	Y035		
-	15 to 40	40	220	Light Anneal	Y040		
Max69	25 to 60	40	205	Soft Anneal	O	C1220 (Cu-DHP)	JIS
Max73	Max40	40	205	Light Anneal	OL		
Min100	-	-	315	Hard	H		

Cu DHP is a Phosphorus-Deoxidized Copper with a high limited amount of residual Phosphorus (150 - 400 ppm or 0.015 - 0.040%wt). It has excellent thermal conductivity, as well as good bending, drawing and welding properties. It is also resistant to corrosion and hydrogen embrittlement.

$$P = \frac{2St}{D - 0.8t}$$

- P: Sustainable Hydrostatic Pressure of Copper tubes (bar)
- S (Annealed): Fiber Tension equivalent to 414 bar at 37.7 degree Celsius for anneal form.
- S (Drawn): Fiber Tension equivalent to 710 bar at 37.7 degree Celsius for drawn form.
- Minimum Thickness.
- Maximum Outer Diameter.

Dimensional Range of Products:

Products and Dimension Range	Shape	Outer Diameter			Thickness		Length (m)		
			from	to	from	to	from	to	
	Straight	Inch	3/8	1-1/8	0/013	0/059	2.5		
mm		9.52	28.57	0.33	1.5				
Pancake	Inch	1/4	7/8	0/016	0/056	15	30	50	
	mm	6.35	22.22	0.4	1.42				
Coil	Inch	3/16	3/4	0/013	0/056				
	mm	4.76	19.05	0.33	1.42				



Copper Tube Plant

LWC (Level Wound Coil)

LWC (Level Wound Coil) Tubes Dimensions:

W.T O.D	O.D															
	mm	0.33	0.35	0.40	0.45	0.50	0.60	0.63	0.70	0.75	0.80	0.90	1.0	1.14	1.24	1.42
mm	in	0.013	0.014	0.016	0.018	0.020	0.024	0.025	0.028	0.030	0.031	0.035	0.039	0.045	0.049	0.055
4.76	3.16							✓	✓							
6.35	1/4		✓	✓	✓	✓		✓	✓	✓	✓		✓			
7.93	5/16			✓	✓	✓		✓			✓		✓			
9.52	3/8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
12.00							✓			✓			✓			
12.70	1/2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
14.00							✓									
15.87	5/8					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
16.00												✓				
18.00								✓	✓	✓	✓					
19.05	3/4							✓	✓	✓	✓	✓	✓	✓	✓	✓

IBCCO is capable of producing other sizes within demanding period of time and according to customer's order.



LWC

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Copper Tube Plant

Straight Tubes

Straight Tubes Dimensions:

W.T O.D	mm	0.33	0.35	0.40	0.45	0.50	0.55	0.60	0.63	0.65	0.70	0.75	0.80	0.90	1.0	1.14	1.24	1.42
	in	0.013	0.014	0.016	0.018	0.020	0.022	0.024	0.025	0.026	0.028	0.030	0.031	0.035	0.039	0.045	0.049	0.055
9.52	3/8					✓		✓	✓	✓	✓	✓	✓	✓	✓			✓
10.00															✓			
12.00				✓				✓							✓			
12.70	1/2		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓
14.00											✓							
15.00															✓			
15.87	5/8					✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
16.00														✓				
18.00						✓					✓	✓	✓	✓				
19.05	3/4					✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
22.00										✓					✓			✓
22.22	7/8												✓	✓	✓	✓	✓	✓
23.00											✓							
28.00															✓			
28.57	1 1/8														✓			

IBCCO is capable of producing other sizes within demanding period of time and according to customer's order.

STRAIGHT

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Copper Tube Plant

Pancake

Pancake Tube Dimensions:

W.T O.D	mm	0.40	0.45	0.50	0.60	0.63	0.70	0.75	0.80	0.90	1.0	1.14	1.24	1.42
mm	in	0.016	0.018	0.020	0.024	0.025	0.028	0.030	0.031	0.035	0.039	0.045	0.049	0.055
6.35	1/4		✓	✓		✓	✓	✓	✓		✓			
7.93	5/16			✓		✓					✓			
9.52	3/8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
12.70	1/2		✓	✓	✓	✓	✓	✓	✓	✓	✓			
15.87	5/8					✓	✓	✓	✓	✓	✓			
19.05	3/4					✓	✓	✓	✓	✓	✓		✓	
22.22	7/8								✓	✓	✓			

IBCCO is capable of producing other sizes within demanding period of time and according to customer's order.

PANCAKE

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Quality Control and Laboratories/HSEC

The quality control department of Iranian Babak Copper Company, as an independent unit, with the help of equipped lab and experts, leads IBCCO toward continuous improvement in terms of quality and production process.

It's also necessary for the quality control unit to act along the all production units from the early steps of purchasing raw material to the final step of product delivery. And that's the reason for this department to follow up the below topics in order to guarantee customers satisfaction:

- Production Process Control
- Product Sampling
- Sample Inspection
- Entry Material Control
- In-Process Control preventive measurements

1- Central Lab

This Lab is launched to control entry material, the quality of products and cathode plant materials.

2- Copper Tube Plant

This lab has been designed to control final products and production process of copper tube plant and the following tests are executed according to international standards.

Row	Room name	Equipment & Tools Name	Company	Comment
1	Sample Preparation	Pulverizer	Alborz	In order to powder the size of sample to less than 75 µm.
		Balance	Sartorius	Accuracy of 0.001 gr, Capacity of 320 gr, In order to weigh sample for packing and sending it for Analysis.
2	Analysis Equipment	Particle Size Analyzer	Retsch	In order to specify the grain size of sample by drawing curve.
3		Atomic Adsorption	Agilent-Tech	To determine chemical elements inside solution (ppm range).
4	Chemical Decomposition Lab.	Balance	Sartorius	Accuracy of 0.001 gr, Capacity of 120 gr, In order to weigh Concentrate sample for testing.
5		Filtration Set	Value	Separation of solid sample and analysis of solid and solution.
6		Hot Plate	Harry	Thermal plate with size of 40x50 cm, temperature control up to 600c.
7		Shaker	IKA	Make a solution by stirring.
8		Oven	Memmert	30 Liters.
9		Turbidity Meter	WTW	
10		EC Meter	WTW	To determine conductivity.
11		Density Determination Kit	Sartorius	
12		Titration	Milwaukee	To determine chlorine.
13	Titration	-	In order to measure Fe and Cu.	
14	Mineralogy	Mineralogy Microscope	JENUS	To identify minerals.
15		Mounting Press	BAINMOUNT	To prepare mineralogy sample.
16		Polisher	Poyesh	To polish samples for checking under microscope.





RESPECT FOR LIFE, COMMITMENT TO FUTURE GENERATIONS

Quality Control and Laboratories/HSEC

- Eddy Current: In order to eliminate defective products (tube with hole or scratch) from production line and ensure the intact tubes, this test is performed on 100% of products according to ASTM E243 and through Defectomat and Rotating devices.
- Chemical (Elemental) Analysis: Based on ASTM B75 and ASTM E255 and in order to determination of chemical composition with "Belec" quantometer device. Amount of Hydrogen and Oxygen are also measured by Eltra OH.
- Tensile Strength Test: Based on ASTM E8M and in order to determination of Elongation and strength of products.
- Hardness Test: Based on ASTM E18 and EN6507- 1 and during different stages of production.
- Metallography: Determination of grain sizes based on ASTM E112 and with help of optical microscope.
- Dimensional Control: Diameter and Thickness are determined by micrometer in order to control the dimensional accuracy and its conformity with tolerances mentioned in INSO 16927, ASTM B251, ASTM B280, ASTM B75, EN1057 and EN12735.

- Bend and Expand Test: in order to examine the bending and expanding ability and also evaluate the customer's request for special applications.
- Hydrostatic and Pneumatic Pressure: in order to determine the sustainable pressure of tubes based on ASTM B75.

Main Laboratory Equipment:

No.	Device	Manufacturer	No.	Device	Manufacturer
1	Spectrometry	Germany	5	Tensile Strength Test	Iran
2	OH Analyser	Germany	6	Dwinter Microscope	India
3	Hardness Tester	Netherlands	7	Pressure Test	Iran
4	Micrometer Diameter and Thickness Test	Japan	8	Expand and Bend Test	Iran

HSE:

The HSE policy of IBCCO is based on zero damage level. We had aimed to make this industry as green as possible by least consumption of energy and prevention of water, soil and air pollution.



Chah-Firouzeh copper concentration plant

In order to complete the chain of copper business from mine to final product, IBCCO with cooperation with NICICO, started to construct a beneficiation plant on an area of 623 Hectare near Chah-Firouzeh mine at Kerman province.

The capacity of this plant is estimated to be approximately 100,000 metric ton per year and with the investment around 185 Million dollar, it will be launched within four years. Technical studies and process unit modeling had been done with cooperation with National Iranian Copper Industries Co. and now first activities are in progress to buy machineries and equipment.

Chah-Firouzeh Copper Concentrator Project

Location	Chah-Firouzeh Mine, Kerman, Iran
Capacity	100,000 TPA (Copper Concentrate, Grade: 25%)
Total Investment	380 Million USD
Physical Progress	10 Percent until August 2020