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ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
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ON THE STATE OF INDUSTRIAL INJURIES OF WORKERS IN INDUSTRIAL ENTERPRISES OF THE AKTUBINSK REGION

Abstract. In our country, in recent years, according to statistical data, there has been a slight decrease in the level of industrial injuries in the industry as a whole. However, in the metallurgical industries, there has been an increase in injuries, and sometimes with a fatal outcome. The aim of the work is to identify reserves for reducing injuries by determining the psychological stability necessary for working at hazardous production facilities, as well as creating a mathematical model for predicting injuries at work.

This article analyzes injuries according to the statistical method of studying injuries of production personnel at the Aktobe ferroalloy plant of JSC "TNK "Kazchrome" for the period from 2015 to 2019. Data on the dynamics of indicators of industrial injuries are given: the number of accidents, the number of victims, the injury frequency coefficient, etc. It is established that the main causes of industrial injuries are the insufficient level of organization of training in safe methods and techniques of work and the rules of organization of transportation, loading and unloading of goods, as well as violations of the rules of operation of vehicles and equipment, devices and mechanisms.

The main types of incidents and the causes of their occurrence are identified. The study of the dynamics of accidents over the years shows that the number of accidents in the enterprise as a whole is very uneven. The necessity of improving the system of organization of occupational safety and health when performing technological operations, maintenance and repair of equipment, devices and mechanisms is shown. Recommendations are presented on the main areas of work in order to reduce injuries and improve the occupational safety management system (OSH) at metallurgical enterprises as an integral mechanism.

Key words: Ferroalloys, research, frequency coefficient, injuries, accident.

Introduction. It is well known that the issues of the state of industrial injuries at industrial enterprises are of paramount importance when assessing the efficiency of production activities of enterprises, the degree of technical equipment and the organization of their production. The risks of the probability of industrial injuries of varying severity increase significantly at enterprises with low personnel culture and backward production technology. At industrial enterprises, the concept of an index of fatal accidents per thousand employees has been introduced. According to this indicator, enterprises of the Republic of Kazakhstan are significantly behind similar indicators of enterprises of a number of developed countries of the world. For example, such an index in such countries as Denmark, Sweden and Norway is 3.3 times lower than at the enterprises of the Republic of Kazakhstan [1], which indicates that there are large reserves in improving the state of labor protection at the enterprises of the Republic of Kazakhstan, including at the Aktobe Ferroalloy plant of JSC TNK Kazchrome. [2,3].

Relevance. In our country, in recent years, according to statistical data, there has been a slight decrease in the level of industrial injuries in the industry as a whole. However, in the metallurgical industries, there has been an increase in injuries, and sometimes with a fatal outcome. In this regard, the task of developing methods of preventive protection of employees from accidents and a reliable forecast of the probability of injuries at enterprises is relevant.

The analysis of statistical data from many countries allows us to conclude that the more perfect the technical side of the production process, the more the percentage of accidents associated with psychophysiological

characteristics of a person, personal factors, type of behavior, etc.increases /4-5/. Practice shows that the main causes of injuries and accidents are most often associated with engineering omissions, shortcomings in the organization of work on the operation of equipment, an incorrect assessment of the state of affairs at work, that is, the reason lies in the person himself, the so-called "human factor".

Both his own safety and the safety of the enterprise as a whole depend on the psychological stability of the employee. Only when using an integrated approach to predicting injuries, taking into account the psychological stability of production personnel, it is possible to significantly reduce injuries at the enterprise and improve labor safety, since psychological stability is the reserve that is currently not fully used in practice.

The purpose of the dissertation is to identify reserves for reducing injuries by determining the psychological stability necessary for working at hazardous production facilities, as well as creating a mathematical model for predicting injuries at work.

Materials and methods of research. The indicators of industrial injuries at the Aktobe Ferroalloy Plant (hereinafter referred to as AZF) for the last 5 years are shown in Table1.

To determine the level of injuries, a statistical method was used [28, 29], which consists in processing and studying statistical material based on the results of the investigation of accidents for the specified period. According to this method, a number of coefficients are determined, which are relative indicators of the level of injuries at the enterprise. This allows you to get a correct and complete picture of the level of injuries, moreover, only according to the data of the absolute number of accidents that occurred at the enterprise during the studied period of time. These include: coefficient of injury frequency Cf; coefficient of severity of injury Cs; hazard coefficient Ch or indicator of general injury rate; fatal injury rate Cf.

The analysis of the data given in the table shows that the number of employees at the AZF whose work is associated with harmful and dangerous working conditions, respectively, by year is: in 2015 - 3,189; in 2016 – 3,332; in 2017– 3,345; in 2018-3,578 and in 2019 - 3,58 thousand people. During the period from 2015 to 2019, 15 accidents occurred at the plant, including 2 fatal accidents, 4 severe cases, and 1 group case. A total of 15 people were injured.

The study of the dynamics of indicators of industrial injuries shows that for four years the number of accidents and their frequency decreased, but in 2019 these indicators increased sharply. At the same time, out of six accidents, one belongs to a group type, and out of 8 injured workers, 3 refers to serious cases.

It should also be noted the uneven dynamics of changes in statistical evaluation indicators, namely, the coefficient of the frequency of accidents per 1000 employees (Cf). For the period 2015-2019, this indicator varies in the redevelopments of 0.23-1.42. The coefficient of the frequency of fatal accidents per 1000 employees (CFS) in 2016 is equal to 1.002.

Table 1-Quantitative indicators of industrial injuries at the gas station

№ п/п	Indicators	The value of the indicator by year				
		2015	2016	2017	2018	2019
1	The number of employees in organizations, thousand people.	3872	3991	4236	4278	4219
2	The number of employees employed in harmful and dangerous conditions, thousand people.	3189	3332	3345	3578	3580
3	Number of accidents	3	3	2	1	6
4	Number of victims	3	1	2	1	8
5	Number of dead	-	2	-	-	-
6	The number of victims with a severe outcome	-	-	1	-	3
7	Number of victims in group accidents	-	-	-	-	3
8	Number of accidents investigated	3	3	2	1	6
9	Accident rate per 1000 employees (Kh)	0,77	1,25	0,47	0,23	1,42
10	The coefficient of the frequency of fatal accidents per 1000 employees (Kch)	-	1,002	-	-	-

Thus, according to the first indicator (Cf), the level of decline has been achieved since 2016 and the next two years by 2.5 times. At the same time, in 2019, the number of accidents and victims in a group accident increased and the indicator (Cf) increased to 1.42. The latter indicates the need to increase the requirements for the quality of the organization and safety of the production process in individual structural divisions of enterprises [6, 7].

The causes of industrial injuries with varying degrees of severity are numerous and include such types of accidents as technical, organizational and technical, technological operations, falls during work, maintenance and repair, and other types of accidents. Let's consider the dynamics and quantitative ratio of these factors in the total share of industrial injuries of employees at enterprises (Table 2).

Table 2-Dynamics of the number of victims by type of accidents

Typesofincidents	Valuesbyyear				
	2015	2016	2017	2018	2019
Technical	-	-	-	-	1
Organizational and technical	-	-	-	-	1
Technologicaloperations	-	2/2	-	-	4
Falling during the production of works	2	-	-	-	-
Liftingoperations	-	-	-	-	-
Maintenance and repair	-	-	-	-	2
Roadtrafficaccidents	-	-	-	-	-
Othertypesofaccidents	1	1	2	1	-
Total	3	3/2	2	1	8

The study of the dynamics of accidents over the years shows that the number of accidents in the enterprise as a whole varies and is very uneven. The analysis of the given data shows the need to improve the system of organization of safety and labor protection during maintenance and repair of technological operations, equipment, organizational and technical causes of accidents. There is a certain positive trend towards a decrease in the number of victims for some types of accidents. A significant decrease is noticeable in such indicators as a drop in the production of work and other types of accidents.

It is obvious that the development of comprehensive measures to reduce the number of victims of technological operations, maintenance and repair is one of the most important problems that need to be resolved.

It is also advisable to improve the complex of organizational and technical measures aimed at ensuring safe working conditions in case of possible falls from a height in the workplace.

The analysis of the above data indicates the need to develop a set of measures to prevent accidents occurring at enterprises, depending on the type of accidents. The latter leads to the need for more detailed, local studies of their causes and the development of specific measures for the safe organization of the work of production personnel.

In the conditions of production, the development of a set of effective measures to ensure safe working conditions for employees in enterprises is primarily associated with the establishment of the causes that led to the occurrence of accidents.

Table 3 shows the indicators of occupational injuries, depending on the causes of accidents.

Table 3-The number of victims, depending on the causes of accidents

№ п/п	Nameofthereasons	Number of injured people, by year				
		2015	2016	2017	2018	2019
1	Increased dustiness and gas contamination of the working area air	-	-	-	-	-
2	Increasednoiselevel	-	-	-	-	-
3	Increasedvibrationlevel	-	-	-	-	-
4	Increased level of ionizing radiation	-	-	-	-	-
5	Contact with sources of infectious diseases (specify the name of the diseases)	-	-	-	-	-
6	The impact of physical overload on the human body	-	-	-	-	-
7	Design disadvantages of machines, mechanisms and equipment	-	-	-	-	-

8	Operation of faulty machines, mechanisms and equipment	-	-	-	-	-
9	Violationoftechnologicalprocesses	-	-	-	-	-
10	Violation of safety requirements when operating vehicles	-	-	1	-	-
11	Violation of the rules of road traffic	-	-	-	-	-
12	Violation of the rules of railway traffic	-	-	-	-	-
13	Violation of the rules of air transport traffic	-	-	-	-	-
14	Violation of the rules of water transport traffic	-	-	-	-	-
15	Accidents	-	2	-	-	-
16	Unsatisfactory organization of work production	-	-	1	-	4
17	Unsatisfactory technical condition of buildings, structures, maintenance of territories and shortcomings in the organization of workplaces.	-	-	-	-	-
18	Disadvantages in teaching safe working methods.	-	-	-	-	-

The data given in table 3 indicates compliance with the regulatory requirements of the harmful impact of production factors on the environment, the health of production workers, compliance with the requirements of the technological regulations for the production process, the basic requirements of the instructions on labor protection and life safety.

A detailed study of the number of victims at work shows that the most significant causes of accidents at enterprises are violation of safety requirements when operating vehicles, unsatisfactory organization of work, gross negligence of the victim [7].

Table 4

Distribution of accidents by occupation.

Profession	2015	2016	2017	2018	2019	2020	Totalamount
Ferroalloysmelter			1		2	1	4
Locksmithrepairman		1			5		6
Ferroalloybreaker	1					2	3
Gaselectricwelder					1	2	3
Linemandriver							-
I.O. of the shift supervisor							-
Locomotivedriverassistant							-
Electrician							-
Bunker			1				1
Seniorrepairman				1			1
Installer				1			1
Driver						1	1
Ferroalloydispenser						1	1

Based on Table 4, the distribution of accidents by occupation for 2015-2020, it can be seen that workers in hazardous occupations such as smelters-ferroalloys (19%), locksmiths, repairmen (28.5%), breakers of ferroalloys (14.2 %), gas electric welders (14.2%), in other professions have isolated cases.

Results and discussion. The statistical analysis of injuries led to the following conclusions:

- in general, the Aktobe Ferroalloy plant in recent years has seen a positive trend towards a decrease in the total number of accidents;

- the most significant types of accidents that cause high danger and risks of injury are unsatisfactory organization of work and gross negligence of performers when performing production operations.

The main **causes** of occupational injuries are:

- insufficient level of organization of training in safe methods and techniques of work, as well as the rules of organization of transportation, loading and unloading of goods;

- violations of the rules of operation of vehicles and equipment, maintenance of technically defective devices and mechanisms.

To eliminate these shortcomings and reduce occupational injuries at the AZF, it is recommended to

introduce a set of organizational, technical and psychophysiological measures aimed at improving the occupational safety management system (OSH) as an integral mechanism.

Conclusions. The analysis made it possible to conclude that the main ways to reduce industrial injuries at the gas station are:

- introduction of new progressive and safe production technologies;
- introduction of new methods of personnel management, taking into account the so-called "human factor";

further improvement of the system of measures for the prevention and prevention of industrial injuries.

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АҚТӨБЕ ОБЛЫСЫНЫҢ МЕТАЛЛУРГИЯЛЫҚ КЛАСТЕР КӘСІПОРНЫНДА ЖҰМЫСШЫЛАРДЫҢ ӨНДІРІСТІК ЖАРАҚАТТАНУ ЖАҒДАЙЫ ТУРАЛЫ

Аннотация. Біздің елімізде соңғы жылдары, статистикаға сәйкес, жалпы өнеркәсіп бойынша өндірістік жарақаттану деңгейінің біршама төмендеуі байқалады. Алайда, өнеркәсіптің металлургия салаларында жарақаттанудың өсуі, ал кейде өліммен аяқталуы байқалып отыр. Жұмыстың мақсаты қауіпті өндірістік объектілерде жұмыс істеу үшін қажетті психологиялық орнықтылықты айқындау есебінен жарақаттануды төмендету резервтерін анықтау, сондай-ақ өндірісте жарақаттануды болжамдаудың математикалық моделін құру болып табылады.

Осы мақалада "Қазхром "ТҰК" АҚ Ақтөбе ферроқорытпа зауыты бойынша өндірістік персоналдың жарақаттануын зерттеудің статистикалық әдісі бойынша 2015 - 2019 жылдар аралығындағы кезеңде жарақатқа талдау жүргізілді. Өндірістік жарақаттанудың негізгі себептері Еңбектің қауіпсіз әдістері мен тәсілдеріне және жүктерді тасымалдауды, тиеуді және түсіруді ұйымдастыру қағидаларына оқытуды ұйымдастырудың жеткіліксіз деңгейі, сондай-ақ көлік құралдары мен жабдықтарды, құрылғылар мен механизмдерді пайдалану қағидаларын бұзу болып табылатыны анықталды.

Оқиғалардың негізгі түрлері және олардың пайда болу себептері анықталды. Жылдар бойынша жазатайым оқиғалардың динамикасын зерттеу кәсіпорын бойынша оқиғалардың саны тұтастай алғанда біркелкі емес екенін көрсетеді. Технологиялық операцияларды орындау, жабдықтарға, құрылғылар мен механизмдерге техникалық қызмет көрсету және жөндеу кезінде қауіпсіздік техникасы мен еңбекті қорғауды ұйымдастыру жүйесін жақсарту қажеттілігі көрсетілген. Тұтас тетік ретінде металлургия кәсіпорындарында жарақаттануды азайту және еңбекті қорғауды басқару жүйесін (ЕҚБЖ) жетілдіру мақсатында жұмыстың негізгі бағыттары бойынша ұсынымдар ұсынылған.

Түйінді сөздер: ферро қорытпалар, зерттеулер, жиілік коэффициенті, жарақат, жазатайым оқиға.

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О СОСТОЯНИИ ПРОИЗВОДСТВЕННОГО ТРАВМАТИЗМА РАБОТАЮЩИХ В ПРЕДПРИЯТИИ МЕТАЛЛУРГИЧЕСКОГО КЛАСТЕРА АКТЮБИНСКОЙ ОБЛАСТИ

Аннотация. В нашей стране за последние годы, согласно статистическим данным, в целом по промышленности происходит некоторое снижение уровня производственного травматизма. Однако, в металлургических отраслях промышленности отмечен рост травматизма, а иногда со смертельным исходом. Целью работы является выявление резервов снижения травматизма за счет определения психологической устойчивости, необходимой для работы на опасных производственных объектах, а также создание математической модели прогнозирования травматизма на производстве.

В настоящей статье проведен анализ травматизма по статистическому методу исследования

травматизма производственного персонала по Актюбинскому заводу ферросплавов АО «ТНК «Казхром» за период с 2015 по 2019 г.г. Приведены данные по динамике показателей производственного травматизма: количество несчастных случаев, количество пострадавших, коэффициент частоты травматизма и др. Установлено, что основными причинами производственного травматизма являются недостаточный уровень организации обучения безопасным методам и приёмам труда и правилам организации транспортировки, погрузки и разгрузки грузов, а также нарушения правил эксплуатации транспортных средств и оборудования, устройств и механизмов.

Выявлены основные виды происшествий и причины их возникновений. Изучение динамики несчастных случаев по годам показывает, что количество происшествий по предприятию в целом отличается большой неравномерностью. Показана необходимость улучшения системы организации техники безопасности и охраны труда при выполнении технологических операций, технического обслуживания и ремонта оборудования, устройств и механизмов. Представлены рекомендации по основным направлениям работы с целью уменьшения травматизма и совершенствование системы управления охраной труда (СУОТ) на металлургических предприятиях, как целостного механизма.

Ключевые слова: ферросплавы, исследования, коэффициент частоты, травматизм, несчастный случай.

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МАЗМҰНЫ-СОДЕРЖАНИЕ-CONTENTS

Abuova R.Zh., Ten E.B., Burshukova G.A.
STUDY OF VIBRATION PROPERTIES OF CERAMIC-METAL NANOSTRUCTURAL TIN-CU COATINGS WITH DIFFERENT COPPER CONTENT 7 AND 14 AT. % ON CHROMIUM-NICKEL-VANADIUM STEELS.....6

Abetov A., Kudaibergenova S.
INTEGRATED RESEARCH OF SUFFOSION AND KARST PROCESSES AT THE KOGCF BY GEOLOGICAL AND GEOPHYSICAL AND GEODESIC METHODS.....14

Amangeldykyzy A., Kopobayeva A.N., Bakyt A., Ozhigin D.S., Blyalova G.G.
MINERALOGY AND GEOCHEMISTRY OF THE SHUBARKOL DEPOSIT JURASSIC COALS.....23

Dikanbayeva A.K., Auyeshov A.P., Satayev M.S., Arynov K.T., Yeskibayeva Ch.Z.
RESEARCHING OF SULFURIC ACID LEACHING OF MAGNESIUM FROM SERPENTINES.....32

Duisen G.M., Aitzhanova D.A.
NATURAL RESOURCE POTENTIAL OF KAZAKHSTAN AND CENTRAL ASIAN COUNTRIES: PROSPECTS OF USE.....39

Edygenov E.K., Vassin K.A.
ELECTROMAGNETIC VEHICLE WITH AUTOMATED CONTROL SYSTEM FOR SURFACE MINING OPERATIONS.....47

Ismailov B.A., Dossaliev K.S.
TECHNOLOGICAL REGULATIONS OF CONDITIONS IN PRODUCTION OF FERTILIZER MIXTURES “ZHAMB-70”.....54

Issagaliyeva A.K., Istekova S.A., Aliakbar M.M.
GEOPHYSICAL DATA COMPLEX INTERPRETATION TECHNIQUES FOR STUDIES OF THE EARTH CRUST DEEP HORIZONS IN THE NORTH CASPIAN REGION.....61

Mekhtiyev A.D., Soldatov A.I., Neshina Y.G., Alkina A.D., Madi P.Sh.
THE WORKING ROOF ROCK MASSIF DISPLACEMENT CONTROL SYSTEM.....68

Mustafayev Zh.S., Kozykeeva A.T., Tursynbayev N.A., Kireychev L.V.
APPLIED MODEL OF ENVIRONMENTAL SERVICES - DEVELOPMENT OF ECOLOGICAL AND ECONOMIC DRAINAGE SYSTEM OF TRANSBOUNDARY RIVER BASINS (on the example of the Talas river basin).....77

Petr Hajek, Baimaganbetov R.S.
GEOSTABILIZATION OF ECOLOGICAL EQUILIBRIUM AS A RESULT OF FOREST FIRES.....84

Salikhov N.M., Pak G.D., Shepetov A.L., Zhukov V.V., Seifullina B.B.
HARDWARE-SOFTWARE COMPLEX FOR THE TELLURIC CURRENT INVESTIGATION IN A SEISMICALLY HAZARDOUS REGION OF ZAILIYSKY ALATAU.....94

Saukhimov A.A., Ceylan O., Baimakhanov O.D., Shokolakova Sh.K.
REDUCING POWER AND VOLTAGE LOSSES IN ELECTRIC NETWORKS OF OIL FIELDS USING THE MOTH FLAME OPTIMIZATION ALGORITHM.....103

Soltanbekova K.A., Assilbekov B.K., Zolotukhin A.B., Akasheva Zh.K., Bolysbek D.A.
RESULTS OF LABORATORY STUDIES OF ACID TREATMENT OF LOW-PERMEABILITY ROCK CORES.....113

Surimbayev B., Bolotova L., Shalgymbayev S., Razhan E.
RESEARCH OF THE COMPLEX STAGE-BY-STAGE SCHEME OF GRAVITY SEPARATION OF GOLD ORE.....124

Temirbekov N.M., Los V.L., Baigereyev D.R., Temirbekova L.N.
MODULE OF THE GEOINFORMATION SYSTEM FOR ANALYSIS OF GEOCHEMICAL FIELDS BASED ON MATHEMATICAL MODELING AND DIGITAL PREDICTION METHODS.....137

Tileuberdi N., Zholtayev G.ZH., Abdeli D. Zh., Ozdoev S.M.
INVESTIGATION OF DRAINAGE MECHANISM OF OIL FROM PORES OF OIL SATURATED ROCKS USING NITROGEN AT THE LABORATORY CONDITION.....146

Tleulesov A.K., Suyundikov M.M., Shomanova Zh.K., Akramov M.B., Suiindik N.M.
ASSESSMENT OF QUALITATIVE AND QUANTITATIVE ELEMENTAL COMPOSITION OF WASTE IN THE TERRITORY OF SLUDGE COLLECTOR OF PAVLODAR ALUMINIUM PLANT.....153

Turgumbayev J.J., Turgunbayev M.S.
PREDICTION OF THE CUTTING RESISTANCE FORCE OF THE SOIL CONTAINING STONY FRACTIONS.....161

Uakhitova B., Ramatullaeva L., Imangazin M., Taizhigitova M., Uakhitov R.
ON THE STATE OF INDUSTRIAL INJURIES OF WORKERS IN INDUSTRIAL ENTERPRISES OF THE AKTUBINSK REGION.....170

Sherov K.T., Sikhimbayev M.R., Absadykov B.N., Karsakova N.Zh. Myrzakhmet B.
METROLOGICAL ENSURING ACCURACY OF MEASUREMENT OF ANGLES V-SHAPED SURFACES GUIDE PARTS OF MACHINES FOR PETROCHEMICAL AND GEOLOGICAL EXPLORATION INDUSTRY.....176

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