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ANALYSIS OF OCCUPATIONAL INJURIES IN THE MINING INDUSTRY OF RUSSIA AND THE REPUBLIC OF BASHKORTOSTAN

The mining industry is one of the key industries for the economy of Russia and the Republic of Bashkortostan. However, despite its significant contribution to economic development, this sector is characterized by a high level of industrial injuries. In this article, we will consider the main causes of injuries, statistical data, and measures to reduce them.

According to statistics, the main causes of injuries in the mining industry are: violation of safety rules, faulty equipment, low level of production control, insufficient training of workers, poor working conditions, lack of personal and collective protective equipment, and the human factor.

Industrial injuries in the mining industry of Russia and the Republic of Bashkortostan remain a serious problem that requires attention from both employers and government agencies. Taking effective measures to improve working conditions, train workers, and monitor compliance with occupational safety standards can significantly reduce the number of accidents at work and improve overall safety in the industry.

Keywords: mining industry, injuries, fatalities, statistics, industrial control

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Introduction. The mining industry is a key component of the Russian economy, encompassing the extraction of coal, precious metals, rare earth elements, and natural stones. In Russia, as in other countries with developed mining industries, this sector has a significant impact on technological progress, living standards, and generally accepted standards. Without mining, many industries, including construction, electronics, and many others, would be impossible.

The mining industry encompasses all stages of deposit development—from

prospecting and exploration to extraction and processing. Despite the innovative technologies and equipment used, mining enterprises pose a high risk of harm to worker health, due to the specific nature of their production.

Over the past 10 years, the proportion of workers working in hazardous and harmful conditions at copper-zinc ore mining enterprises has ranged from 40% to 71.9%. These are extremely alarming statistics, especially considering that in underground ore mining units, this figure reached 100% [1-3, 6]. A high rate of occupational injuries, including group accidents and fatalities, is a direct consequence of harmful and hazardous working conditions. Therefore, the analysis of occupational injuries at mining enterprises is of paramount importance [7].

Given the development trends of the industry, as well as its specific characteristics at the national and industry levels, it is necessary to implement scientific and methodological foundations for risk management. One of the key aspects and relevant areas for further research is an objective assessment of working conditions and safety systems at production facilities.

Research Materials and Methods.

This study analyzed statistical annual reports from Rostekhnadzor and the Federal State Statistics Service for 2013-2023 on accidents and injuries in the mining industry. Statistical data processing was performed in Microsoft Excel. Descriptive statistics were used to analyze the data obtained.

Results and Discussion. Hazardous production facilities in the mining industry include underground mines (shafts), quarries, processing plants, crushing and screening plants, sintering plants, and subsoil use facilities for purposes unrelated to mineral extraction.

According to official data from the Federal State Statistics Service, 30 to 35% of workers in the Russian mining industry perform heavy work and work in hazardous and harmful conditions, under conditions of elevated levels of the following factors: chemicals, aerosols (primarily fibrogenic), noise, vibration, insufficient lighting, microclimate, and the severity and intensity of the work process.

The proportion of workers in the Republic of Bashkortostan mining industry engaged in hazardous working conditions during the period under review was 44.5–43.0%, ranking first among all types of economic activity [4].

In recent decades, the number of accidents at Russian mining sites has declined, despite an increase in rock extraction volumes by 169 million m³. This is possibly due to a reduction in the number of workers in this industry by 197,780,000.

Over the past 10 years, accident rates have more than halved across the constituent entities of the Russian Federation. In 2014, the number of accidents peaked at 58, and in 2023, it dropped to 28 (Figure 1). A total of 499 accidents occurred during the period under review. In the Republic of Bashkortostan, there were no accidents at

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enterprises in this industry during the period under review.

The number of fatal occupational injuries from 2013 to 2023 decreased from 7 to 3 (in the Republic of Bashkortostan, from 5 to 2 cases, respectively) (Figure 2).

Having examined the distribution of incidents and fatalities in the Russian mining industry from 2013 to 2023 (Table 1), it can be concluded that in a number of situations, fatal injuries were not related to natural disasters. Based on this, it can be argued that the human factor plays a significant role in the occurrence of life-threatening crises.

In practice, the most common traumatic factors are falls from heights, injuries caused by moving machinery, and incidents related to rock falls (Table 1). These circumstances often lead to serious consequences not only for the health of workers but also for overall production efficiency.

The distribution of accidents by traumatic factors in the mining industry is an important aspect of industrial safety and occupational health analysis. In the complex technological environment typical of this industry, accidents can occur for various reasons.

As can be seen from the data presented (Table 2), insufficient control over production processes was the primary cause of the greatest number of injuries due to inadequate control over production processes was the primary cause of the largest number of injuries. These injuries resulted from untimely inspections of mining equipment, improper organization of work areas, the absence of protective structures at mine workings, poor coordination among personnel, and the failure to start vehicles during maintenance work. Violations of work procedures, such as deviations from design solutions, technical standards, and work permits, are also a primary cause of accidents. Failure to comply with work regulations and discipline, including arriving at work intoxicated, also has a significant impact. Insufficient knowledge of safety rules and regulations, in particular, allowing individuals without the necessary training and instruction to enter hazardous areas, has caused between 2% and 7% of worker deaths over the years.

According to the Department for Technological and Environmental Supervision of the Federal Service for Environmental, Technological and Nuclear Supervision in the Republic of Bashkortostan, industrial injuries at mining enterprises in Bashkortostan are due to severe equipment deterioration—70-80%. To improve safety at these enterprises, it is essential to ensure

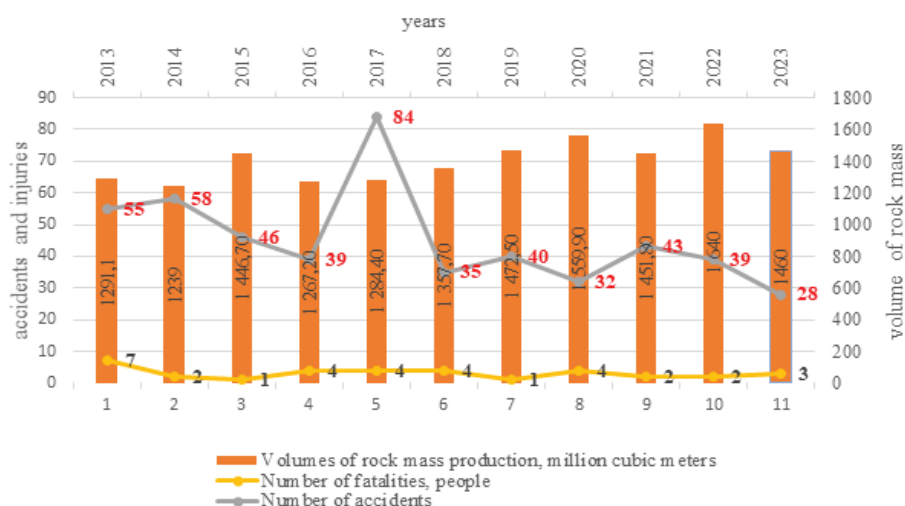


Fig. 1. Dynamics of indicators of rock mass extraction, accidents and fatalities at mining and non-metallic industry enterprises, underground construction sites [4]

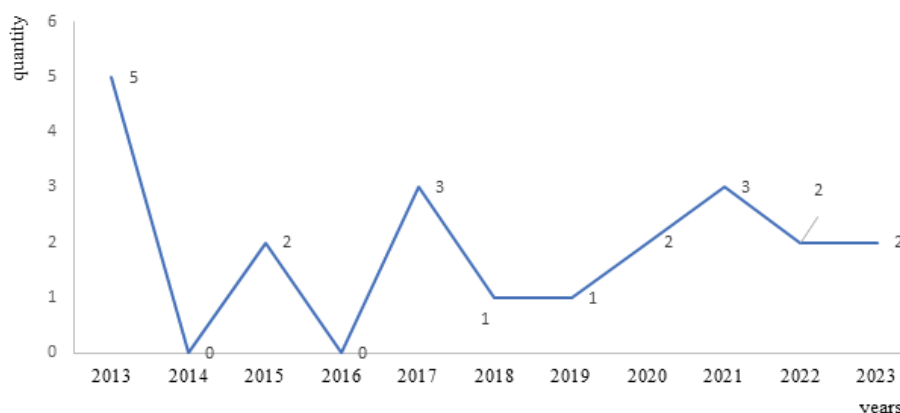


Fig. 2. Fatal industrial injuries in the mining industry in the Republic of Bashkortostan

a sufficient supply of serviceable equipment, and equipment that has reached its standard service life must undergo timely inspections. Furthermore, given the specific nature of their operations, mining enterprises in the region are particularly in need of qualified specialists, whose com-

petence is crucial for resolving issues related to industrial safety and subsoil protection.

According to statistics, the majority of fatalities occurred as a result of the operation of load-haul-dump machines (LHDs) in underground mining opera-

Table 1

Distribution of accidents by injury factors in the mining industry for 2013–2023 in the Russian Federation, number [4]

Traumatic factor	years											
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	
Destruction of machinery and equip-ment	-	-	-	-	-	-	-	-	-	2	1	
Motor transport	5	-	-	2	-	-	-	-	-	1	-	
Accidents involving cranes and lifting equipment	-	-	-	-	-	-	1	-	-	1	1	
Collapses	1	1	1	1	-	-	-	1	-	-	-	
Destruction of technical equipment	-	-	-	1	2	3	-	-	-	-	-	
Destruction of structures	-	-	-	-	-	-	-	1	-	-	1	
Fires, conflagrations, uncontrolled explosions	-	-	-	-	1	1	-	-	-	-	1	
Flooding	-	1	-	-	-	-	-	1	-	-	-	

Table 2

Distribution of causes of accidents and incidents in the mining industry for 2013–2023 in the Russian Federation, % [4]

Causes of the accident	years										
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Low level of production control	19	24	16	32	32	53	45	41	48	39	65
Violations of work procedures	8	11	40	32	22	11	20	38	22	28	20
Severe violations of work regulations and labor discipline	24	9	13	7	15	21	15	9	10	10	5
Poor organization of work procedures	42	52	27	27	29	11	18	6	13	18	5
Low level of knowledge of safety standards and regulations	7	4	4	2	2	4	2	6	7	2	5

tions and conveyors at crushing and processing plants. The primary cause of fatal accidents involving LHDs and conveyors was poor production control—10 of the 17 incidents investigated (59%). In the case of LHDs, this was due to a lack of safety oversight by technical supervision, poor workplace conditions, poor visibility and lighting, the use of faulty equipment, and the presence of people in hazardous areas. Regarding conveyors, the main problems were the lack of collective safety equipment (rotating and moving parts were not guarded), the absence of shut-off devices to stop the conveyor in the event of belt slippage, the performance of production operations in the conveyor operating area, and the start-up of equipment without warning signals.

Conclusion. Injuries in the mining industry are caused by a variety of factors, including mechanical, chemical, and physical impacts. To reduce the risk of injury, it is necessary to implement modern safety technologies and strictly adhere to occupational health and safety standards at all stages of production.

Industrial control in the mining industry plays a key role in ensuring occupational

safety and environmental protection. It is a system of measures aimed at monitoring and managing technological processes, which helps minimize risks and increase production efficiency. Fundamental aspects of control include continuous measurement of parameters, analysis of the obtained data, and the implementation of modern technologies.

A key element of industrial control is the development and implementation of standards regulating production processes, which clearly define employee responsibilities and ensure compliance with safety regulations. Furthermore, regular audits and inspections help identify deviations from established procedures and prevent emergencies.

The introduction of new technologies, such as process automation, sensors, and monitoring systems, significantly improves the accuracy of control and the speed of response to unforeseen situations. Thus, effective industrial control is not only a safety tool, but also a key factor in increasing the competitiveness of mining companies in the global market.

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