

**AP19579377 “Investigation and substantiation of the parameters of special drilling and blasting operations in order to minimize the negative impact on the stability of the sides to increase the efficiency of the quarries: – p.m. Hussan B.**

***Relevance:***

Currently, at large mineral deposits developed through open-pit mining, there is a transition to the development of deep horizons. As depths increase, ensuring the stability of quarry slopes and benches becomes one of the key challenges in mining operations. Slope stability is evaluated based on both the initial mining-geological conditions of the environment and the parameters of special blasting operations, as well as the seismic impact of explosions, which must be considered through the parameters of their influence. Increasing the bench slope angle reduces the amount of debris movement and enhances the economic efficiency of deposit development. However, this also increases the risk of slope failure due to geodynamic movements caused by rock pressure and the influence of short-term impulsive loads from blasting operations. The evaluation of the stable state of the slope structure at a specific angle is based on measurements of mass displacement in various directions over extended observation periods, while short-term deformations leading to local interblock movements are not considered when justifying stable angles. Therefore, scientifically unfounded or insufficiently careful blasting operations near slope structures can destabilize them and lead to catastrophic landslide phenomena.

The subject of the study is mineral deposits developed by open-pit methods in deep horizons, with a focus on the stability of quarry slopes.

***The objective of the project*** is to investigate the impact of blasting on the quarry face near the limit contour, to ensure minimal impact of blasting on the stability of the quarry face, to improve safety when working under high ledges. The development of effective parameters of special drilling and blasting operations will provide the bulk of well-crushed, loosened blasted rock, as well as undestroyed slope according to the project. It is required to establish the relationship between the parameters of drilling and blasting operations, mining and geological conditions and stability of the pit walls, taking into account the influence of seismic impact of the explosion..

***Expected and Achieved Results:***

***Achieved Results:***

A study was conducted on the impact of the shockwave on the out-of-bound massif. The results of the study allowed for the optimization of blasting parameters, improved the control over the rock fragmentation process, and minimized the negative impact on the stability of the out-of-bound mass and the surrounding environment.

Using a laser scanner, a survey of the quarry slopes was conducted before and after the blasting operations to identify the main crack systems and determine the dynamics of the slope massif. To develop a methodology for conducting blasting operations in the boundary areas, a comprehensive data preparation process was required, along with its integration into the program. To determine the negative effects of shockwave processes from blasting operations on the slope of the bench, the impact of the explosion on the boundary massif slope was modeled in the “Ansys Mechanical” program.

Collaboration was established with the mining company LLP “Kazakhmys Corporation” at the “Konyrat” deposit.

As part of grant funding, a license for the "ANSYS Academic Research Mechanical, perpetual version" program was acquired, intended for modeling solid body mechanics, explicit dynamics, computational fluid dynamics, and heat transfer.

A technology for conducting boundary blasting operations (BBO) was developed for the areas, which minimized the disturbance of the out-of-bound massif and improved the accuracy of the contour formation of the excavations. The developed methods include the optimization of drilling parameters, selection of charges considering the geomechanical characteristics of the

massif, and control of blasting processes to reduce rock fall and ensure the stability of rock walls. The application of this technology enhances the efficiency and safety of mining operations.

A specialized training course "Introduction to ANSYS LS-DYNA" was completed, and certificates were obtained. Using this program, a blasting operation model is planned to be developed, and results will be obtained. To compare domestic blasting operations with international experience and identify deficiencies, an internship was conducted at Eskisehir Osmangazi University, Turkey. Consultations were held with experienced engineers and researchers.

One article was published in peer-reviewed foreign and domestic journals recommended by the CQASHE.

Husan B., Mustafin S.A, Eskenova G.B., Asanova Zh.M. "Methodology for determining the influencing factors on the stability of the pit walls during drilling and blasting operations" // Mining Journal of Kazakhstan, 2024. No.10 - C. 27-32. <https://doi.org/10.48498/minmag.2024.234.10.006>

Husan B., Mustafin S.A., Eskenova G.B., Asanova. Z.M. "Methodology for Determining the Impacting Factors on the Stability of Quarry Slopes during Blasting Operations" // Mining Journal of Kazakhstan, 2024. No. 10 – Pp. 27-32. <https://doi.org/10.48498/minmag.2024.234.10.006>

One certificate of state registration of intellectual property rights was obtained: (Khasan Bolatkhan, Asanova Zhanar Mazhitovna, Mustafin Saken Amanzholovich, Eskenova Gulnur Berikovna, Ivadilinova Dina Tolegenovna. Methodology for Determining the Impacting Factors on the Stability of Quarry Slopes during Blasting Operations No. 329870 from 27.11.2024.).

*Expected Results:*

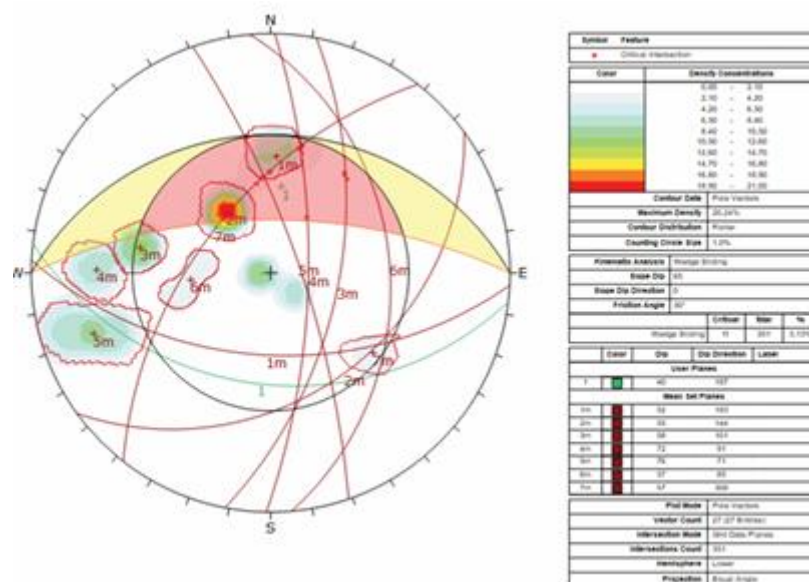
- A methodology for boundary blocks will be developed to reduce the dynamic load from blasting operations on the out-of-bound massif. Blasting operations will be modeled using the "Bigras" software or similar programs. One article or review will be published in a peer-reviewed foreign or domestic recommended journal, CQASHE, and one monograph will be published by a Kazakhstan-based publishing house.

- The technical and economic efficiency of the developed parameters for special blasting operations in open-pit mining will be determined. The main benefits of the research work for the socio-economic environment will be presented.

- Two articles and/or reviews will be published in peer-reviewed scientific journals related to the project's scientific direction, indexed in the Science Citation Index Expanded database of Web of Science and/or having a CiteScore percentile in the Scopus database of at least 35. Two certificates of state registration of intellectual property rights will be obtained.



**Figure 1** – Block diagram No.620-007 for boundary clarification



**Figure 2** – Determination of the crack systems of the southwest and northeast slopes at the +630 m horizon

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Ожидаемые публикации:

***Expected Publications:***

1. Husan B., Mustafin S.A., Eskenova G.B., Asanova Z.M. “Methodology for Determining the Impacting Factors on the Stability of Quarry Slopes During Blasting Operations” // Mining

2. Certificate of State Registration of Intellectual Property Rights: (Khasan Bolatkhan, Asanova Zhanar Mazhitovna, Mustafin Saken Amanzholovich, Eskenova Gulnur Berikovna, Ivadilinova Dina Tolegenovna. Methodology for Determining the Impacting Factors on the Stability of Quarry Slopes During Blasting Operations No. 329870 from 27.11.2024).

***Information for Potential Users:***

The result of the research is the improvement of the blasting operations technology in the boundary zone of the quarry and the minimization of the negative impact of blasting operations on the stability of quarry slopes. The potential consumers of the research results are research centers, mining, and design companies.

***Scope of application:***

Geology, extraction and processing of mineral and hydrocarbon raw materials, new materials, technology, safe products, and constructions

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