

**AP14869145 “Development of an intelligent fiber-optic system for monitoring the geotechnical condition of mine workings of quarries and open-pit mines” – p.m. Neshina E.G.**

***Relevance***

The relevance of the project is conditioned by the importance of warning about sudden changes in parameters that affect the strength of the mine workings of quarries, open pits and ensure the personnel protection against sudden collapse. The work proposes to improve labor safety by using new scientific achievements related to the use of fiber-optic technologies, namely a fiber-optic sensor (FOS) included in the hardware and software complex.

***Project objective***

Developing an intelligent fiber-optic system for monitoring the geotechnical condition of mine workings of quarries and open pits, operating in real time for timely notification of changes in geotechnical parameters leading to the collapse of the sides of the quarry and open pit, which allows increasing the level of safety of mining operations and reducing economic costs for elimination of the collapse consequences.

***Achieved results***

A prototype of an intelligent fiber-optic system for monitoring the geotechnical condition of quarry and open-pit mine workings was developed.

An article was published in a domestic publication recommended by the CQASHE: Neshina Ye., Yugay V., Alkina A., Bilichenko E., Yurchenko A. Hardware and Software Complex for Identification of Displacement Based on a Fiber-optic Sensor. University Proceedings. No. 3 (96), 2024, pp. 445-451.

Technical documentation for a fiber-optic system for monitoring the geotechnical condition of quarry and open-pit mine workings was developed. Recommendations for use were prepared.

Test certificate No. 1 dated August 24, 2024 was received at the enterprise Qaz Network Solution LLP.

A prototype of a fiber-optic system for monitoring the geotechnical condition of quarries and open pit mines was prepared for presentation to potential consumers for concluding preliminary agreements. An agreement was concluded on implementing the results of scientific and technical activities of the Kazakhmys Coal LLP.

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#### ***List of publications in 2022:***

1. Neshina E.G., Mekhtiyev A.D., Kaliaskarov N.B., Yugay V.V., Alkina A.D. Geotechnical monitoring of optical fiber technologies. University Proceedings, Abylkas Saginov Karaganda Technical University NJSC, No. 3, 2022. P. 347-352.

2. Alkina A.D., Neshina E.G., Brazhanova D.K., Bilichenko E.N. Studying additional losses in optical fibers under mechanical impact. Certificate of entry of information in the state register of rights to objects protected by copyright No. 29392 dated 10/12/2022.

#### ***In 2023:***

1. Mekhtiyev A.D., Kovtun A.A., Neshina E.G., Alkina A.D., Yugay V.V. Distributed fiber-optic system for protecting the perimeters of various objects. University Proceedings, No. 1, 2023. P. 360-364

2. Neshina E.G., Mekhtiyev A.D., Alkina A.D., Bilichenko E.N., Malikov N.M. Fiber-optic system for ensuring the safety of mining operations in open pit mines. Certificate of entry of information in the state register of rights to objects protected by maritime law No. 32036 dated 01/26/2023.

3. Y.G. Neshina, A.D. Mekhtiyev, V.V. Yugay, A.D. Alkina, P.Sh. Madi. Developing A Sensor For Controlling The Pit Wall Displacement. News Of The National Academy of Sciences of The Republic Of Kazakhstan. Series of Geology and Technical Sciences, Almaty: ST “Aruna”, Vol.2, No. 458, 2023. P. 160-167.. (Scopus 40 percentile)

4. Mekhtiyev A.D., Yurchenko A.V., Kalytka V.A., Neshina Y.G., Alkina A.D., Madi P.Sh. Fiber-Optic Long-Base Deformometer for a System for Monitoring Rocks on the Sides of Quarries. Technical Physics Letters, Vol. 48, No. 15, 2022, pp. 30–32. (Scopus, Science Citation Index Expanded)

5. Neshina E.G., Mekhtiyev A.D., Kaliaskarov N.B., Bilichenko E.N., Alkina A.D., Malikov N.M. Fiber-optic sensor for monitoring the stability of quarry sides. Patent for utility model No. 8004. Application registration number 2023/0108.2, dated 03.02.2023 Neshina Y.G., Mekhtiyev A.D., Alkina A.D., Dunayev P.A., Manbetova Z.D. Hardware-Software Complex For Identification Of Rock Displacement In Pits. NEWS of the National Academy of Sciences of the Republic of Kazakhstan SERIES OF GEOLOGY AND TECHNICAL SCIENCES ISSN 2224-5278. Volume 3, Number 459 (2023), 180–192 <https://doi.org/10.32014/2023.2518-170X.30> (Scopus 40 процентиљ)

6. Neshina E.G., Mekhtiev A.D., Kaidanovich O.Yu. System for monitoring the displacement of the rock massif of the roof of workings. Certificate of entering information into the state register of rights to objects protected by copyright No. 33844 dated 03/27/2023.

7. Mekhtiyev A.D., Abdikashev Y.N., Neshina Y.G., Dunayev P.A., Manbetova Z.D. Monitoring the geotechnical condition of underground minings using digital technologies.

8. A. Mekhtiyev, Y. Neshina, A. Alkina, V. Yugai, V. Kalytka, Y. Sarsikayev and L. Kirichenko. Developing an Intelligent Fiber-optic System for Monitoring Reinforced Concrete Foundation Structure Damage, Applied Sciences (Switzerland), Appl. Sci. 2023, 13(21), 11987; <https://doi.org/10.3390/app132111987> (Scopus, 62 percentile)

**in 2024:**

1. Neshina Ye.G. Development of a hardware and software complex for identifying the displacement of quarry rocks”, No. 42745 dated February 8, 2024.

2. Ye. Neshina, A. Mekhtiyev, V. Kalytka, N. Kaliaskarov, O. Galtseva, I. Kazambayev. Fiber-Optic System for Monitoring Pit Collapse Prevention. Appl. Sci. 2024, 14(11), 4678; <https://doi.org/10.3390/app14114678> (Scopus 75 процентиљ, WoS Q2).



**Figure 1** – Laboratory prototype of the system

***Information for potential consumers***

Kazakhstan has a developed mining industry and potential consumers can include about 80 large enterprises engaged in the extraction of various minerals. Since the proposed system solves the important problem of early diagnostics of mine workings and sides of quarries and open pits collapse, it will allow potential consumers to significantly reduce material costs for accident elimination and to avoid losses of process equipment, as well as casualties among production personnel in the event of a sudden collapse of rock in mining areas. The result of the project will be the development of a prototype fiber-optic system for monitoring the geotechnical condition of mine workings of quarries, open pits and preparing documentation.

***Scope***

Enterprises engaged in the extraction of various minerals

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