

Experience and Practical Results of Marmorized Limestone Reserves Re-Evaluation

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Abstract:

On the example of the Shipunovskoe-1 deposit located in the Iskitimsky district of the Novosibirsk region, results of marmorized limestone reserves evaluation have been examined, with development and approval of new conditions and the use of reserves in the deposit as building stone.

Keywords: audit and re-evaluation of reserves, profitability, marble, limestone, facing stone, geological exploration, mining, building stone, feasibility study of permanent conditions, drilling, quarry, categories A, B, C1 and C2 reserves.

I. INTRODUCTION

At the moment, the issue of rational use of mineral resources is vital [1], due to the fact that the rate of new mineral deposits formation is significantly lower than that of production development [2]. This problem has become especially acute in recent years due to inefficient and insufficient exploration work, which fact forces companies to reassess reserves whose development is economically inefficient in current conditions.

Any kind of mining is characterized by foremost depletion of rich ore, compared to the poor one, which complicates extraction of useful components, increases energy requirements and production costs, and subsequently decreases profitability of production; that is the reason why small businesses are virtually unprofitable. [3,4].

JSC Novosibirsk Quarry (JSC NC) faced a similar problem. The Quarry has the right to develop marmorized limestone at the Shipunovsky-1 deposit [5]. Deposit development was discontinued by previous subsoil user in 1996 due to low profitability caused by insufficient output of rock mass blocks.

In this regard, in 2007 OJSC NC addressed the

Federal State Agency "State Commission for Reserves of Commercial Minerals" (FSA SCRCM) with a letter about the need to write off reserves of facing stone at Shipunovsky-1 deposit and converting them into reserves of building stone basing on the report about re-evaluation of quality made by OJSC «Novosibirskyageologicheskayaekspeditsiya» (Novosibirsk geological expedition) under contract with OJSC NC. In this case, Shipunovsky-1 limestone deposits can be worked out in course of northbound development of Quarry No. 1 for building stone extraction that develops the Shipunovsky deposit (plots Altaysahartrest and Dyatlovsky).

Expert Commission of FSA "SCRCM" after considering the materials submitted, in its letter No. SR-15/2245 dd. October 28, 2008, abstained from reassessment of reserves due to lack of credible justification for their unsuitability for manufacturing facing blocks and slabs and recommended to:

- perform an audit and reassessment of remaining reserves of facing marmorized limestone at the Shipunovsky-1 deposit;
- perform a feasibility study (FS) of constant

conditions with justification expediency of using marmorized limestone as cladding material and proving effectiveness of its mining for building rubble;

- calculate reserves of marmorized limestone and submit the results for state examination according to the established procedure.

The size of this article does not make it possible to explain in complete detail the entire sequence of all results of this work, however, the authors hope that a summary will be useful for enterprises facing similar problems.

II. METHODS

In order to fulfill recommendations of the expert committee of FSA SCRCM, the following activities have been scheduled:

1. To performing audit and reassessment of marmorized limestone reserves at Shipunovsky-1 deposit within the mining license boundaries.

2. In order to obtain reliable evidences about the quality of marmorized limestone, to drill three wells to the horizon of reserves calculation (+70 m), locating them evenly in the area of reserves calculation (10-20 m from the detailed exploration wells made in 1974).

3. In accordance with the requirements of modern GOST, to analyze and summarize laboratory tests results, to establish from documentation for drill-holes core and experimental-industrial quarry the degree of influence of blasting on the fractural tectonics of the Shipunovsky-1 deposit and recalculate the expected output of block stone.

4. To perform laboratory research of marmorized limestone suitability for use as building stone.

5. To develop a feasibility study of permanent conditions substantiating expediency of using marmorized limestone as cladding materials and as building rubble.

6. To develop a project of mining work with recalculation of balance reserves of building stone in the area that includes all deposits of the

Shipunovsky limestone massif: Altaysahartrest and Dyatlovsky plots, Shipunovsky-2, Shipunovsky-1.

III. MAIN PART

Over the entire period of the operation of the Shipunovsky-1 deposit from the moment of reserves confirmation to September, 1996 the total of 25 thousand m³ of rock mass have been excavated directly from the quarry. Actually facing stone extraction was performed for three or four years in the 70s, i.e., only in the initial phase of deposit development. During this period, in order to increase the output of commercial blocks, all variants of stone extraction and processing were elaborated (increasing benches, changing processing modes, use of modern equipment, etc.). In 1987, an attempt was made to use diamond-and-cable installations for extraction, but it did not bring a positive result, after which facing stone production from the quarry was virtually stopped. Reserves of limestone for decorative facing stone were confirmed by FSI SCRCM in 1974 and totaled 2,297 thousand m³ by categories B+C1.

Additional exploration work on the Shipunovsky-1 deposit was performed in 2008 in order to re-assess remaining reserves of marmorized limestone and determine the possibility of their further use as facing/cladding material or building stone.

The main requirement for the raw materials for obtaining facing stone is the possibility to obtain blocks with required dimensions, shape and surface, that makes it possible to manufacture standard facing plates [6-10].

The minimum block volume according to GOST 9479-98 [11] should be greater than 0.1 m³ (group IV). Thus, the block should have rectangular or close to rectangular shape with the following dimensions: length 0.4 to 3.5 m, width and height - 0.2 to 2 m.

By analogy with 1974, drill core taper angle was measured by chlorite-carbonate veinlets, and the measurement results confirm the data from

1974 by the number of veinlets per 1 m of drill core and their fall angle.

However, the number of measurements shows that open fractures associated with chlorite-carbonate veinlets have become more numerous - 5 to 50 per 1 m of drill core in the areas of excessive fissuring. Most likely, it was caused by blasting works in the nearby quarries.

The average yield of the finished blocks during development of the deposit was 14.7% m²/m³ that did not meet requirements of conditions approved by FSI "SCRCM" (minutes No. 798-k dd. 17 May 1974), according to which the minimum output of facing plates is 16.4 m²/m³.

The performed laboratory tests revealed that the limestone in Shipunovsky-1 deposit by its physical-and-mechanical properties does not differ from the limestone at the adjacent deposits, and by its mining and geological characteristics are the best in this massif for production of construction materials.

Capital expenses for development of limestone reserves at Shipunovsky-1 deposit in order to obtain building stone are not required, as they will be extracted and processed in course of further development of Quarry No. 1 that develops Altaysahartrest and Dyatlovsky plots.

Totally, the following scope of work has been performed for audit and reserves reassessment at the Shipunovsky-1 marbled limestone deposit:

1. Mechanical coring of three wells with ancillary works - 181.0 m.
2. Taking samples for performing full range of physical and mechanical tests of the stone - 10 samples.
3. Taking samples for performing brief range of physical and mechanical tests of the stone - 30 samples.
4. Taking samples for performing full range of physical and mechanical tests of the rubble - 6 samples.
5. Wells breakdown, horizontal and vertical tie-in - 3 workings.

6. 1:1000 scale topographic survey - 16 hectares.
7. Laboratory testing of samples made by Analytic and Technological Testing Center of OJSC «Novosibirskyageologicheskayaekspeditsya» (Novosibirsk geological expedition).

IV. RESULTS

Marmorized limestone of the Shipunovsky-1 deposit is sufficiently decorative and its physical-and-mechanical properties and petrographic composition features are potentially suitable for manufacturing facing materials; however, the data about fracturing of the useful rock mass obtained as a result of the work conducted in 2008, as well as the data about yield of quality blocks obtained during operation do not make it possible to recommend the deposit for its further exploitation for obtaining block stone for manufacturing facing materials.

Reserves of the Shipunovsky-1 deposit as of 01.01.2009 are by categories: B - 574 thousand m³, C1 - 1,698 thousand m³. It is recommended to take these reserves off the balance due to absence of commercial value (for manufacturing facing plates).

Performed laboratory research confirmed marmorized limestone suitability for use as building stone according to GOST 8267-93 [12]. As a result, reserves of the Shipunovsky-1 deposit in 2009 have been written off the balance of facing stone and transferred to the balance of building materials of the Novosibirsk region.

Mining-and-geological and hydrogeological conditions are favorable for open-pit mining in the course of development of Quarry No. 1 (Altaysahartrest and Dyatlovsky deposits) for extraction of building stone in northern direction.

V. CONCLUSIONS

In 2008, basing on technical and economic characteristics of the Altaysahartrest, Dyatlovsky, Shipunovsky-2 deposits, the average profitability

of which in 2007-2008 was not more than 50%, a justification was made of involving facing stone reserves at the Shipunovsky-1 deposit into production of rubble.

Taking into account identical development conditions, similar yield is expected.

At present, at the Shipunovsky-1 deposit uncovering and mining operations are being conducted, during 2013 about 10 thousand m³ of conditioned rock mass have been produced, and about 100 thousand m³ of overburden rocks have been removed to the dump.

Involvement of this deposit into production had significant influence on the company's operation, which can be reflected by a number of indicators:

- limestone reserves/production ratio for rubble production increased from 30 years to 56 years with the same production volume;
- profitability increased by 10-12% due to the improvement of production technology, including decreasing distance to the overburden rock dump by 5 km, and the distance to the crushing facility by 7 km;
- quality indicators of manufactured rubble improved, as production involves reassessed stock of building stone, i.e., monolithic marmorized limestone that contains no clay and dust inclusions.

Thus, this experience of combining several quarries can be considered an effective innovative solution that made it possible to improve efficiency of production and create preconditions for increasing competitive advantage of the enterprise in the market.

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