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ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
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Satbayev University

ХАБАРЛАРЫ

ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ
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NAS RK is pleased to announce that News of NAS RK. Series of geology and technical sciences scientific journal has been accepted for indexing in the Emerging Sources Citation Index, a new edition of Web of Science. Content in this index is under consideration by Clarivate Analytics to be accepted in the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index. The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of News of NAS RK. Series of geology and technical sciences in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential content of geology and engineering sciences to our community.

Қазақстан Республикасы Ұлттық ғылым академиясы «ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы» ғылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Webof Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді геология және техникалық ғылымдар бойынша контентке адалдығымызды білдіреді.

НАН РК сообщает, что научный журнал «Известия НАН РК. Серия геологии и технических наук» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Известия НАН РК. Серия геологии и технических наук в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по геологии и техническим наукам для нашего сообщества.

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ANALYSIS OF INJURIES AND PSYCHOLOGICAL RESEARCHES OF WORKERS IN THE MELTING SHOPS OF THE AKTUBINSK FERRALOYS PLANT

Abstract. The purpose of the study is to increase the level of labor safety based on the developed criteria for the professional selection of personnel for hazardous professions in ferroalloy shops.

Based on a review of literary sources, the article shows that the main causes of injury at metallurgical enterprises are divided by factors into 3 groups: technical; organizational and psychophysiological. It is shown that the issues of studying injuries at ferroalloy plants of ferrous metallurgy have not been sufficiently studied. The information given in these works, from a scientific point of view, indicates the need for a more detailed analysis and study of the forms of manifestation of personal factors in subjects to reduce the degree of risk when performing production operations. The insignificant level of influence of the performers' competence on industrial injuries testifies to another established principle of personnel selection at industrial enterprises, based on the preference for professional training and work experience.

The article analyzes injuries in the smelting shops of the Aktobe Ferroalloy Plant for the period from 2012 to 2020. Using the statistical method and the method of Jan Strelyu, it was determined that the most dangerous professions in the smelting shops of AZF during the study period were ferroalloy smelters 26% and locksmiths - repairmen 20%. These two professions account for almost half of all injured people (47%). According to the results of the study, it was found that the

most dangerous age of the injured is 40 years and above. In general, this group of workers accounts for 50%, i.e. half of all injured workers. According to the results of testing according to the Jan Strelau method, a tendency towards injuries was revealed on average in 12% of all tested workers. Based on the results of the study, it was recommended that people who are predisposed to injuries by a special factor should be transferred to less hazardous professions and jobs.

Key words: traumatism; accident; labor protection, hazard forecast, risk, hazardous professions.

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АҚТӨБЕ ФЕРРОҚОРЫТПА ЗАУЫТЫНЫҢ БАЛҚЫТУ ЦЕХТАРЫНДАҒЫ ЖҰМЫСШЫЛАРДЫҢ ЖАРАҚАТТАНУЫ МЕН ПСИХОЛОГИЯЛЫҚ ЗЕРТТЕУЛЕРІНЕ САРАПТАМА

Аннотация. Зерттеудің мақсаты – ферроқорытпа цехтарының қауіпті кәсіптеріне қызметкерлерді кәсіби іріктеудің әзірленген критерийлері негізінде еңбек қауіпсіздігі деңгейін арттыру.

Мақалада әдебиеттік шолу негізінде металлургиялық кәсіпорындарда жарақаттың пайда болуының негізгі негізгі себептері факторлар бойынша 3 топқа бөлінетіндігі көрсетілді: техникалық, ұйымдастырушылық және психофизиологиялық. Қара металлургияның ферроқорытпа зауыттарындағы жарақаттануды зерттеу сұрақтары, жетік зеттелмегенін көрсетті. Аталмыш жұмыстардағы келтірілген мәліметтер, ғылыми көзқарас бойынша, өндірістік операцияларды орындаған кезде, анағұрлым толық сараптаманың және қауіп-қатер дәрежесінің төмендеуіне субъекттерге жеке факторларды көрсету формаларын зерттеу қажеттілігіне меңзейді. Өндірістік жарақаттануға атқарушының біліктілігі әсерінің болмашы деңгейі, кәсіби дайындық пен өндірістік еңбек өтілінің артықшылығын ескере отырып, өнеркәсіптік кәсіпорындарда кадрларды таңдаудың тағы бір орнатылған принципінің барын куәландырады.

Мақалада Ақтөбе ферроқорытпа зауытының балқыту цехтарындағы 2012-2020 жылдар аралығындағы жарақатқа талдау жасалды. Статистикалық әдіс пен Ян Стрелау әдісін қолдана отырып, зерттеу кезеңінде АФЗ-ның балқыту цехтарындағы ең қауіпті мамандықтар 26% ферроқорытпа

балқытушылары және 20% слесарь - жөндеушілер болып табылады, бұл екі мамандық барлық жарақат алғандардың жартысына жуығын құрайды (47%). Зерттеу нәтижелері бойынша жарақаттанушылардың ең қауіпті жасы 40 жастан бастап және одан жоғары жалпы алғанда 50% - ды, яғни барлық жарақаттанатын қызметкерлердің жартысын құрайтынын анықтады. Тестілеу нәтижелері бойынша (Ян Стреляу әдісі) талдау жүргізілді және тестіленген барлық қызметкерлердің орта есеппен 12%-ында жарақаттану тенденциясы анықталды. Зерттеу нәтижелерінің негізінде жарақаттануға бейім адамдарды арнайы фактор бойынша қауіптілігі төмен кәсіптер мен жұмыс орындарына ауыстыру мүмкіндігі туралы қорытынды жасалды.

Түйін сөздер: жарақаттану; жазатайым оқиға; еңбекті қорғау, жарақат, қауіп, қауіпті кәсіптер.

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АНАЛИЗ ТРАВМАТИЗМА И ПСИХОЛОГИЧЕСКИЕ ИССЛЕДОВАНИЯ РАБОТНИКОВ ПЛАВИЛЬНЫХ ЦЕХОВ АКТЮБИНСКОГО ЗАВОДА ФЕРРОСПЛАВОВ

Аннотация. Цель исследования – повышение уровня безопасности труда на основе разработанных критериев профессионального отбора персонала на опасные профессии ферросплавных цехов.

В статье на основе обзора литературных источников показано, что основные причины возникновения травматизма на металлургических предприятиях подразделяются по факторам на 3 группы: технические, организационные и психофизиологические. Показано, что вопросы изучения травматизма на ферросплавных заводах чёрной металлургии недостаточно исследованы. Сведения, приведенные в данных работах, с научной точки зрения указывают на необходимость более детального анализа и исследования форм проявления личностных факторов субъектам на снижение степени риска при выполнении производственных операций. Незначительный уровень влияния компетентности исполнителей на производственный травматизм свидетельствует еще об одном установившемся принципе подбора кадров на промышленных предприятиях, исходя из предпочтения профессиональной подготовки и производственного стажа.

В статье проведен анализ травматизма в плавильных цехах Актюбинского завода ферросплавов за период с 2012 по 2020 годы. Используя статистический метод и метод Яна Стреляу, определили, что наиболее опасными профессиями в плавильных цехах АЗФ-а в исследуемый период, являются плавильщики ферросплавов 26% и слесари-ремонтники 20%: на эти две профессии приходится почти половина всех травмированных (47%). По результатам исследования определили, что наиболее опасный возраст травмируемых от 40 лет и выше в целом приходится 50%, т.е. половина всех травмируемых работников. По результатам тестирования (метод Яна Стреляу) проведен анализ и выявлена тенденция к травматизму в среднем у 12% всех протестированных работников. На основании результатов исследования сделан вывод о возможности перевода лиц, предрасположенных к травматизму по специальному фактору, на менее опасные профессии и рабочие места.

Ключевые слова: травматизм, несчастный случай, охрана труда, травма, риск, опасные профессии.

Introduction. Industrial injuries (hereinafter PT) as a result of accidents and accidents at industrial enterprises is one of the urgent problems in all countries of the world. According to the International Labor Organization (ILO), more than 2 million people die, which is almost 5% of the total death rate on the planet and 270 million people are injured, 160 million people suffer from various diseases related to work. Today, the level of PT in Kazakhstan, as one of the CIS countries, is an order of magnitude higher than similar indicators in countries such as Great Britain, Germany, Canada, Japan, and the level of fatal injuries at work in our country is 2.5 times higher than in the USA, 7 times more than in Japan, 8.7 times - than in England. (Imangazin, 2014).

Industrial injuries pose a serious danger to the health and life of people, especially employees of hazardous production facilities. In our country, in recent years, according to statistics, in the industry as a whole, there has been a slight decrease in the level of industrial injuries. Enterprises of the metallurgical industry, distinguished by a high level of mechanization and automation of production processes, are distinguished by a significant level of indicators of the risk of industrial injuries.

Moreover, in the metallurgical industries there is an increase in injuries, in some cases with fatal outcomes. In this regard, the task of developing methods of preventive protection of workers from accidents and a reliable forecast of the likelihood of injury at enterprises becomes urgent.

Practice shows that the main causes of injuries and accidents at workplaces are most often associated with engineering omissions, shortcomings in the

organization of work on the operation of equipment, and an incorrect assessment of the state of affairs in production. That is, there is reason to assert that the reason lies in the person himself, the so-called "human factor". Both his own safety and the production 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, is it possible to significantly reduce injuries at the enterprise and increase labor safety, since psychological stability is the reserve that is currently not fully used in practice. (Uakhitova et al, 2022).

A review of the available literary sources on this issue shows that a significant portion of the available scientific special literature is made up of studies devoted to methods of analyzing industrial injuries and the causes of accidents and their prevention based on common premises. (Khakimzhanov, 2008).

The most complete picture of the conditions, circumstances and reasons for the maturation of hazardous industrial situations can be obtained by applying a systematic approach to the accounting and analysis of the results of the implementation of the system of safety principles.

A number of works highlight the features of injuries among workers in the metallurgical industry. Labor safety of metallurgists depends on many factors, including the personal characteristics of the worker. In the literature, very close attention is paid to the study of the role of the latter in the occurrence of injuries and accidents. In particular, it was shown that 35% of workers who committed erroneous actions that led to injuries had a reduced ability to distribute and concentrate; 31% - inability to quickly and correctly assess the situation; in 13% of those who worked, an insufficient level of development of psychomotor abilities was noted. It is also noted that 23% of the working contingent had a low level of professional fitness. According to the same author, decreased performance and unpleasant subjective sensations can occur not only due to fatigue, but also as a result of a low level of body activity, which primarily affects the visual and motor reactions of a person. In some cases, injuries are influenced by the state of stress of workers. Stress can be caused by the difficulty of the task (high requirements for accuracy and speed of execution, work with a lack of time or in conditions of information overload, etc.). The discrepancy between personal properties and the optimal set of necessary qualities contributes to the excessive stress of the worker, which can lead to injury or the occurrence of a serious chronic illness.

The analysis of injuries shows that scientific methods and the latest technology are insufficiently used in determining the causes of PT. As a result, the quality of the investigation is often inadequate, and there are serious omissions in injury prevention. In the practice of investigation, mistakes are made, consisting in the fact that often only the consequences of the true cause of the incident are

determined, which directly entailed the incident (carelessness, negligence, violations of safety rules by the injured), and the reasons for these violations are not are being clarified. In addition, often the investigation, especially if it is not associated with serious consequences, is of a formal nature, and the developed preventive measures do not agree with the causes of accidents and are ineffective.

For a long time it was believed that the main cause of injuries and accidents, equipment malfunctions is determined by the lack of professional knowledge of the worker. However, with the accumulation of knowledge on the operation of equipment and the peculiarities of technological processes for operation and an increase in the professional competence of personnel servicing the equipment, the number of accidents and failures in the operation of units not only does not decrease, but grows.

A person working in the system "man - machine - environment" ("CHMS"), "man - machine", "man - environment", "man - man" strives to avoid mistakes, as he constantly realizes the degree of their danger and the severity of the consequences, therefore, the level of neuro-emotional stress and psychological stress for the decisions made is very high. The risk of severe consequences of human errors, the "human factor" in the "ChMS" systems is too great, and not every person who has good professional and technical training is able to withstand this burden.

The development of technology, universal computerization, the introduction of new innovative and digital technologies into production, cause the appearance of problems not only of artificial intelligence, but also of a number of specific requirements for the performer, based on the human factor. One of the defining aspects of the human factor can be the psychophysiological qualities of the subject.

The "human factor" refers to a wide range of psychological and psychophysiological properties that people possess and which, in one way or another, are manifested in labor activity, affect its safety, quality and efficiency.

An analysis of statistical data from a number of studies 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.

In recent years, the attention of researchers is again directed to the phenomenon of "predisposition" to accidents, but, as it were, at a new level, i.e. this phenomenon is not considered fatal, but is presented as a person's abilities formed in the process of labor, which impede overcoming a dangerous situation.

It should be noted that in recent years, the role of the psychophysiological factor among the causes of injuries has been increasing.

Due to the various parameters of attention, temperament, character, psychological makeup of the personality and other characteristics, each person perceives the production process differently, learns its parameters faster or slower,

has a certain reaction rate to signals coming from the environment: industrial, technogenic, urban. In ensuring safe working conditions, the subjective factor associated with the personality of the worker is of great importance. This factor is often underestimated. The discrepancy between the worker's profession and the work being performed contributes to the appearance of erroneous or dangerous practices, i.e. the problem of taking into account the "human factor" is now becoming increasingly acute.

Despite the increase in professional competence in the field of modern technologies and equipment operation, the number of accidents and failures in the operation of units not only does not decrease, but also grows for psychophysiological reasons, and not due to a lack of professional knowledge of the service personnel. A person working in the system "man - machine - environment", "man - machine", "man - environment", "man - man" strives to avoid mistakes, as he constantly realizes the degree of their danger and the severity of the consequences, therefore his level is nervous - emotional stress and psychological stress on the decisions made is very high. The risk of severe consequences of mistakes is too great and not every person, from those who have good professional and technical training, is able to withstand this burden. As the literature data show, the most important tasks of forming a safe type of personality are: stimulating motivation for self-improvement in physical and spiritual terms; choosing an effective personal safety path; increasing the adequacy of self-assessments of psychophysiological personality traits necessary for the implementation of actions of a safe type; training in the skills of harmonious interaction with the outside world in all spheres of life and habitats (technogenic, urban, household, natural) and safe communication skills; rationalization of work and rest regimes; training in methods and ways to improve performance and maintain health; mastering the basics of psychophysiological relaxation, mental self-regulation and neuromuscular rehabilitation; mastering the knowledge of choosing the most effective personal protective equipment. Not only mastering, but also the introduction and development of a scientifically grounded system aimed at the formation of additional normative and unintended qualities of an employee based on psychophysiological characteristics or on his psychological characteristics in performers of different categories.

The development of criteria for a safe type of personality will give managers and specialists of labor protection services a tool for designing safe conditions, focused on accounting and mobilizing those reserves of the "human factor" that are still underestimated or little used in production conditions.

Based on the above analysis of the state of the problem of labor safety and increasing the working capacity of a worker in metallurgy, the following generalizations should be made.

Technological progress creates changing specialized structures that often do not take into account human characteristics. A living organism does not have the ability to quickly adapt to changing conditions, like artificial objects developed and adapted by human action. A qualitatively new environment appears (industrial, informational, technogenic, sanitary and hygienic, etc.), which gives rise to the problem of depleting the natural resource of human health and working capacity.

Statistical data on the growth in the number of accidents, accidents and disasters confirm their growing dependence on the human factor (including their prevention). It is believed that the share of the corresponding prerequisites ranges from 50 to 90%. Consequently, the establishment of criteria for the safety of workers, the formation of a safe type of personality for certain working conditions, psychophysiological selection, training and education of workers may be prevalent among the main in solving problems of labor protection. The technical characteristics of the controlled system must correspond to the capabilities of a person, his physiological, psychophysiological and socio-psychological characteristics, as well as professional training.

Conclusions from the literature review. Injury in the metallurgical industry is a complex and multifactorial phenomenon. From the analysis of literary sources, it follows that the main reasons are divided by factors into 3 groups:

- technical;
- organizational;
- psychophysiological.

There are few literary sources on the study of injuries at ferroalloy plants of ferrous metallurgy, which may indicate a lack of research in this area. There are no analytical and predictive works, the issues of methods for determining the risks of hazards at ferroalloy plants are not well covered. In other industries, the issues of risk theory have been extensively and thoroughly worked out both from a theoretical and practical point of view. For example, in the transport industry there are studies by a number of authors devoted to the issues of risk theory and the use of the results in practice in order to prevent hazardous industrial situations. Although the injury rate at enterprises of this type is quite high, not inferior in terms of the average level to other enterprises of the ferrous metallurgy, for example, steel plants in Kazakhstan and Russia.

The influence of psychophysiological (personal) factors on the level of injuries at ferroalloy plants, both in Kazakhstan and other CIS countries and far abroad, has not been studied. A more detailed study of the forms of manifestation of personal factors in subjects to reduce the degree of risk when performing production operations is needed.

The influence of the competence of the personnel of ferroalloy plants, especially the line personnel of the engineering and technical workers of the shops, on injuries has not been studied, although studies carried out in Russia

directly prove this influence, which, for reasons, can reach 12-15% of the total level of injuries at the enterprise. The insignificant level of influence of the performers' competence on industrial injuries testifies to another established principle of personnel selection at industrial enterprises based on the preference for professional training and work experience.

Materials and methods. Studies to assess the level of injuries at enterprises of the metallurgical cluster were carried out on the basis of materials from the Aktobe Ferroalloy Plant (hereinafter APF). The results of studies using statistical methods for processing experimental data for the period from 2012 to 2020 are shown in Table 1.

The study of the dynamics of indicators of industrial injuries shows that within nine years from 2012 to 2020. the number of accidents, namely their frequency, has been decreasing, but in recent years, it tends to increase. At the same time, out of 32 accidents, one belongs to a group type, and out of 30 injured workers - 19 severe cases, 11 cases with an easy outcome, 4 cases with a fatal outcome. This fact may indirectly indicate a loss of a sense of danger, a decrease in the attentiveness of an individual outside of society.

In order to get a correct and complete picture of industrial injuries that occurred at the enterprise during the studied period of time, we analyzed the coefficient of injury frequency Cf; coefficient of injury severity Cs; hazard coefficient Ch or indicator of general injury rate; indicator of fatal injuries Cf. (Khakimzhanov, 2008)

Table 1

Quantitative indicators of industrial injuries at the Aktobe Ferroalloy Plant

№ п/п	Indicators	Indicator value by years								
		2012	2013	2014	2015	2016	2017	2018	2019	2020
1	Number of employees in organizations, B, people	3161	3311	3784	3872	3991	4236	4278	4402	4286
2	Number of accidents, A	7	4	2	1	1	2	2	6	7
3	Number of victims	7	2	1	1	1	2	1	8	7
	The number of dead, L	0	2	1	0	0	0	1	0	0
	The number of victims with a severe outcome	5	2	-	-	-	2	-	5	5
	The number of victims with lung outcome	2	-	1	1	1	-	1	3	2
4	Number of people injured in group accidents	-	-	-	-	-	-	-	3	-
5	Number of calendar days of incapacity for work, C	604	197	31	132	60	282	254	471	563
6	Frequency coefficient, Cf	2,21	1,21	0,52	0,25	0,25	0,47	0,46	1,36	1,63
7	Gravity coefficient, Cg	86,3	49,25	15.5	132	60	141	127	78.5	80,4
8	Indicator general injury, Cg	191	59,6	8,1	33	15	66,3	59	106.8	131
9	Mortality rate, Cm	0	0,6	0,26	0	0	0	0,23	0	0

The coefficient of injury frequency Cf determines the number of accidents per 1000 workers for a certain calendar period (month, quarter, year), and is determined by the formula:

$$Cf = (A / B)\ 1000, \quad (1)$$

where A is the number of accounted accidents for the reporting period; B - the average number of employees at this enterprise in the period under review.

When determining Cf, all registered accidents with loss of ability to work were taken into account. However, the frequency factor does not take into account the severity of injury, which is characterized by the average duration of disability per accident. Therefore, the coefficient of severity of trauma Cs is introduced, which characterizes the average loss of working capacity in days per victim for the reporting period and is determined by the formula:

$$Cs = C / A \quad (2)$$

where C is the total number of days of incapacity for work due to accidents.

The injury severity rate does not include fatalities. Therefore, for a more complete assessment of industrial injuries, the indicator of general injuries Cg was determined and the indicator of injuries with a fatal outcome Cf:

$$K_o = K_ч \cdot K_т, \quad (3)$$

$$or K_o = (C/B) \cdot 1000, \quad (4)$$

$$Kc = (L/B) \cdot 1000, \quad (5)$$

where L is the number of fatal accidents; B - the average annual composition of the plant's employees.

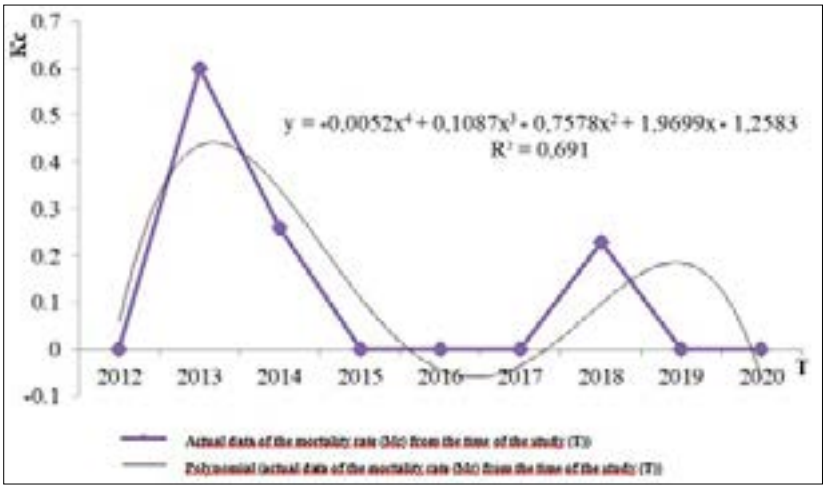

Fig. 1 - Graph of dependence of the mortality rate Cm (y) from the time of research T (x).

Figure 1 shows a graph of the dependence of the mortality rate Cm - the mortality rate for the study period, which has a polynomial character. It was found that the Cm indicator is 0.6 in 2014 equal to 0.26 and in 2018 - 0.23. The actual values of the points were also approximated by a 4th degree polynomial (using Microsoft Excel): y = -0.0052x4 + 0.1087x3 - 0.7578x2 + 1.9699x - 1.2583. There is one peak of the maximum, falling on 2013. In general, the distribution of Cm is unequal with periods of decline and rise. Average Cm = 0.12.

Table 2

Distribution of accidents by occupation.

Profession	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total amount
Ferroalloy smelter	3		2			1		2	1	9
Locksmith repairman	1				1			5		7
Ferroalloy breaker	1			1					2	4
Gas electric welder		1						1	2	4
Lineman driver	1									1
I.O. of the shift supervisor		1								1
Locomotive driver assistant		2								2
Electrician			1							1
Bunker						1				1
Senior repairman							1			1
Installer							1			1
Driver									1	1
Ferroalloy dispenser									1	1

Based on Table 2, the distribution of accidents by occupation for 2012-2020, it can be seen that workers in hazardous occupations such as smelters-ferroalloys (26.5%), locksmiths-repairmen (20.5%), breakers of ferroalloys (12%), gas electric welders (12%), and in other professions they have isolated cases. The group of performers of smelters - ferroalloys - includes all age categories with work experience from 1 month to 6 years; the degree of injury is 4 lungs and 5 with a severe outcome. Locksmiths repairmen - the age of workers is over 50 years - 4 people with experience of 3 years, 6 years, 11 years and 22 years; 48 years with 2 years of experience; and 23 and 33 years, experience within 2 years. The degree of injury is 4 lungs and 3 with a severe outcome.

Table 3

Distribution of accidents by length of service and age.

Age / experience	До 1 года	1-2	3 - 4	5 -6	7- 9	10 – 14	15- 20	Over 20 years	Total amount
16 – 21	1								1
22 – 24		4	1(1)						5
25 – 29		1	1(1)	2					4
30 – 34	1	2		3					6
35 – 39					1				1

40 – 49	2(1)	2	1	1	2	1			9
over 50 years			1	1	2(1)	3		1	8
Note 1 (1) - 1 number of victims, (1) - number of victims.									

Further, the influence of the age of performers on injury rates was studied, data on injuries by age and seniority of workers are presented in Table 3. Analysis of the data given in the table shows that the largest number of workers - 26.5% and 23.5% - falls into the category " 40 - 49 "and" over 50 years old ". These workers, regardless of their length of service, are the most susceptible to injury. At the third level "30-34 years", which is 18%, workers with 5-6 years of experience are most susceptible to injury. At the fourth level "from 22 to 24 years" and "25-29" -15% and 12%, with experience of 1-2 and 3-4 years.

As mentioned above, the manifestation of cases of injuries at enterprises, in particular, metallurgical plants, is associated with technical, organizational and psychophysiological factors. Moreover, the influence of the latter factor, according to literature data, can be 65-70%. The results of these studies practically confirm the data of previous researchers. According to the research results, it can be seen that the injury rate in recent years has an upward trend. Moreover, these indicators are of greatest importance in responsible and complex workplaces (professions), and also increase in connection with the age of workers. The next factor is that at present in metallurgical production there is a reconstruction and introduction of new innovative technologies, which impose more increased requirements not only on the professional level, but also on the psychophysiological parameters of workers. In order to assess the significance of this factor in ensuring safe working conditions, it is necessary to develop measures and conduct research on the factual materials of enterprises.

The method for diagnosing temperament by Jan Strelyau [https://psycabi.net/testy/458-metodika-diagnostiki-temperamenta-yana-strelyau-test-lichnostnyj-oprosnik-izucheniya-temperamenta] is used to study three main characteristics of the nervous system: level (strength) the processes of excitation, the level (strength) of the processes of inhibition, the level of mobility of the nervous processes.

Equilibrium in force R is equal to the ratio of the excitation force Fe to the braking force Fb:

$$R = Fe / Fb.$$

The closer the R value is to one, the higher the equilibrium is. A balanced person is one for which the value of R does not go beyond the interval 0.85 - 1.15. If the value of R goes beyond the interval, then it can be argued that this individual is distinguished by the imbalance of his psychological activity. Moreover, if the

value of the fraction is greater than 1.15, this means imbalance in the direction of excitement, i.e. the processes of arousal do not balance the processes of inhibition. With a significant shift in the balance of nervous processes towards excitement, strong short-term emotional experiences, an unstable mood, good adaptation to new things, riskiness, a strong striving for a goal with full dedication, a fighting attitude to danger without special calculation, poor noise immunity are likely. If the value is less than 0.85, this means imbalance in the direction of braking, i.e. inhibition processes do not balance the excitation processes. With a significant shift in the balance of nervous processes towards inhibition, balanced behavior, stable mood, weak emotional experiences, good patience, restraint, composure, an equanimous attitude to danger, a real assessment of one's abilities, and good noise immunity are likely.

Table №4

Results of tests according to the methodology for diagnosing temperament by Jan Strelyau, carried out in the smelting shops of the Aktobe Ferroalloy Plant in 2019.

		Amount of workers			Age of workers									Psychophysiological factors
		SS №1	SS №2	SS №4	Up to 30 years old			31-40 years old			Over 40			
					SS №1	SS №2	SS №4	SS №1	SS №2	SS №4	SS №1	SS №2	SS №4	
	Total number of employees (186 people)	69	65	52	30	36	31	24	15	17	15	14	4	
1	The level of excitation processes													
	Normfrom 25 to 49	21	7	7	6	2	6	11	2	1	4	3	-	
	Secondary up to 59	29	37	26	14	20	15	8	10	9	7	7	2	Strong response to excitement, stimulus, quick engagement in work, workability and achievement of high productivity; low fatigue; high performance and endurance
	Over 59	19	21	19	9	14	10	7	3	7	3	3	2	
	Below 24	-	-	-	-	-	-	-	-	-	-	-	-	Weak delayed reaction to excitement, transcendental inhibition is quickly achieved, slow: inclusion in work, training and not high labor productivity; high fatigue of work; low efficiency and endurance

2	Braking process level													
	Normfrom 21 to 43	3	-	-	-	-	-	3	-	-	-	-	-	
	Over 50	66	65	52	30	36	29	21	15	17	15	14	6	Strong nervous processes from the side of inhibition; disturbances, incentives are easily extinguished; quick response to responses to simple sensory signals, good response; high self-control, composure, vigilance, composure in behavioral reactions
	Below 24	-	-	-										Weakness of inhibition processes, impulsivity in response to a stimulus, weak self-control in behavioral reactions, a certain disinhibition, undemandingness and indulgence towards oneself; slow or belated, responding to simple signals.
	The level of mobility of nervous processes													
	Norm from 24 to 49	7	2	1	1	1	1	3	1	-	3	-	-	
	Over 50	62	63	51	29	35	28	21	14	17	12	14	6	Ease of switching nervous processes from excitement to inhibition and vice versa; quick transition from one type of activity to another; fast switching, decisiveness, courage in behavioral reactions.
	Below 24	-		-										
	Balance in strength													
	0,85-1,15	58	60	45	25	32	24	21	14	17	12	14	4	Balanced person
	0,85	11	3	6	5	2	6	3	1	-	3	-	-	Imbalance towards braking, i.e. inhibition processes do not balance the excitation processes.
		-	2	1	-	2	1	-	-	-	-	-	-	Imbalance towards excitement, i.e. the processes of arousal do not balance the processes of inhibition.

SS – smelting shop

Results and discussion. In order to establish the significance of psychophysiological factors in the conditions of the Aktobe Ferroalloy Plant, the authors carried out a test on the method of diagnosing the temperament of workers according to the method of Jan Strelyau, in which 186 people participated. According to the results of test processing, it was revealed that for 163 workers the value of the equilibrium indicator R is within the range of 0.85 - 1.15. Analysis of the above data shows that 23 work performers have values of R indicators that go beyond the specified interval. It was also found that out of the number of surveyed workers, 3 people have a value of the R indicator above the upper level, equal to 1.15, and 20 people are less than the lower level, equal to 0.85. Obviously, these workers can form a risk group where the most likely manifestation of events associated with cases of violation of regulatory requirements for labor protection and industrial safety at work.

The analysis of the given data shows that of the total number of workers in the main shops who have passed the test, the share of workers with an unbalanced indicator according to Jan Strelau's tests is 12.36%. In the context of workshops, the specified group of workers is distributed as follows:

smelting shop # 1 - 16%; smelting shop # 2 - 8%; for smelting shop No. 4 - 13%. The data presented show that the value of the R indicator in the considered group of workers weakly correlates with professional qualifications, work experience and age of the employee, which indicates the importance of the psychological characteristics of the subject and the need to take these characteristics into account when recruiting personnel in order to check the predisposition of the latter to the manifestation of weakened self-control when fulfillment of the functional duties assigned to them at production enterprises, which can lead to injuries (accidents). Thus, the given data testifies to the consideration of the significance of the psychophysiological qualities of individual performers when planning and organizing technological operations at the sites and workplaces of enterprises and production structures.

Conclusions. The most prone to the manifestation of accidents and injuries at workplaces in metallurgical enterprises are: smelters of ferroalloys - (26.5% of the total number of injured); locksmith repairmen - (20.5% of the total number of injured).

When organizing the planning of workplaces in critical areas, it is also necessary to take into account the age indicator of workers.

According to the results of the study, it was found that 50% of all injured workers are workers over 40 years old, which indicates the need to take into account the age qualification when organizing and planning jobs at production sites

The results of the study show that 12.36% of all workers are predisposed to

violation of the normative requirements for health and safety in terms of their psychophysiological indicators.

The data presented indicate that organizational preventive measures are being taken by transferring persons with a predisposition to traumatism for a psychological factor to less hazardous professions and jobs, which can reduce the risk of injury hazard in smelting shops by at least 10%.

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