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Selection and Substantiation of the Method of Exploiting the Tebinbulak Deposit

Ilmuratov Ubaydullo, Shamayev Murat,Toshtemirov Umarali

Senior Lecturer, Department of Mining Business, Almalyk branch of the Tashkent state technical university, Uzbekistan, Tashkent region, Almalyk;
Head of the Department of Mining Business, Almalyk branch of the Tashkent state technical university, Uzbekistan, Tashkent region, Almalyk;
Senior Lecturer, Department of Mining Business, Almalyk branch of the Tashkent state technical university, Uzbekistan, Tashkent region, Almalyk;

ABSTRACT: The article discusses the brief geological and mining-technical characteristics of the Tebinbulak deposit of titanomagnetite ores, located in the northwestern part of the Sultan-Uvais mountain system, administratively - in the Karauzyak district of the Republic of Karakalpakstan, 12 km north-east of the village of Karatau. The method of mining, opening and selection of the development system has been preliminarily determined, the approximate technological parameters of the development of the deposit and the method of transporting overburden and ore from the deep pit as applied to the Tebinbulak deposit using cynical-flow technology are also given.

KEY WORDS: deposit, opening scheme, development system, steeply inclined conveyor, ore, overburden, hydrogeology, titanium-magnetite ore, relief.

I.INTRODUCTION

One of the largest mining and metallurgical complexes in Central Asia will be built in the Republic of Karakalpakstan, and on the eve of the construction project of a mining and metallurgical complex on the basis of the Tebinbulak deposit in the Karauzyak district, it was presented to the President of the Republic of Uzbekistan.
The companies involved in the preparation and implementation of the project were DMT-Group Consulting (Germany) and Horst Wiesinger Consulting (Austria).
The potential of the deposit was determined according to the JORC Code system and iron ore reserves were determined to a depth of 350 m 1.1 billion tons with an average grade of 13.2%. To date, together with these companies, work has been carried out to study the project of a deposit in the complex of a mining quarry, an enrichment factory and a metallurgical plant with the production of steel products from titanomagnetite ores and the project has been evaluated positively.
In addition, the production capacities of the mining enterprise and the processing complex with the optimization of the technological chain are determined .The intrusion is a body stretched from south to north by 4500 m 1800 m wide, extending to a depth of more than 800 m. The western contact of the intrusion falls east at an angle of 65 - 700, east - west at an angle of 80 - 850. The ore zones are mostly interspersed. ores (up to 97%) with the content of titanomagnetite in them 10 - 20% and an admixture of pyrite, chalcopyrite, pyrrhotite (up to 1%). Titanomagnetite accounts for 75 - 80% of the total amount of ore minerals [1] and [2].
Veins of massive titanomagnetite ores are noted mainly in the central part of the Western ore zone, less often in its northern part and in the east of the intrusion. Ore minerals in them make up 85 - 95% and are represented by titanomagnetite and single inclusions of pyrite and chalcopyrite. The mining and metallurgical complex will have an annual production capacity of finished products of 900 thousand tons of fittings, 225 thousand tons of wire, 375 thousand tons of corners and channels with the release of 22 thousand tons of vanadium slag .
The implementation of the project will contribute to the replacement of a significant volume of imports and the sustainable development of industry. The complex will provide work for about 3 thousand people. It is planned to export 35 percent of the products. And in the future, it is planned that from vanadium slag it will receive a more expensive intermediate product - ferrovanadium.

II. SIGNIFICANCE OF THE SYSTEM

The potential of the deposit was determined according to the JORC Code system and iron ore reserves were determined to a depth of 350 m 1.1 billion tons with an average grade of 13.2%.To date, together with these companies, work has been carried out to study the project of a deposit in the complex of a mining quarry, an enrichment factory and a metallurgical plant with the production of steel products from titanomagnetite ores and the project has been evaluated positively. In addition, the production capacities of a mining enterprise and a processing complex with optimization of the technological chain are determined.

The preliminary mining of iron-containing ores is annually 33 million tons of ore with an average iron content of 13.2% to produce 1.5 million tons of finished products. But, the final annual production capacity for ore mining will be installed after optimization of the mining and processing complexes, after which a feasibility study and working documentation of the project will be developed. The mining conditions of the Tebinbulakskoye field allow it to be mined in an open way - a quarry. The field has developed mainly the geotechnical complex of strong (intrusive rocks: pyroxenites, tebinites, hornblendites), less often - medium strength (metamorphic rocks: schists, marbled limestones and skarns) rocks.

III. LITERATURE SURVEY

Previously, the calculation of determining the volume of production based on the data of the feasibility study of conditions was made on the basis of data obtained from the practice of the Kachkanarsky GOK and the results of studies of the titanomagnetite ore of the Tebinbulak deposit in the Uralmekhanobr research institute in 1983 on the topic "Technological studies of hard-to-treat titanomagnetite ores of the Tebinbulak deposit".

The Uralmekhanobr Institute previously processed 2 ore samples from the Tebinbulak deposit. Based on preliminary technological studies, an enrichment scheme is recommended, including dry magnetic separation of ore in fineness of 25-0 mm, two-stage enrichment of the intermediate product of dry magnetic separation in the first stage to 0.5-0 mm, in the second stage to 95% cells. minus 0.074 mm. From ore with a mass fraction of iron of 15.53%, an iron-vanadium concentrate was obtained in an amount of 10.9% with an iron content of 65.5%, vanadium pentoxide 0.63%, titanium oxide 3.02%, while extracting iron into a concentrate 46, 0%. At the same time, 15.6% of tails of dry magnetic separation with a total iron content of 9.72%, magnetite 1.99% and 73.5% of wet magnetic separation tails with a total iron content of 9.3%, magnetite 0.99% were isolated.

During this period, the pre-accepted volume of iron ore production is 33 million tons of ore per year with an average iron content of 13.2% to produce 1.5 million tons of finished produc.The fall of the rocks is eastern, consistent with the fall of the contacts of metamorphic rocks of the Lower Devonian with the intrusion: the western - at an angle of 60 - 70 °, the eastern - supposedly 80 - 85 °.[3]:

The rocks are slightly fractured, in the zones of tectonic disturbances and weathering - strongly fractured. The average density of ore is 3.33 t / m3, natural humidity is 1.0% (conditional), and the coefficient of fortress according to the MM scale. Protodyakonova –7–9. Overburden (pyroxenite) is planned to be processed into crushed stone and sand.Approximate quarry parameters at the end of mining (Fig. 1).

- quarry depth - 300 m;
- length of the quarry bottom - 2310 m;
- width of the bottom of the quarry - 150-560 m;
- open pit bottom area - 680 thousand m3;
- the length of the quarry on the surface - 2860 m;
- open pit surface area - 2767 thousand m3;
- height of the working ledge - 15 m;
- angle of the ottts of the working ledge
  - rock formations - 75 deg ;
  - covering friable rocks - 65 degrees;
- the height of the ledge in the extreme position - 30 m;
- slope angle in extreme position;
- rock formations - 60 deg ;
- covering friable rocks - 40 degrees;

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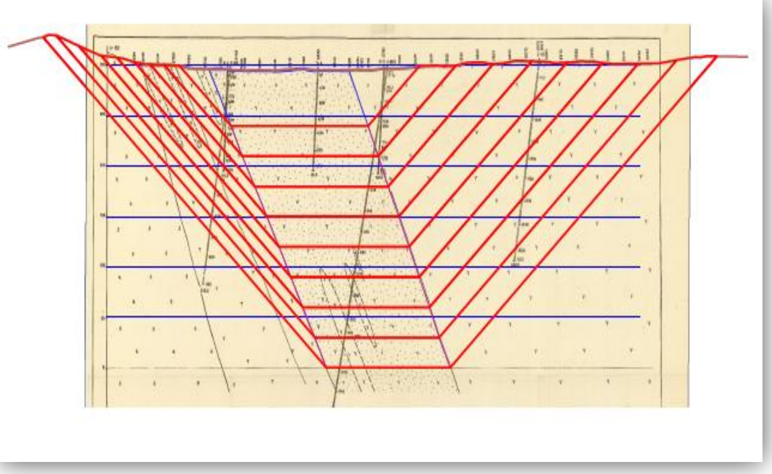

Fig.1. Cross section of a quarry

The terrain, engineering-geological, hydrogeological conditions of the deposit, the parameters of occurrence of ore bodies determine the development of the Tebinbulak deposit in an open way.

IV. METHODOLOGY

The mining depth is determined on the basis of a comparison of the economically feasible boundary and contour overburden coefficients. It is possible to reassess the reserves of the deposit by categories due to the additional examination of the geological data of the ore zone.The stripping ratio of the deposit is very low due to the large thickness of the ore zone and its location with access to the earth's surface.

The slope angles of the ledges and sides of the quarry, the height of the working ledges and ledges at redemption are taken by analogy with the parameters of the development system for the group of quarries mining the Gusevogorskoye deposit of disseminated vanadium-containing titanium-magnetite ores of Kachkanarsky GOK OJSC.The construction of a quarry and wireframe model of the field was carried out using the Surpac 3D modeling software package (Australia). To create a wireframe model of the western deposit, we used geological information (geological sections, horizon plans) from a report (on the results of prospecting and evaluation work carried out at the Tebinbulaksky deposit of titanomagnetite ores in the Republic of Karakalpakstan in 1991-1996). Using the obtained wireframe model, a quarry was built at a cost-effective depth limited by the horizon for calculating reserves for category C_2.

The principle of quarry detuning in Surpac software is to build a scheme for opening the quarry and transport berms with the minimum amount of rock necessary for excavation, subject to the conditions for the most complete mining of minerals, taking into account the economically acceptable boundary overburden coefficient.It is proposed to open the working zone from the central part of the deposit, where the ore zone and its exit to the earth's surface are more concentrated, by a system of sliding car exits. And he is preparing the horizons with split trenches laid to the height of the working ledge. To put the quarry into operation at a defined starting capacity, with normative provision with reserves, according to the degree of readiness for production, it is necessary to carry out mining and capital works.Based on mining conditions, a deep, longitudinal double-sided development system with external dumping is proposed (according to the classification of V.V. Rzhevsky).

The parameters of the proposed development system [4]:
- the height of the overburden and mining ledges - 15 m;
- the angle of slope of the ledge of rock - 75 degrees;
- the angle of slope of the ledge of loose rocks - 65 degrees;
- width of the safety berm - 10 m;
- minimum width of the working platform - 45-52 m;
- width of the transport berm:

a) with a two-lane carriageway - 34 m,
b) with a single-lane roadway
for two-way traffic - 28 m,
c) with a single-lane roadway
for one-way traffic - 20 m.

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Transportation of ore and stripping for the period of geological prospecting is proposed to be carried out by road. Ore is transported aboard the quarry to a stationary crushing plant, followed by transportation of crushed ore to the processing plant by conveyor belt.The preparation of the rock mass for excavation is carried out using drilling and blasting. Drilling of wells in ore and overburden is proposed to be carried out by cone rotary drilling machines of the SBSh-270A type. For blasting overburden and production wells, it is acceptable to use emulsion explosive explosives of our own production, based on the experience of the AlmalykNavoi MMC, for which it is necessary to take into account the construction of an explosive production plant in the project.The explosion of rock mass is multi-row short-lived.

The initiation of an explosive is provided for using a non-electric blasting system of the type "Iskra", "Kite" or other approved by the bodies of the State Institution "Sanoatkontekhnazorat". When carrying out blasting operations, the choice of the blasting network installation scheme is determined, first of all, by the need to ensure the specified camber parameters and the quality of crushing of the rock mass [5].Ore mining and overburden excavation should be carried out by career excavators of the EKG-18R type (rack pressure) with a bucket with a capacity of 18 m^3.It is proposed to transport ore and overburden with BelAZ-75170 dump trucks with a carrying capacity of 160 tons. The height of the ledges in the extinguished state will be 30 m, the safety berms will be 10 m wide. Sandvik DP900 (Pantera) drilling rigs are proposed for drilling contour blast holes. Putting rail into the quarry will lead to an increase in its parameters in this case by about 1.5 times.

The most appropriate use of combined modes of transport while increasing the depth of quarries. The use of conveyor transport leads to a noticeable increase in labor productivity during transportation, since this type of transport is easily automated. Statistics show that, compared to rail and road transport, conveyor transport is the safest.And the use of cyclic-flow technology (CPT) allows to reduce the cost of transporting rock mass, because it is known that when deepening a quarry for every 100 m, transport costs increase when using cars by 1.5 times, and conveyors by only 5-6% .

The conveyor KNK-270, using the example of the Muruntau quarry, developed by NKMZ CJSC, is a unique transport unit that does not have a lift height, productivity, or operating conditions of analogues in the world.From the working faces of the ore to the discharge point, designed to prepare the rock mass for movement by steeply inclined conveyor transport, it is delivered by dump trucks. The basis of the complex is a powerful steeply inclined two-belt conveyor KNK-270 [6].

V. EXPERIMENTAL RESULTS

The use of a steeply inclined conveyor lift as part of the central heating system for the Tebinbulak field is practically the only cost-effective solution. The introduction of conveyors with clamping tape allows not only to reduce the cost of delivering the rock mass and reduce the cost of the finished product, but also to improve the ecology of quarries.

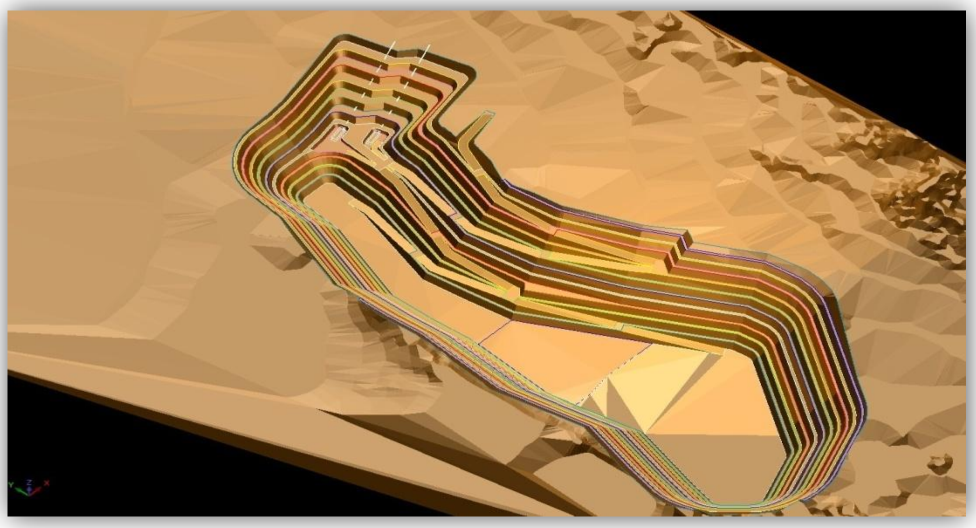

Fig.2.Development of the Tebinbulak deposit with the transportation of rock mass by road and steeply inclined conveyor transport.

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Both belts - load-bearing 1 and clamping 2 - move along the roller bearings 3 as in conventional belt conveyors. The difference lies in the fact that the working branch of the clamping tape is pressed against the load transported on the load-carrying tape by rollers of the clamping devices, and along the edges directly to the surface of this tape(Fig. 2). Special clamping devices are installed on the steeply inclined part B of the conveyor, creating an additional clamping force in addition to the gravity of the clamping belt and the load [7].
This allows you to ensure that the load is pressed against the load-carrying tape and to increase the friction forces between the load and the working surfaces of the pressure and load-bearing tapes.
Mineral output from the quarry in replaceable production volumes must meet the requirements for the following indicators characterizing its quality:
- the ratio of the volume of minerals of various technological types in terms of material composition, enrichment;
- the average content of the main averaged components;
- standard deviations of the contents of the main averaged components from their average values;
- minimum and maximum content of other controlled components.

VI. CONCLUSION AND FUTURE WORK

The maximum permissible value of the standard deviation of the content of the useful component in the ore mined from open pits, in variable volumes of production, should vary from 0.8 to 1.2%. If the averaged indices deviate from the average level by an amount exceeding the technologically permissible one, provide for internal quarry downhole averaging by changing the load on the production faces. For the implementation of intracarrier averaging, it is necessary to provide a reserve of mining technological mining and transport equipment .The implementation of the project will contribute to the replacement of a significant volume of imports and the sustainable development of industry. The complex will provide work for about 3 thousand people. It is planned to export 35 percent of the products. And in the future, it is planned that from vanadium slag it will receive a more expensive intermediate product – ferrovanadium [8].

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AUTHOR’S BIOGRAPHY

№	Full name place of work, position, academic degree and rank	Photo
1	**Ilmuratov Ubaydullo Khalbayevich**, senior Lecturer, Department of Mining Business, Almalyk branch of the Tashkent state technical university, Uzbekistan, Tashkent region, Almalyk. 110100, Region of KichikNokhiya 5/2., MirzoUlugbek Street house 54	

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2	**Shamayev Murat Kurbanbayevich,** Head of the Department of Mining Business, Almalyk branch of the Tashkent state technical university, Uzbekistan, Tashkent region, Almalyk .110100, Region of KichikNokhiya 5/2., MirzoUlugbek StreetStreet house 54	
3	**Toshtemirov Umarali**, senior Lecturer, Department of Mining Business, Almalyk branch of the Tashkent state technical university, Uzbekistan, Tashkent region, Almalyk. 110100, Region of KichikNokhiya 5/2., MirzoUlugbek Street house 54