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Indexing in Scopus and Web of Science ensures high international visibility of publications, promotes citation growth, and reflects the editorial board's commitment to publishing relevant, original, and scientifically significant research in the fields of geology and technical sciences.

«Қазақстан Республикасы Ұлттық ғылым академиясының Хабарлары. Геология және техникалық ғылымдар сериясы» ғылыми журналы 2016 жылдан бастап халықаралық реферативтік және ғылымиметриялық Scopus дерекқорында индекстеледі және тұрақты библиометриялық көрсеткіштерді көрсетіп келеді.

Сонымен қатар журнал Web of Science платформасының (Clarivate Analytics, 2018) халықаралық реферативтік және наукометриялық дерекқоры Emerging Sources Citation Index (ESCI) тізіміне енгізілген.

ESCI дерекқорында индекстелуі журналдың халықаралық ғылыми рецензиялау талаптары мен редакциялық этика стандарттарына сәйкестігін растайды, сондай-ақ Clarivate Analytics компаниясы тарапынан басылмды Science Citation Index Expanded (SCIE), Social Sciences Citation Index (SSCI) және Arts & Humanities Citation Index (AHCI) дерекқорларына енгізу қарастырылуда.

Scopus және Web of Science дерекқорларында индекстелуі жарияланымдардың халықаралық деңгейде жоғары сұранысқа ие болуын қамтамасыз етеді, олардың дәйексөз алу көрсеткіштерінің артуына ықпал етеді және редакциялық алқаның геология мен техникалық ғылымдар саласындағы өзекті, бірегей және ғылыми тұрғыдан маңызды зерттеулерді жариялауға ұмтылысын айқындайды.

Научный журнал «News of the National Academy of Sciences of the Republic of Kazakhstan, Series of Geology and Technical Sciences» с 2016 года индексируется в международной реферативной и наукометрической базе данных Scopus и демонстрирует стабильные библиометрические показатели.

Журнал также включён в международную реферативную и наукометрическую базу данных Emerging Sources Citation Index (ESCI) платформы Web of Science (Clarivate Analytics, 2018).

Индексирование в ESCI подтверждает соответствие журнала международным стандартам научного рецензирования и редакционной этики, а также рассматривается компанией Clarivate Analytics в рамках дальнейшего включения издания в Science Citation Index Expanded (SCIE), Social Sciences Citation Index (SSCI) и Arts & Humanities Citation Index (AHCI).

Индексирование в Scopus и Web of Science обеспечивает высокую международную востребованность публикаций, способствует росту цитируемости и подтверждает стремление редакционной коллегии публиковать актуальные, оригинальные и научно значимые исследования в области геологии и технических наук.

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RECOMMENDATIONS FOR HAZARD IDENTIFICATION AND OCCUPATIONAL SAFETY RISK ANALYSIS CONSIDERING GEOLOGICAL AND TECHNICAL FACTORS

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Abstract. *Relevance.* Ensuring the life and health of employees, especially in the construction, mining, and manufacturing sectors, is a priority task of the state. The fundamental principles of occupational safety are enshrined in legislation and are based on ratified conventions and agreements of the International Labour Organization. Particular importance is given to accounting for geological and technical factors (soil instability, landslides, underground operations, seismic activity, erosion, etc.) that affect workplace safety. *Objective.* To develop and substantiate a risk-oriented approach to occupational health and safety management, taking into account geological and technical factors, as well as to form a universal risk management algorithm applicable to enterprises across various industries. *Methods.* The methodological basis of the study is a risk management system that

includes the identification, assessment, and control of occupational hazards. The international standard ISO 45001 was used as the regulatory framework, focusing on comprehensive risk management, including geological and technical aspects. *Results and Conclusions.* The article presents an overview of new sections of the ISO 45001 standard aimed at transitioning from the principle of acceptable risk to practical mechanisms for preventing and mitigating the consequences of occupational and geological hazards. A generalized risk management algorithm applicable to construction, mining, and infrastructure enterprises has been developed. In addition, a system for monitoring, measurement, and analysis of occupational safety performance indicators, taking into account geological and technical factors, has been proposed. The research results were implemented at “Golden Camel Group LTD” LLP with the achievement of ISO 45001 certification. The application of a risk-oriented approach based on ISO 45001 improves the effectiveness of occupational health and safety systems, reduces the level of occupational risks and injuries, and ensures the sustainable operation of enterprises under the influence of geological and technical factors.

Keywords: occupational health and safety management system, ISO 45001, occupational diseases, occupational injuries, geological and technical risks, risk management, identification

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ӨНДІРІСТІҢ ГЕОЛОГИЯЛЫҚ-ТЕХНИКАЛЫҚ ФАКТОРЛАРЫН ЕСКЕРЕ ОТЫРЫП, ҚАУІПТІ СӘЙКЕСТЕНДІРУ ЖӘНЕ ЕҢБЕКТИ ҚОРҒАУ ТӘУЕКЕЛДЕРІН ТАЛДАУ БОЙЫНША ҰСЫНЫСТАР

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Аннотация. *Өзектілігі.* Кәсіпорын қызметкерлерінің өмірі мен денсаулығын сақтау, әсіресе құрылыс, тау-кен және өңдеу өнеркәсібі салаларында, мемлекеттің басым міндеттерінің бірі болып табылады. Еңбекті қорғаудың негізгі қағидаттары заңнамада бекітіліп, Халықаралық еңбек ұйымының ратификацияланған конвенциялары мен келісімдеріне негізделеді. Еңбек қауіпсіздігіне әсер ететін геологиялық және техникалық факторларды (топырақтың тұрақсыздығы, көшкіндер, жерасты жұмыстары, сейсмикалық белсенділік, эрозия және т.б.) ескеру ерекше маңызға ие. *Мақсаты.* Геологиялық және техникалық факторларды ескере отырып, еңбекті қорғау мен қауіпсіздігін басқаруда тәуекелге бағдарланған тәсілді әзірлеу және негіздеу, сондай-ақ әртүрлі салалар кәсіпорындары үшін тәуекелдерді басқарудың әмбебап алгоритмін қалыптастыру. *Әдістері.* Зерттеудің әдіснамалық негізін кәсіби қауіптерді анықтау, бағалау және басқару процестерін қамтитын тәуекелдерді басқару жүйесі құрайды. Нормативтік база ретінде геологиялық және техникалық аспектілерді қоса алғанда, тәуекелдерді кешенді басқаруға бағытталған ISO 45001 халықаралық стандарты қолданылды. *Нәтижелері мен қорытындылары.* Мақалада ISO 45001 стандартының рұқсат етілетін тәуекел қағидатынан кәсіби және геологиялық қауіптердің салдарын алдын алу немесе төмендетудің практикалық механизмдеріне көшуге бағытталған жаңа бөлімдеріне шолу жасалған. Құрылыс, тау-кен және инфрақұрылым салалары кәсіпорындарына қолдануға болатын тәуекелдерді басқарудың жалпыланған алгоритмі әзірленді. Сонымен қатар, геологиялық және техникалық факторларды ескере отырып, еңбекті қорғау саласындағы қызмет көрсеткіштерін мониторингтеу, өлшеу және талдау жүйесі ұсынылды. Зерттеу нәтижелері «Golden Camel Group LTD» ЖШС кәсіпорнында енгізіліп, ISO 45001 сәйкестік сертификаты алынды. ISO 45001 стандарты негізіндегі тәуекелге бағдарланған тәсілді қолдану еңбекті қорғау жүйесінің тиімділігін арттыруды, кәсіби тәуекелдер мен өндірістік жарақаттану деңгейін төмендетуді, сондай-ақ геологиялық және техникалық факторлардың әсері жағдайында кәсіпорындардың тұрақты жұмыс істеуін қамтамасыз етеді.

Түйін сөздер: еңбек қауіпсіздігін басқару жүйесі, ISO 45001, кәсіптік аурулар, өндірістік жарақаттану, геологиялық-техникалық тәуекелдер, тәуекелдерді басқару, сәйкестендіру

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РЕКОМЕНДАЦИИ ПО ИДЕНТИФИКАЦИИ ОПАСНОСТЕЙ И АНАЛИЗ РИСКОВ ОХРАНЫ ТРУДА С УЧЕТОМ ГЕОЛОГО- ТЕХНИЧЕСКИХ ФАКТОРОВ ПРОИЗВОДСТВА

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Аннотация. *Актуальность.* Обеспечение безопасности, сохранение жизни и здоровья работников предприятий, особенно в строительной, горнодобывающей и обрабатывающей промышленности, является одной из приоритетных задач государственной политики в области охраны труда. Основополагающие принципы охраны труда закреплены в национальном законодательстве и международных нормативных документах, включая ратифицированные конвенции Международной организации труда. Особую значимость приобретает учет геологических и технических факторов, таких как нестабильность грунтов, оползневые процессы, условия проведения подземных работ, сейсмическая активность и эрозионные процессы, оказывающих непосредственное влияние на безопасность производственной деятельности. *Цель.* Разработать и обосновать риск-ориентированный подход к управлению охраной труда с учетом геологических и технических факторов, а также сформировать универсальный алгоритм идентификации опасностей, оценки и управления профессиональными рисками для предприятий различных отраслей промышленности. *Методы.* Методологическую основу исследования составляет риск-ориентированный подход, предусматривающий последовательное выявление опасностей, оценку профессиональных рисков и разработку мероприятий по их

снижению. В качестве нормативно-методической основы использован международный стандарт ISO 45001, устанавливающий требования к системе менеджмента охраны здоровья и обеспечения безопасности труда. Особое внимание уделено интеграции геологических и технических факторов в процессы идентификации опасностей, оценки рисков, мониторинга и контроля производственной безопасности. *Результаты и выводы.* Проведен анализ положений международного стандарта ISO 45001, направленных на предупреждение производственных опасностей, снижение профессиональных рисков и совершенствование системы управления охраной труда. Разработан обобщенный алгоритм управления профессиональными рисками с учетом геологических и технических факторов, который может применяться на предприятиях строительной, горнодобывающей и инфраструктурной отраслей. Предложена система мониторинга, измерения и анализа показателей в области охраны труда, предусматривающая учет специфических производственных опасностей, обусловленных геологическими условиями и техническими особенностями производственных процессов. Представленные подходы использованы при совершенствовании системы менеджмента охраны труда в ТОО «Golden Camel Group LTD», получившем сертификат соответствия требованиям ISO 45001. Применение риск-ориентированного подхода на основе данного стандарта способствует повышению эффективности управления охраной труда, снижению профессиональных рисков и предупреждению производственного травматизма, а также созданию условий для устойчивого функционирования предприятий, деятельность которых связана с воздействием геологических и технических факторов.

Ключевые слова: система менеджмента охраны труда, ISO 45001, профессиональные заболевания, производственный травматизм, геолого-технические риски, управление рисками, идентификация

Introduction. With the emergence of labour as a fundamental way of human life and conscious human activity, aimed at satisfying its needs and society, the question of ensuring safe and comfortable working conditions, as for the main resource of any industrial production, arose. The stages of industrialisation went hand in hand with the struggle of wage earners for their rights to safe and decent working conditions, which culminated in the creation of the International Labour Organization (ILO), which united the efforts of many countries in the joint development of criteria for an industrial society and the legislative enshrinement of workers' rights in the field of occupational safety and health at work. The review of existing approaches and concepts has shown that first of all it was necessary to create at the state level national systems of labour protection, which are based on the implementation of the requirements of ILO Conventions, through their ratification in the countries that are members of this organization, as well as bringing their legislation in line with international norms and rules (Bekyashev,

2019; Jasmien, 2008; ILO Conventions; International Labour Organization, 2018).

Kazakhstan, as a full member of the ILO, which joined it as an independent state in 1993, is on the way to improving its legislative and regulatory framework, taking into account the recommendations of this organisation, one of which includes the introduction of proven and internationally accepted occupational health and safety management systems, regulating the requirements of ISO international standards, the development of which was initiated by the ILO, based on a systematic approach to health and safety management at any enterprise, taking into account the recommendations of the ILO (Takala et al., 2014; Jakovleski et al., 2019; Anner and Caraway, 2010).

However, despite the efforts of the ILO, several international organisations in the field of occupational safety and health, the latest statistics, which they periodically compile, have shown that approximately 2.78 million workers die each year as a result of occupational accidents and diseases, and of these, 2.4 million deaths are disease related, i.e. 86% are deaths due to occupational diseases rather than occupational injuries (Piper and Foley, 2021; International Labour Organization; International Labour Organization. (n.d.)). One of the ways to improve this situation was the introduction of the British standard OHSAS 18001, which increased the involvement of top management in improving the effectiveness of occupational health and safety, as well as the degree of training and interaction of employees, which reduced the number of accidents and incidents in the workplace, but the issues of occupational health and hygiene have not been fully addressed. This was the decisive factor in the emergence of ISO 45001, developed by an international team of researchers and leading experts in the field of occupational health and safety at the request of the ILO, the implementation of which allows to improve the reduction of injuries and occupational diseases of workers in enterprises through a risk-oriented approach to safety processes, both in the workplace and related occupational diseases (Center for Humanitarian Technologies, 2006–2023; OHSAS 18001-2007; World Health Organization, 2018; Beiseev et al., 2018; Sansyzbayeva et al., 2020; Razakova et al., 2020). The new ISO 45001 standard focuses not only on risks but also on opportunities for the company, both internally and in its interactions with other companies and organisations in the course of its trading market activities.

The continuing globalisation of the world economy, the acceleration of scientific and technological progress, the implementation of the results of which is no longer years, but months and even days, the threat of infectious diseases of global scale, such as the COVID-19 pandemic, has led to the emergence of new professions, restrictive requirements in terms of social distance between people, and therefore new workplaces in terms of working conditions. All these challenges should be taken into account in the formation of the management system of labour protection and occupational health at enterprises and companies of our country and introduce new management systems, primarily in the field of occupational health.

At the same time, occupational hazards in industrial enterprises may be

influenced not only by direct technological factors but also by external and site-related conditions affecting the stability and technical condition of production infrastructure. In particular, seismic effects, ground instability, differential settlement, deformation of foundations and structural elements, and deterioration of engineering systems may act as initiating or aggravating factors for technological hazards. Their influence can result in changes in equipment stability, vibration characteristics, alignment of technological units, integrity of pipelines and storage facilities, and consequently in changes in the probability and severity of occupational incidents.

Therefore, geological and technical factors should be considered not as isolated hazards replacing the conventional classification of hazardous and harmful production factors, but as factors capable of initiating or aggravating physical, mechanical, chemical, thermal and other occupational hazards. Such an approach makes it possible to establish a causal relationship between the condition of the industrial site and infrastructure, technological disturbances, exposure of workers and the resulting occupational risk (Alsheriyeu et al., 2025).

Since, as a national standard in the Republic of Kazakhstan ISO 45001 was adopted only in 2019 and the practical experience of its implementation has just begun, the purpose of our research was to develop methodological and methodological approaches to its implementation in the form of recommendations and techniques that allow step by step to build a systemic management in the field of labour protection and safety to reduce the risks of occupational hazards and negative factors affecting the health of workers with the application of international norms and rules in practice.

The objective of this study is therefore to develop recommendations for hazard identification and occupational risk analysis that integrate geological and technical factors into an ISO 45001-based occupational health and safety management system. The proposed approach is intended to complement the conventional assessment of hazardous and harmful production factors by considering geological and technical conditions as potential initiating or aggravating factors.

Materials and Methods. As an object of research the current management systems of labour protection and safety of food industry enterprises of Turkestan region and Shymkent city are chosen. As the subject of research - methods and means of management of ISO 45001 standard, application of which allows to reduce the risks of industrial injuries and occupational diseases.

For the purposes of the present study, the research object is considered as a production system consisting of technological processes, workers, equipment, buildings, foundations and engineering infrastructure. In addition to direct workplace hazards, the assessment framework includes geological and technical conditions that may affect the safe functioning of these components.

The geological and technical component of the assessment is understood as a set of external and structural conditions capable of affecting the stability and technical state of an industrial facility. These include potential seismic effects,

ground instability and differential settlement, deformation of foundations and structural elements, displacement or misalignment of technological equipment, and deterioration or failure of engineering systems.

The proposed methodology distinguishes between a direct occupational hazard and a geological or technical initiating factor. A geological or technical factor does not necessarily cause an occupational incident directly; instead, it may change the technical or technological condition of the production system and thereby increase the probability or severity of an existing hazard.

The stage of transition of the existing labour protection management system to the personnel health and safety management system starts with the classification of hazardous and harmful production factors (HHPF) depending on the type of work and workplace. Classification is carried out in accordance with GOST 12.0.003. «SSBT. Hazardous and harmful production factors. Classification». Depending on the nature of their impact on the worker, hazardous and harmful production factors are classified into the following groups - physical, chemical; biological; psychophysiological. On the example of the technological scheme of oil and fats production in Table 1, the characteristics of each group depending on the work performed and the possible consequences for the health of the worker are given (Beiseyev et al., 2019).

To integrate the geological and technical component into the existing classification, the assessment was supplemented by an initiating-factor level. The resulting analytical sequence was defined as follows: geological and technical condition → technical or technological disturbance → hazardous event → worker exposure → consequence → occupational risk.

Table 1. List of hazardous and harmful production factors at workplaces by type of work in the production of vegetable oils.

No	Types of work	Hazardous and harmful factors	Geological and technical initiating/aggravating factors	Possible consequences
1 1.1	Cleaning of seeds	Vibration; excessive noise; falling objects; moving machinery; inadequate lighting; cutting parts; electric shock; dust	Possible equipment displacement or increased vibration resulting from deformation or differential settlement of the supporting foundation	Nervous system, vision and hearing disorders; fractures, bruises and cuts
2	Moisture conditioning of seeds	Electric shock; high surface temperature; falling from height; moving equipment; noise	Loss of equipment stability or misalignment caused by foundation deformation or technical deterioration of supporting structures	Burns; contusions; fractures; crushing injuries
3	Crushing of seeds	Vibration; noise; falling objects; moving machinery; inadequate lighting; cutting parts; electric shock; dust	Increased vibration or equipment misalignment associated with differential settlement or deformation of the equipment foundation	Fractures, bruises, cuts; nervous system, vision and hearing disorders

4	Separation of fractions	Noise; vibration; moving machinery; falling from height; dust	Changes in equipment position or stability caused by structural deformation or ground movement	Contusions, fractures, crush injuries; respiratory and eye disorders
5	Kernel grinding	Moving machinery; noise; vibration; electric shock	Misalignment of rotating equipment caused by deformation or settlement of supporting structures	Contusions, fractures, crush injuries; nervous system, vision and hearing disorders
6	Extraction with organic solvents	Hexane and petrol vapours; electric shock; high temperature; moving machinery; noise; vibration	Damage or displacement of pipelines, tanks or equipment resulting from structural deformation or seismic effects	Chemical exposure; burns; respiratory and cardiovascular effects; fractures
7-8	Distillation operations	Solvent vapours; high temperatures; noise; vibration; electric shock	Potential displacement or deformation of technological units and pipelines under seismic or structural influences	Chemical exposure; burns; injuries; disruption of technological processes
9	Cleaning and refining	Solvent vapours; high temperatures; moving equipment; overpressure; slippery surfaces	Ground or structural deformation potentially affecting pipelines, equipment connections and supporting elements	Chemical exposure; burns; injuries; leakage and technological disturbance
10	Oil drying	High surface temperature; noise; vibration; electric shock; slippery floor	Equipment instability or misalignment caused by deformation of foundations or supporting structures	Burns; contusions; hearing disorders; falls
11	Oil cooling and storage	Noise; vibration; electric shock; slippery surfaces	Potential seismic displacement or structural deformation of storage and supporting systems	Bruises, fractures; equipment damage; loss of containment

The geological and technical factors presented in the additional column are considered potential initiating or aggravating scenarios for risk assessment rather than documented accident events at the investigated enterprise. Their purpose is to establish a methodological connection between external/site conditions and the occupational hazards already identified in the technological processes.

The listed sources generate the following significant harmful and hazardous production factors: risk of occupational injuries when servicing the second tier of augers and elevators from a suspended platform mounted on a monorail at a height of 3 metres (height of steps 30 cm, angle of elevation of the metal ladder 60°), as well as the risk of falls on the floor slippery from spilled oil. Flow of cold air in winter and overheated air in summer into the shops due to the lack of airlocks (according to the project) at the entrances to the shops of the enterprise. High air temperature in the working zone at 27% of workplaces due to insufficient thermal insulation of equipment (fryers, washing machine, extractor, distiller, steam pipes), contributes to increased perspiration, which in mustard oil production

causes numerous complaints of various skin manifestations, especially in places of increased perspiration. Very high concentrations of dust as a result of leaky equipment, lack of mechanisation of cleaning processes for powder spilled on the floor. High concentrations of petrol vapours due to leaking equipment and sweating. Work in forced uncomfortable posture, physical dynamic stresses during cleaning and washing of equipment (roasters, presses, sieves), in conditions of high concentrations of grain dust and heating microclimate. Uncomfortable form of labour at the filling stage - as a consequence of imperfect design of automatic machines and conveyors. Ergonomic inadequate working positions, prolonged standing posture becomes a fact of overloading the musculoskeletal apparatus, limbs and blood stagnation in the pelvic organs.

From the perspective of the integrated approach, the above direct hazards may also be influenced by changes in the technical condition or stability of the production system. For example, an increase in equipment vibration may be aggravated by foundation deformation or misalignment; damage or displacement of pipelines may increase the probability of chemical exposure; and structural deformation may increase the probability of falling objects or loss of equipment stability.

Identification of the main sources of harmful production conditions of the enterprise employees, forms risks, by types of hazards existing for them:

Type of hazard: Chemical. Exposure: Plant dust, vapours and gases. Inhalation, skin penetration, contact with liquid or semi-liquid substances (petrol, benzene), powders (bleach). Types of risks: diseases - silicosis, bronchitis, skin allergies, neurological disorders among workers in contact with organic solvents - benzyl, benzene.

Type of hazard: Physical (environmental exposure). Effects on the body: Noises, increased and decreased ambient temperature, radiation, vibration, barometric pressure. Risk types: Hearing loss or hearing loss, vibration sickness, hypothermia, frostbite, heat stroke, ionising radiation, visual impairment or eye injury, decompression sickness, inert gas poisoning, aseptic bone necrosis, sprained tendons, carpal tunnel syndrome, lower back pain, falls.

Type of hazard: Biological. Exposure: Infectious microorganisms, toxic substances of biological origin and animal bites. Risk types: Histoplasmosis, infectious lung diseases, influenza, tuberculosis, malaria, yellow fever, sand sickness, skin rashes, allergies, diseases associated with animal bites, insect bites (Baghaei Naeini and Badri, 2024).

Type of hazard: Social (psychophysiological). Impact on the organism: Heavy production load, stresses of different nature, remoteness from family, conflicts with superiors, with workers of their shift. Types of risks: Nervous diseases, stressful breakdowns (Beiseyev et al., 2021).

For integrated assessment, geological and technical factors were additionally assigned the role of initiating or aggravating conditions. Their influence is evaluated through the resulting change in the probability and/or severity of the occupational hazard rather than through a separate risk scale.

Production risks at the industrial enterprise were assessed using the method described in ST RK 12.0.002-2016 «System of labour safety standards. Occupational Safety Management System in Organisations. Guidelines for risk assessment and management», according to which the quantitative risk criterion is calculated using the following formula:

$$R = \sum_{i=0}^N P_i U_i, \quad (1)$$

where, R - quantitative criterion of risk

U_i - quantitative criterion of severity of consequences of risk occurrence

N - number of discrete values of possible damages to health and life of an employee (of the same type, of the same dimension) or groups uniting them

P_i - quantitative criterion of probability of occurrence of risks of possible damages to health and life of an employee.

The quantitative criterion of the probability of occurrence of risk P_i , caused by the presence of harmful and hazardous production factors of food enterprises, is ranked in several categories, from 'minimal' to 'critical' with a description of the severity of consequences.

When a geological or technical factor is identified as capable of initiating or aggravating a hazardous event, its potential influence is considered when assigning the probability category. If the factor may increase the scale of consequences, its influence is additionally reflected in the severity category.

The cumulative assessment of the probability of risk occurrence is ranked according to the risk category and the degree of its consequences:

1. Minimal, at $0 < P < 1$, the probability of risk occurrence is negligible. It is virtually impossible to assume that such a factor could occur

2. Low, at $1 \leq P < 2$, the probability of occurrence remains low. This type of condition occurs on occasion, but the chances for it to occur are low

3. Moderate, with $2 \leq P < 3$ the probability of occurrence is at a medium level. Conditions for this may actually and unexpectedly occur

4. High, with $3 \leq P < 4$ the probability of occurrence is high. The conditions for this occur fairly regularly and/or within a certain time interval

5. Significant, with $4 \leq P < 5$ the probability of occurrence is very high. The conditions inevitably occur over a sufficiently long interval of time

6. Unacceptable, with $5 \leq P < 6$ the probability of occurrence is unacceptably high. The conditions are bound to occur over a sufficiently long period of time

7. Critical, at $6 \leq P \leq 7$, the probability of occurrence is critical

The quantitative criterion of the severity of the consequences of the risk U_i is derived by the impact of harmful and hazardous production factors on the employee, damage (harm) caused to the material and production environment and is ranked by categories from 'acceptable' to «catastrophic»:

Severity of the impact of the risk:

1. Acceptable, at $0 < U < 1$ there is little or no risk of health hazard for the worker, no impact on equipment or work flow for the work environment

2. Minor, at $1 \leq U < 2$ there is a risk of minor injury to the worker, micro-injuries that heal quickly, for the work environment there is a risk of minor impact on equipment or work flow

3. Medium, at $2 \leq U < 3$ there is a risk of medium severity injuries, not life-threatening, with temporary incapacity for work, for the work environment there is a risk of materially costly repair of the damage

4. Significant, with $3 \leq U < 4$ there is a risk of significant damage requiring longer term treatment, for the production environment risks of significant material investment for remedial action

5. Severe, at $4 \leq U < 5$ there is a risk of accident with severe consequences resulting in permanent disability, for the production environment the risks of significant impact on equipment with significant material inputs

6. Very severe, at $5 \leq U < 6$ there is a risk of group accidents with severe consequences and/or fatal accidents, for the production environment there is a risk of very significant impact on equipment and work stoppages

7. Catastrophic, at $6 \leq U \leq 7$ there are risks of several fatal accidents, for the production environment - significant damage to the production environment, work stoppage.

In the proposed approach, the severity assessment should also account for secondary consequences that may arise when a geological or technical initiating factor causes a technological disturbance. For example, structural deformation or seismic effects may result in equipment displacement, pipeline damage, leakage, falling objects or interruption of technological processes, which may subsequently increase the severity of worker exposure.

An important aspect in building a health and safety management system according to ISO 45001 is the requirement to develop a system of monitoring, measurement, analysis and evaluation of performance indicators in the field of occupational health and safety, which primarily include the control and management of hazardous and harmful production factors through their quantitative assessment, allowing to analyse the risks of accidents, incidents and occupational diseases. The main means of control include various technical means, in particular measuring instruments (MI) in the field of labour protection.

Within the integrated approach, monitoring should also cover changes in the technical condition of buildings, foundations, supporting structures, technological equipment and engineering systems where such changes may affect occupational risk. This allows geological and technical factors to be incorporated into the continuous improvement cycle of the occupational health and safety management system.

In order to obtain reliable information when measuring parameters of harmful and (or) hazardous production factors, the used measuring instruments shall be verified in accredited laboratories with the periodicity specified in the documentation

for this instrument. During the verification of measuring instruments, metrological characteristics necessary for the use of measuring instruments in accordance with a specific measurement technique and to ensure that the results are obtained with an error not exceeding the established standards of accuracy of measurement of parameters of harmful and (or) hazardous production factors shall be confirmed (determined). When confirming compliance of a health and safety management system to ISO 45001, the absence of an SI List, either an SI certificate or an SI verification certificate, will be recognised as non-compliance with ISO 45001. In this regard, a methodology was developed for the formation of the 'Map of potential risks and preventive actions to reduce the risk of nonconformities to meet the requirements of the section «Monitoring, Measurement, Analysis and Evaluation2, the Map is formed in the form of a table, which includes:

- stages of the process of MI verification;
- factors and stakeholders;
- risk description;
- preventive actions.

For the purposes of geological and technical risk monitoring, the Risk Map can additionally include:

- geological or site-related initiating factor;
- affected structural or technological element;
- possible technological disturbance;
- potential secondary occupational hazard;
- probability/severity change;
- preventive or corrective action.

Results. The results on classification of quantitative risks hazardous and harmful production factors at the enterprise on manufacture of edible vegetable oils have allowed to develop a matrix 7x7, convenient enough for calculations and full reflection of situations connected with an estimation of risks of technological process, caused by hazardous and harmful production factors of working environment, which is presented in Table 2.

Table 2. Matrix for calculating quantitative risk criteria.

Quantitative criterion of the severity of the consequences of exposure to HHPF, U_i	Quantitative risk criterion						
	Quantitative criterion for the probability of risk occurrence due to the presence of HHPF, P						
	P = 1	P = 2	P = 3	P = 4	P = 5	P = 6	P = 7
U=7	7	14	21	28	35	42	49
U=6	6	12	18	24	30	36	42
U=5	5	10	15	20	25	30	35
U=4	4	8	12	16	20	24	28
U=3	3	6	9	12	15	18	21
U=2	2	4	6	8	10	12	14
U=1	1	2	3	4	5	6	7

The results of the data in Table 2, obtained by matrix evaluation of quantitative risk criteria, are also ranked into categories according to their significance, as follows:

- I (insignificant) when $R < 7$,
- A (acceptable) when $7 \leq R < 14$,
- L (low) when $14 \leq R < 21$,
- M (medium) when $21 \leq R < 28$,
- S (significant) when $28 \leq R < 35$,
- H (high) when $35 \leq R < 42$,
- VH (very high), when $42 \leq R < 49$,

Determination and ranking of quantitative risk criteria depending on the type of hazardous and harmful production factors is carried out by expert assessment method.

For geological and technical scenarios, expert assessment should consider both the likelihood of the initiating condition and the ability of the affected infrastructure or equipment to maintain safe operation. This provides a basis for reassessing the occupational risk when changes in the site, structures, foundations or equipment are detected.

The results of the analysis of requirements to measuring instruments in the field of labour protection allowed to develop a Risk Map of the process «Verification and repair of measuring instruments in the field of labour protection» to meet the requirements of the section «Monitoring, measurement, analysis and evaluation» of ISO 45001, which allows to more fully take into account internal and external risk factors in the activities of metrological services, determines ways to ensure sustainability, ability to withstand adverse situations. The result of identification is a list of risks and opportunities at the stages of MI verification. Monitoring of risks and preventive actions should be carried out annually in order to identify all changes that have occurred. This will allow to identify new risks, use previously unavailable opportunities, develop new activities, optimise existing activities, etc.

In the context of the proposed approach, monitoring should not be limited to conventional occupational safety indicators. Where relevant to the facility, changes in the condition of foundations, supporting structures, technological equipment, pipelines and storage systems should also be considered as early indicators of a potential increase in occupational risk.

Detected and identified hazardous and harmful production factors at the enterprise for the production of edible vegetable oils with their quantitative assessment allowed to build an algorithm for risk management of the health and safety management system, presented in Figure 1.



Figure 1. Risk management algorithm of the OHS MS at the enterprise.

Discussion. Hazard identification and risk assessment should be applied to all processes of the enterprise's activities, as it reveals issues of hazard identification and risk assessment at the level of human impact. No activity can be carried out without a preliminary risk analysis. The main goal of this procedure is to prevent incidents of any severity, preserve the health of the company's employees and all involved persons, build a reasoned evidence base for the allocation of financial and other resources to maintain and improve the health and safety system. For ease of use of data, separate Risk Registers are created, linked either to the types of activities carried out or/and to specific work areas and other activities. Risk Registers have continuous numbering as they are created (Strzałkowski et al., 2025).

The results of the present study indicate that the Risk Register should also contain information on potential geological and technical initiating or aggravating factors where these factors can influence the safety of a particular work process. Such an approach makes it possible to distinguish between the immediate

occupational hazard and the conditions that may contribute to its occurrence or escalation.

Hazard identification and risk analysis should always be a team effort. When a work safety analysis (WSA) is carried out by a team of specialists from different specialties, the risk of missing individual stages with potential hazards is reduced.

For integrated assessment, the WSA team should, where necessary, include not only occupational safety and technological specialists but also personnel competent in the technical condition of buildings, foundations, equipment and engineering systems. Such interdisciplinary participation is particularly important when external or structural conditions may influence the stability of technological processes.

For effective work, the group implementing the WSA must necessarily include responsible persons and work producers, a person responsible for the labor protection department, an employee who is well versed in the technology and methodology of performing work, and the associated hazards. If necessary, experts and / or rare profile specialists.

The value of the base risk is calculated individually for each identified hazard by multiplying the two values of the Probability (P) of an incident by the severity of harm to human health (SH). The calculation of the base risk is carried out with the assumption that no risk management measures exist.

When a geological or technical factor is identified, the base-risk assessment should consider the possibility that this factor may initiate or aggravate the identified hazardous event. Thus, the geological or technical factor becomes part of the causal analysis rather than an isolated additional hazard category.

Depending on the zone to which a certain risk value falls, the need to implement measures that should ensure the reduction of the risk value to an acceptable level is determined. The acceptable risk is calculated with the existing and implemented management measures. The red zone indicates the impossibility of carrying out work and the search for opportunities to reduce the risk. Acceptable risk - an assessment of the acceptable risk after the application of control measures is also carried out using the indicators of consequences and probability. The product of these two indicators is a measure of the acceptable risk, which is the final result of the risk analysis stage. A reduction in the risk value is achieved either by reducing the probability, or the severity of the consequences, or their combined reduction (Burtan et al., 2025; Beś et al., 2025).

In geological and technical scenarios, risk reduction may therefore be achieved through measures directed at the initiating condition itself, through measures protecting the technological system, or through measures protecting workers from the resulting hazard. For example, technical inspection and maintenance of foundations and equipment may reduce the probability of technological failure, while strengthening structural elements, securing equipment or improving emergency protection may reduce the potential severity of consequences.

The information provided in the Tolerable Risk column is used to check whether

the risk is sufficiently controlled. The overall risk assessment, the final step in the risk assessment process, requires determining whether the identified hazards are sufficiently controlled. Since the risk analysis step took into account existing and implemented hazard control measures, the results of the analysis indicate the residual risk level. The results of this analysis are used in the system to determine whether the residual risk for each hazard is:

Low - green zone.

Sufficiently controlled - yellow zone.

Unacceptable - red zone.

For the integrated model, residual risk should be reassessed whenever a significant change occurs in the geological or technical conditions of the production site or in the technical condition of structures, foundations, equipment or engineering systems. This is consistent with the risk-oriented principle of continuous improvement and prevents the Risk Register from becoming a static document.

This tool is the most evidentiary in the system, as a confirmation of the implementation of the Top Management Policy on the constant search for opportunities to manage hazards and reduce risks. The management of the enterprise, the occupational safety engineer, the heads of structural divisions, the representatives of employees are obliged to constantly search for new opportunities to reduce risks, offering best practices and innovations.

Accordingly, the proposed approach expands the conventional occupational risk assessment model by introducing a causal connection between geological and technical conditions and the occupational hazards already identified in production processes. The principal methodological contribution is not the creation of a separate geological risk scale, but the integration of geological and technical initiating factors into the existing probability–severity framework.

This approach is particularly important for industrial facilities where the stability of buildings, foundations, equipment, pipelines and storage systems can affect the safety of workers. It also provides a basis for transferring the methodology to other industrial sectors, including construction, mining and infrastructure, while retaining the same general risk-management logic.

Conclusions. Existing qualitative and especially quantitative methods for assessing the risks of industrial hazards that can lead to accidents in the workplace and/or increase the risks of occupational diseases should be selected and applied by occupational health and safety specialists based on the concept and tools of risk management when developing and implementing an occupational health and safety management system to meet the requirements of sections of the international standard ISO 45001 on identification, risk assessment of adverse situations in the workplace and to establish (identify) risks and opportunities that must be responded to by developing preventive actions.

The study demonstrates that the identification and assessment of occupational hazards can be strengthened by incorporating geological and technical factors as

potential initiating or aggravating conditions within the existing ISO 45001-based risk-management framework.

The proposed approach establishes a causal sequence linking geological and technical conditions with changes in the technical or technological state of production systems, the occurrence or escalation of occupational hazards, worker exposure and potential consequences.

Unlike a separate assessment of geological hazards, the proposed methodology incorporates their influence into the probability and severity parameters of the resulting occupational risk. This makes it possible to preserve the existing quantitative risk matrix while extending its applicability to external and structural factors affecting industrial safety.

The analysis of vegetable-oil production processes demonstrates that conventional occupational hazards such as vibration, moving machinery, chemical exposure, high temperature, falling objects and equipment-related hazards can be considered together with potential geological and technical initiating conditions such as seismic effects, ground instability, differential settlement and structural or equipment deformation.

The proposed Risk Map and risk-management algorithm can therefore be used to identify changes in geological and technical conditions, assess their potential influence on technological processes and introduce preventive or corrective measures before such conditions result in occupational incidents.

The methodological approach is not limited to the investigated food-production processes and may be adapted to other industrial facilities where the condition of foundations, buildings, technological equipment and engineering infrastructure can affect occupational safety.

Further application of the approach should involve site-specific geological, geotechnical, structural and technical data to quantify the influence of individual initiating factors and to validate the proposed assessment procedure under actual operating conditions.

References

Alsheriyeu E.T., Dossaliyev K.S., Naukenova A.S., & Ismailov B.A. (2025). Radiation, chemical situations and communal damage caused during possible earthquake in Turkestan region. *News of the National Academy of Sciences of the Republic of Kazakhstan. Series of Geology and Technical Sciences.* – No. 5(473). – P. 22-30. <https://doi.org/10.32014/2025.2518-170X.548>. (in Eng.).

Anner M. & Caraway T. (2010) International institutions and workers rights: Between labor standards and market flexibility. *Studies in Comparative International Development.* – No. 45(2). – P. 151-169. <https://doi.org/10.1007/s12116-010-9064-x>. (in Eng.).

Baghaei Naeini S.A., & Badri A. (2024). Identification and categorization of hazards in the mining industry: A systematic review of the literature. *International Review of Applied Sciences and Engineering.* – No. 15(1). – P. 1-19. <https://doi.org/10.1556/1848.2023.00621>. (in Eng.).

Beiseev S.A., Naukenova A.S., Mesheryakova E.V., Tulekbaeva A.K., & Otunshieva A.E. (2018) Improvement of human resources management in the system of quality management. *Industrial Technology and Engineering, M. Auezov South Kazakhstan State University.* – No. 4(20). – P. 46-56. (in Eng.).

Beiseyev S.A., Naukenova A.S., Satayev M.I., Ivakhnyuk G.K. & Tulekbaeva A.K. (2021) Rekomendatsii po otsenke riskov na rabochikh mestakh predpriyatiy, proizvodnyashchikh rastitel'nye masla, na osnove kriteriev mezhdunarodnogo standarta ISO 45001 [Recommendations for risk assessment at workplaces of enterprises producing edible vegetable oils based on the criteria of the international standard ISO 45001]. Reports of the National Academy of Sciences of the Republic of Kazakhstan. – No. 5. – P. 82-94. Almaty. (in Rus.).

Beiseyev S.A., Naukenova A.S., Tulekbaeva A.K. & Kenzhekhanova M.B. (2019) Risk-orientirovannyi podkhod — osnovanie upravleniya okhranoi truda i bezopasnost'yu na predpriyatiyakh Kazakhstana v sootvetstvii s ISO 45001 [Risk-oriented approach: The basis for managing health and safety at Kazakhstani enterprises according to ISO 45001]. In Proceedings of the International Scientific and Practical Conference “Auezov Readings – 17”: New impulses of science and spirituality in the world space. – Vol. 7. – P. 242-244). Shymkent: SKSU named after M. Auezov. (in Rus.).

Bekyashev D.K. (2019) Mezhdunarodnaya organizatsiya truda: stoletie i perspektivy [International Labour Organization: The centenary and prospects]. Moscow Journal of International Law. – No. 3. – P. 68-80. <https://doi.org/10.24833/0869-0049-2019-3-68-80>. (in Rus.).

Bęś P., Strzałkowski P., Górniak-Zimroz J., Szóstak M., & Janiszewski M. (2025). Innovative technologies to improve occupational safety in mining and construction industries Part II. Sensors. – No. 25(18). – P. 5717. <https://doi.org/10.3390/s25185717>. (in Eng.).

Burtan Z., Nowak-Senderowska D. & Szczepański P. (2025). Methodology for identification of occupational hazards using their characteristic features in hard coal mining. Applied Sciences. – No. 15(13). – P. 7079. <https://doi.org/10.3390/app15137079>. (in Eng.).

Center for Humanitarian Technologies. (2006–2023) Reyting stran mira po Global'nomu indeksu konkurentosposobnosti. [Ranking of countries of the world according to the Global Competitiveness Index; Research]. <https://gtmarket.ru/ratings/global-competitiveness-index>. (in Rus.).

International Labour Organization. (2018) Improving the safety and health of young workers (Report). https://www.ilo.org/wcmsp5/groups/public/---europe/---ro-geneva/---ilo-ankara/documents/publication/wcms_627046.pdf. (in Eng.).

International Labour Organization. (n.d.). ILO world statistics on occupational accidents, including fatalities, and occupational diseases. https://www.ilo.org/Moscow/areas-of-work/occupational-safety-and-health/WCMS_249276/lang--ru/index.htm. (in Eng.).

International Labour Organization. (n.d.). Occupatsionnaya bezopasnost' i gigiena: Mirovaya statistika. [Occupational safety and health: World statistics]. https://www.ilo.org/moscow/areas-of-work/occupational-safety-and-health/WCMS_249276/lang--ru/index.htm. (in Rus.).

Jakovleski V., Jerbi S. & Biersteker T. (2019) *The ILO's role in global governance: Limits and potential*. The ILO at Work, – No. 11. – P. 82-108. <https://doi.org/10.4000/poldev.3026>. (in Eng.).

Jasmien Van Daele (2008) International Review of Social History. – Vol. 53. – No. 3. – P. 485-511. <https://doi.org/10.1017/S0020859008003568>. (in Eng.).

OHSAS 18001-2007 Occupational health and safety management systems Requirement. <https://certgroup.org/ohsas-180012007/> (in Eng.).

Piper N. & Foley L. (2021) Global partnerships in governing labour migration: The uneasy relationship between the ILO and IOM in the promotion of decent work for migrants. Global Public Policy and Governance. – No. 1. <https://doi.org/10.1007/s43508-021-00022-x>. (in Eng.).

Razakova, D. I., Nuryanova, S. K., Khalitova, M. M., Tamenova, S. S., Iskakov, U. M., & Konyrbekov, M. (2020). The role and significance of tax incentives in the business activity of entrepreneurs and increasing the country budget: Mediating role of supply chain management. International Journal of Supply Chain Management, 9(2), 815–821.

<https://doi.org/10.59160/ijscm.v9i2.4722>

Sansyzbayeva, G. N., Ashirbekova, L. Zh., Nurgaliyeva, K. O., Ametova, Z., & Asanova, A. (2020). Realities and prospects of using green technologies in Kazakhstan. E3S Web of Conferences, 159, 07002. <https://doi.org/10.1051/e3sconf/202015907002>

Strzałkowski P., Woźniak J., Górniak-Zimroz J., Delijewska B., & Bęś P. (2025). Identification

and systematics of safety hazards in surface rock mining. Scientific Reports. – No. 15. – P. 30492. <https://doi.org/10.1038/s41598-025-16437-z>. (in Eng.).

Takala J., Nenonen N., Hämäläinen P., Saarela K.L. et al. (2014) Global estimates of occupational accidents and work-related illnesses: A poster and infographics. In Proceedings of the XX ILO–ISSA World Congress on Safety and Health at Work. Frankfurt, Germany. – Vol. 20. <https://doi.org/10.13140/2.1.1071.7443>. (in Eng.).

World Health Organization. (2018) World health statistics 2018: Monitoring health for the SDGs, sustainable development goals. <https://www.who.int/docs/default-source/gho-documents/world-health-statistic-reports/6-june-18108-world-health-statistics-2018.pdf>. (in Eng.).

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