BAUXITE-ALUMINA-ALUMINUM

IRANALUMINA

FIRST HOLDER OF BAUXITE, ALUMINA AND ALUMINUM IN THE MIDDLE EAST (BAA CHAIN)

2021

MINISTRY OF INDUSTRY, MINE AND COMMERCE

IRANIAN MINES AND MINING INDUSTRY DEVELOPMENT AND RENOVATION ORGANIZATION

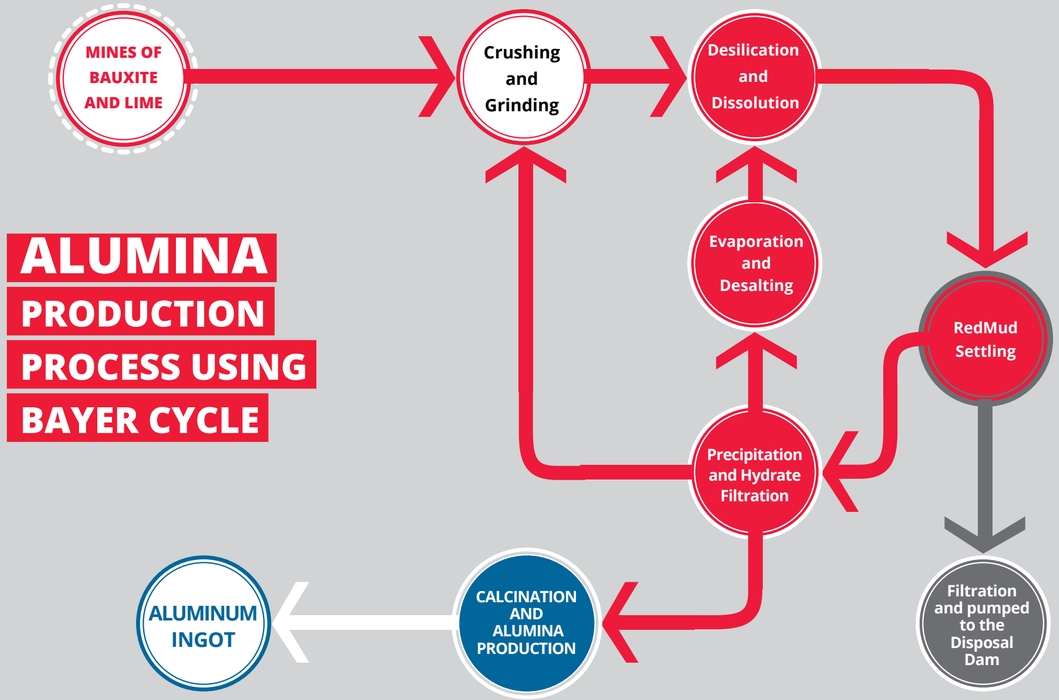
Introduction to

IRAN ALUMINA

Company

Due to the urgent need for alumina powder as a raw material for aluminum production and identification of Jajarm Bauxite mines and based on economic, technical studies, the construction of a factory with an annual capacity of 280,000 tons of alumina began in 1992. After installation, pre-commissioning and test operation, the factory was put in operation in June 8th, 2003.

ALUMINA PRODUCTION PROCESS USING BAYER CYCLE

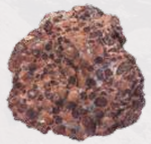


INTRODUCTION TO MINES

Mission of the Mines Department

In line with sustainable national development and to play an active role in downstream industries nationwide and regionally, the mission of Iran's Alumina Company Mines department is the annual supply and production of 850,000 tons of Bauxite from domestic mines.

Introducing Bauxite



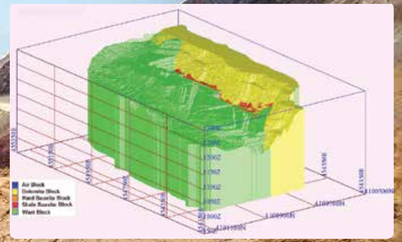
Bauxite is the main source of alumina. It is comprised of minerals such as diaspora, bohemite, gibbsite, iron, titanium and silica. Bauxite is an ore deposit that is enriched during weathering processes. (During this process, most of its major elements such as calcium, sodium and silica are leached out, and its aluminum content increases.)

Bauxite is formed in hot and rainy areas that contain laterite. Bauxite is found in different parts of the world, but it is most abundant in the US, Guinea, Australia, Vietnam, India, Jamaica, Brazil, Ghana, China, Greece, Suriname, Sri Lanka, Kazakhstan, Venezuela, Russia and Iran.

Most of the Alumina Company's mines are karst Bauxite the taht main mineral of which is diaspora.

Discoveries

To maximize the use of Iran's Bauxite deposits, the exploration and discovery of potential Bauxite ore mines is being implemented as a national project. To identify the shale, geometrical and tectonic characteristics of existing ore deposits, up to 150,000 m of core drilling has been done to date.



Mining type and work cycle

The current extraction method is open pit Bauxite mines from Alumina Co. The extraction is carried out in the form of drilling, blasting, loading and shipment cycles. The extracted Bauxite for use in the alumina refinery is crushed in the Jajarm mine area.

MINES SITUATION

BAUXITE MINE OF JAJARM

Bauxite ore of jajarm is situated 19 km north of jajarm city. The area of this mine is 18 km stretching in the north east –southwest.

BAUXITE MINE OF KOOH BABA

The area of this mine is 10 km in southwest of jajarm stretching in the 22 km in the northeast – southwest.

LIME MINE OF JAJARM

This mine is located in the 7 km away from Alumina refinery.
It is operating through annual extraction of 540,000 tons of limestone using open methods and with the properties of CaO≥53%MgO≤2%Fe2O3+Al2O3+SiO2≤3% and feeding of limestone to the quantity of 500,000 tons and carrying packaged stoned (30 up to 70 mm and 70 up to 140 mm) to the factory in the quantity of 300,000 tons annually.

BAUXITE MINE OF TASH

Tash Bauxite ore is situated in the Semnan Province at 40 km away from Shahrood at the neighborhood of Tash village and 205 km from Jajarm .The area of this mine is 3 km in the east – west.

BAUXITE MINE OF GANNO

This mine is situated in the Semnan province at 65 km from northweast of Damqan City and 90 km from northeast of semnan and 100 km of southeast of Sari.
The area of this mine is 84 km in the northeast –southwest.

EAST DASHT DEH BAUXITE MINE

The area of this mine is in the Yazd Province at 30 km of the northeast of Yazd city. The area of this mine is 9 km in the east –west.

WEST DASHT DEH BAUXITE MINE

The area of this mine in the Yazd Province at 30 km of the northeast of Yazd at the western mountains of Kharanegh. This mine is stretching at the 2.8 km in the northeast – southwest.

CHAKCHAK BAUXITE MINE

This mine is situated in the northeast of Yazd and east of Ardakan in the yazd province. Access to it is possible from the asphalt –paved road of Yazd – Kharanegh .This mine is stretching at 3.2 km in the northeast southwest.

BAUXITE MINE OF BOLBOLOOYE

The Bauxite reserve area of this mine is situated 21 km southwest of the city of Kerman and nearly 14 km north of the city of Mahan in the province of Kerman .The area of this mine is 10 km stretching in the northweast –southeast direction.

BAUXITE MINE OF DARSINOOYE

This mine is situated at 25 km from the northeast of city of Kerman and 2 km from southeast of the village of Darsinooye in the province of kerman. the area of this mine is about 1 km in the northweast -southeast direction.

BAUXITE MINE OF MANDOON

This mine is nearly 51 km northeast of the town of Dehdasht in the province of Kohgilooye and Boyer Ahmad. The area of this mine is about 16 km in the northwest –southeast direction.

Introduction to MINING

IRAN ALUMINA COMPANY starts to extract Bauxite and Lime from its mines to feed its own factory's needs.

JAJARM

THE FIRST PRODUCER OF ALUMINA IN THE MIDDLE EAST

Jajarm Alumina Factory is one of the few factories that covers all processes including mine, alumina complex and aluminum ingot production and fully incorporates Bauxite ingot cycle.

The Alumina Production Process

The production plant in Jajarm was built to process Bauxite into Alumina, which is the main raw material in producing aluminum. The plant uses the tube digestion method. In this method, mined Bauxite ore is crushed in two steps down to a size of 20 mm, and then the crushed Bauxite, lime and soda are milled using the wet method to produce Bauxite slurry with 0.09 mm floating particles.

First, silica is removed from the Bauxite slurry. Then, the slurry is heated in the tube digestion unit to 270 °C at 60 bars of pressure by means of steam and furnace heating. Under high heat and pressure, the alumina in the Bauxite reacts with the soda, and the rest stays in the slurry.

The cooled slurry is then diluted and divided into two streams: aluminate solution, and red mud.

The aluminate solution is then crystallized as aluminum hydrate and then converted to powdered alumina in the calcination unit.

PRODUCTS

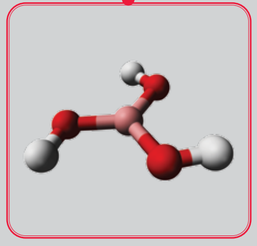
Alpha Alumina Al_2O_3

The calcined Alumina is vastly used in a wide range of applications, as in the refractory and ceramic products. Alpha Alumina is an important material in the industries such as tile, ceramic, enamel, porcelain as well as catalyst industries.

Aluminum Hydroxide $Al(OH)_3$

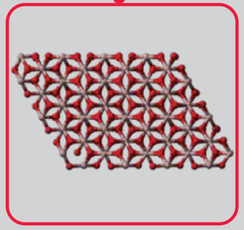
Aluminum Hydroxide has a wide range of applications such as:

- Anti-flame in plastics
- Paper filler and sealant
- Toothpaste filler
- Zeolite products for detergents
- Basic Catalyst in the chemical industries
- White pigment in stone industries
- Raw material for production of Aluminum containing products like Aluminum Sulphate, Aluminium chlorides, Poly Aluminum chloride and Aluminum nitrate



ALUMINUM OXIDE

Aluminum Oxide is primarily used in Aluminum production. It is also used as an abrasive material (due to its high degree of hardness) and as a refractory material (due to its high melting temperature). It is also used in glass, crystal, steel, Electrical insulators and welding electrodes.



1000 POUND INGOTS

- Each Ingot weighs between 450 to 550 Kg.
- Without any sharp edge
- Without Pleating
- do not have any shrinkage cavities
- Free from any non-Aluminum masses
- Without iron wedge

PRODUCT ANALYSIS

Aluminum Oxide Al_2O_3

CHEMICAL ANALYSIS

Parameter	Unit	Limit	Typical	Test Method
Al_2O_3	%	98.5 min	99.05	ISIRI 13461
SiO_2	%	0.020 Max	0.013	ISIRI 908
Fe_2O_3	%	0.020 Max	0.013	ISIRI 904
Na_2O	%	0.55 Max	0.44	ISIRI 10616
CaO	%	0.04 Max	0.012	ISIRI 10619
L.O.I	%	1 Max	0.47	ISIRI 8346
Moist.	%	1 Max	0.17	ISIRI 8346

PHYSICAL PROPERTIES

Parameter	Unit	Limit	Typical	Test Method
- 44µm	%	15Max	11.6	ISO 13320
+150µm	%	25Max	10.4	ISO 13320
Median (d50)	µm	80 - 110	86.2	ISO 13320
Specific Surface Area	m^2/g	50 -70	57.9	ISIRI 12578
Alpha Alumina	%	12Max	8.1	ISO 19950
A.O.R	Degree	30 - 33	30.6	ISIRI 14225

Aluminum Hydroxide $Al(OH)_3$

CHEMICAL ANALYSIS

Parameter	Unit	Limit	Typical	Test Method
$Al(OH)_3$	%	99.5 min	99.7	By difference
SiO_2	%	0.015 Max	0.009	ISIRI 908
Fe_2O_3	%	0.020 Max	0.009	ISIRI 904
Na_2O	%	0.40 Max	0.26	ISIRI 10616
CaO	%	0.020 Max	0.008	ISIRI 10619
L.O.I	%	35 Max	34.71	ISIRI 3403
Moist	%	10 Max	5.7	ISIRI 7505-2

PHYSICAL PROPERTIES

Parameter	Unit	Limit	Typical	Test Method
- 44µm	%	15 Max	9.6	ISO 13320
+150µm	%	25 Max	11.5	ISO 13320
Median (d50)	µm	80 - 120	92.7	ISO 13320

Alpha Alumina Al_2O_3

CHEMICAL ANALYSIS

Parameter	Unit	Limit	Typical	Test Method
Al_2O_3	%	95 min	97.4	ISIRI 13461
SiO_2	%	0.15 max	0.052	ISIRI 908
Fe_2O_3	%	0.20 max	0.065	ISIRI 904
Na_2O	%	0.90 max	0.58	ISIRI 10616
CaO	%	0.04 max	0.013	ISIRI 10619
L.O.I	%	5 max	1.85	ISIRI 8346
Moist.	%	5 max	3.68	ISIRI 8346

PHYSICAL PROPERTIES

Parameter	Unit	Limit	Typical	Test Method
- 20µm	%	65.0 min	81.9	ISO 13320
+44µm	%	5.0 max	1.55	ISO 13320
Median (d50)	µm	5-15	12.7	ISO 13320
Alpha Alumina	%	85.0 max	66.4	ISO 19950
Specific Gravity	(g/ml)	3.3-3.9	3.59	ISO 12578

INGOT

ALUMINIUM GRADE TABLE

	Si_{max} (%)	Fe_{max} (%)	Al_{max} (%)	Grade
HIGH GRADE	0.02	0.02	99.96	P0202
	0.03	0.03	99.94	P0303
	0.04	0.06	99.90	P0406
	0.06	0.10	99.84	P0610
	0.10	0.15	99.75	P1015
	0.10	0.20	99.70	P1020
LOW GRADE	0.15	0.20	99.65	P1520
	0.15	0.35	99.50	P1535
	0.20	0.55	99.25	P2055
	0.20	0.70	99.10	P2070
OFF GRADE	0.25	0.85	98.90	P2585
	...	...	≤99	AB99
	...	...	≤98	AB98

ENVIRONMENT

Explaining a part of environmental activities:

- √ Installation of an online monitoring system on the output of furnaces and an online monitoring system for the HF gas on the exhaust shaft of the aluminum factory
- √ Implementation of the suppression project for dust resultant from the shattering of Bauxite
- √ Implementation of the research investigation on the effect of dust resultant from the shattering of Bauxite on the surrounding environment ,especially on surrounding vegetation
- √ Control of dust of the lime unit through installation of filters with the goal of prevention of environmental and human health damage
- √ Protection of the endangered species of the Asiatic cheetah
- √ Implementation of the ISO14001:2015 environmental standard
- √ Turning furnaces into gas fed furnaces with the goal of using gas energy instead of mazut in order to conserve energy and reduce the pollution resultant from burning (muchmore CO_2 intensive) fossil fuels
- √ Installation of a filter and electro-filter on the exhaust chimnies in order to control air pollution
- √ Performing an environmental Impact Assessment (EIA) due to expansion of the red mud deposit, Environmental Management Plan (EMP) for the Aluminum factory and Tash mine
- √ Commencement of the creation of a sanitary wastewater system and use of runoff water to water the surrounding vegetation
- √ Implementation of a drop by drop watering system in order to reduce the water consumption
- √ Creation and measurement using environmental barometers on the runoff water being discharged from the treatment plant and comparing the measurements with the permitted quantities stipulated by standards and implementing needed controls in the relevant units
- √ Managing the remaining material and extras of the production of the opreation units and the mining sections of Bauxite and lime
- √ Reduction and conservation of the remaining and extra papers using an automated office system
- √ Increasing the working environmental standard using training tools
- √ Establishing and maintaining a useful conduit for research ,training and cooperation between universities and Alumina industry in order to improve the environmental conditions

IRAN ALUMINA
THE THIRD PRODUCER OF
ALUMINUM INGOT IN IRAN

The Aluminum Ingot Plant was built in collaboration with the Iranian Mines and Mining Industry Development and Renovation Organization (IMIDRO) with the aims of:

a) Building an indigenous aluminum industry in Iran

b) Increasing the annual production of the metal

c) Completing the value chain

d) Increasing the financial efficiency of the production plant owned by the Iran Alumina Company

e) Reducing poverty and unemployment in the area

Jajarm has become Iran's third center of aluminum production after Arak and Bandar Abbas.

In June 2007, with the presence of Mr. Harati Nik, Honorable Deputy Minister of Industry and Mines and Head of the IMIDRO Board of Directors, the construction of Phase 1 of an Aluminum ingot plant with an annual capacity of 40,000 tons began.

GENERAL SPECIFICATIONS

Project name	Jajarm Aluminum Project
Project Goal	Production of Aluminum from Alumina
Product specifications	1000 lb. Aluminum ingot
capacity	4000 t annually – first phase
investor	Iran Alumina Company with assistance of IMIDRO
Invest amount	Nearly 13,630,000,000,000 (Rial)
employer	Iran Alumina Company
consulter	Namvaran Enginering Consulting Company

PURPOSE OF PRODUCING JAJARM ALUMINUM INGOTS

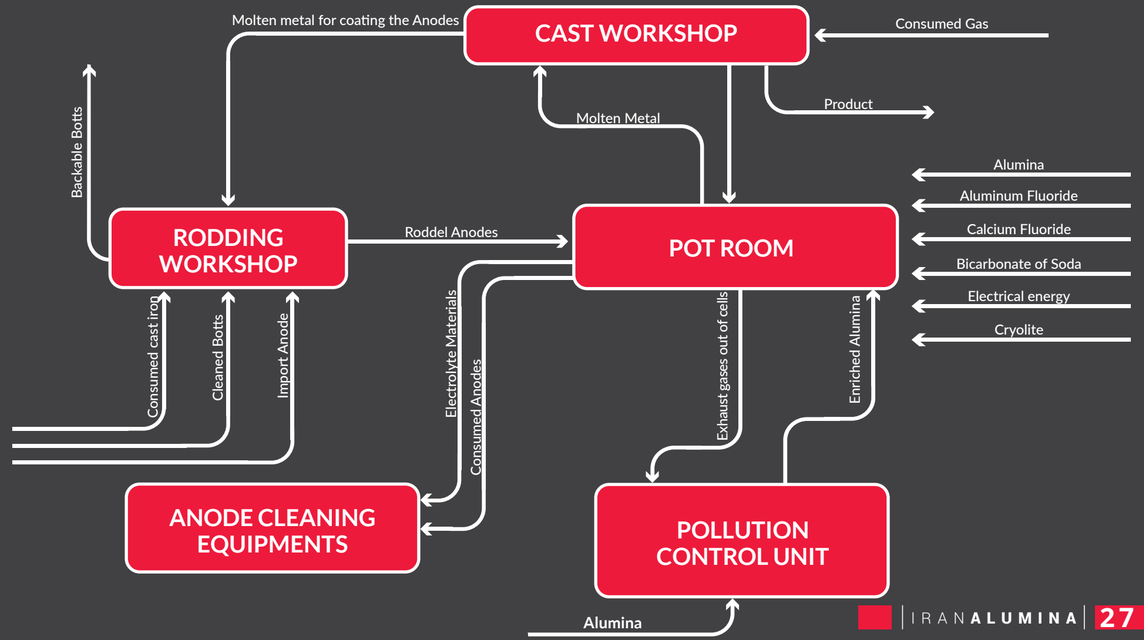
- Increase the annual production capacity of aluminum ingots in the country
- Localization of the aluminum production industry and release from dependence on foreign technology and use of maximum scientific and domestic efficiency
- Increase productivity of Jajarm Alumina Complex with regard to land use, infrastructure and other facilities of Jajarm Alumina Factory, proximity to transportation facilities and consumer market

THE BENEFITS OF ALUMINUM FACTORY

- Increase the added value of the final product
- Availability of 400 and 132 kV transmission and substations
- Apply specialist and technical manpower working in the Alumina complex
- Moving towards sustainable development of the industry in the region and creating downstream aluminum (rolling-profiles) industries in the region and the province
- Creating jobs and learning more advanced technologies and utilizing the energy of the younger generation with relevant responsibilities
- Save on alumina shipping costs
- No need for alumina storage facilities and equipments
- Land use, infrastructure and other facilities
- Proximity to road and rail facilities
- Save on shipping costs of final product
- Establishment of a 120,000-tons aluminum production facility (second phase)

FLOW DIAGRAM OF THE MAIN UNITS OF

ALUMINUM FACTORY



ALUMINUM FACTORY

A) POT ROOM

The first phase of the production line consists of two parallel halls, each with 35 boiler units in series with 220 kA technology.
Each reduction cell consists of a cradle, the boiler's metal body, superstructure, lining material with 28 anodes and 18 cathodes, pneumatic jacks to break the pot shell and charge the feedstock, and the boiler control system.

B) FTP (FUME TREATMENT PLANT)

This system purifies the polluting gases emitted from the boilers to comply with environmental standards implemented at the Jajarm Aluminum Production Plant.

LABORATORY

Labs are envisioned for the pot room, the cast workshop, and environmental protection equipments. To ensure the quality of the raw materials and end products, physical and chemical tests and analyses are carried out on the raw material, the product during production, and the final product. The production lab includes units for spectroscopy, wet method, and physical and chemical analyses.

ELECTRICAL SUBSTATION AND DISTRIBUTION

The electrical demand for the first phase is 70 MW, and is estimated at 210 MW for the three phases. Due to the high demand, a two-circuit transmission line with a capacity of 400 kV has been constructed and is currently being delivered to the plant's electrical substation for the first phase (70 MW) of input power on a 132 kV voltage level. The equipments installed at the substation then transfer the electricity to the distribution transformers and the hall's electricity supply transformers.

CAST AND ANODE RODDING DEPARTMENT

The unit consists of two separate parts, an aluminum casting and an anode rodding. In the rodding section, an average of 70 anode blocks with a set of rods and yokes are cast daily by cast iron melt and used in the pot. In the aluminum casting, an average of 105 tons of molten aluminum sent from the pot room are cast in 1,000 pound molds and aluminum ingots are produced.

BOILERS FEEDING SYSTEM (HDP UNIT)

Boilers feeding system (hyper dense phase or HDP unit):
After recycling the chemical reaction materials and producing aluminum metal, the recycled materials are mixed with the raw materials. After homogenizing the materials, feed the hall pot boilers with them.

TRANSPORTATION

Iran Alumina Company has one of the largest rail, road and inland transportation network. As one of the strategic goals of Iran Alumina Company is to penetrate international markets and supply part of the country›s currency needs to achieve this goal.
This goal has been achieved by delivering products safely and securely by connecting to the national rail freight network.

ISO 14001:2015

ISO 14001:2015

ISO 9001:2015

ISO 9001:2015

ISO 50001:2011

BS OHSAS 18001:2007

CERTIFICATES

Since 2005, Iran Alumina Co. has succeeded in obtaining the international standard certifications of quality management system (ISO 9001), Environmental management system (ISO 14001), Occupational safety and health management system (OHSAS 18001) and Energy management system (ISO 50001).

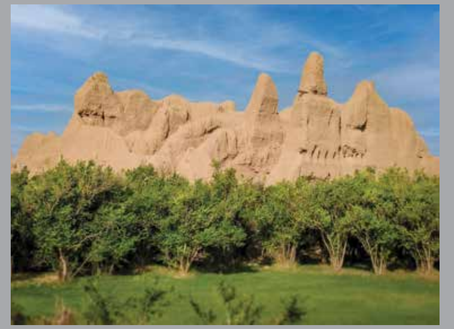
JAJARM

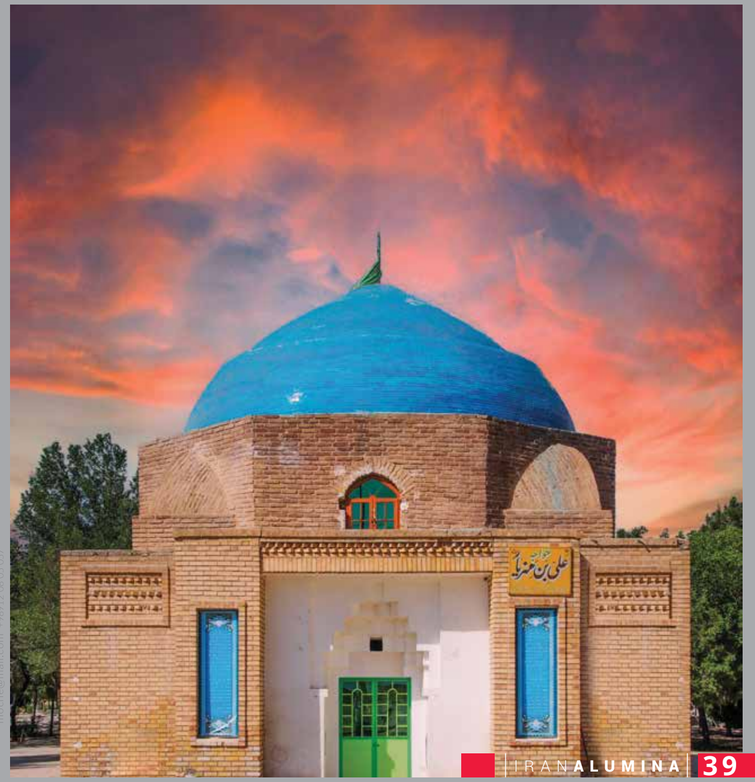
The county of Jajarm is located in the southwest of the province of North Khorasan. It is bounded on the north by the city of Manneh and Samalqan, on the west by the city of Garmeh, on the south by the province of Semnan, on the southeast by the province of Khorasan Razavi, on the east by Esfarain city, and on the northeast by the city of Bojnord. The county has an area of 3,654 square kilometers, and consists of 3 cities, 3 districts, 5 villages and 55 towns.

The population of the county is estimated at 37,000 according to the 2016 census.

The formation of this city goes back to the period of the civilizations of Hesar-e-Damghan hill, Silak Kashan and Yahya hill, which should be at least 4,000 to 5,000 years old. The city enjoyed good weather conditions in the centuries after 600 AD, which helped it survive and expand over time. The Anand Raj dictionary, published in 1894, defines Jajarm as a town in Khorasan, with a large architectural castle in the middle, surrounded by meadows and fields.

The Miandasht Protected Area in Jajarm is the best habitat for the cherished Iranian Cheetah, and is considered the only productive habitat for this species.





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