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«ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫ» РҚБ
«ХАЛЫҚ» ЖҚ

ХАБАРЛАРЫ

ИЗВЕСТИЯ

РОО «НАЦИОНАЛЬНОЙ
АКАДЕМИИ НАУК РЕСПУБЛИКИ
КАЗАХСТАН»
ЧФ «Халық»

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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.

ЧФ «ХАЛЫҚ»

В 2016 году для развития и улучшения качества жизни казахстанцев был создан частный Благотворительный фонд «Халык». За годы своей деятельности на реализацию благотворительных проектов в областях образования и науки, социальной защиты, культуры, здравоохранения и спорта, Фонд выделил более 45 миллиардов тенге.

Особое внимание Благотворительный фонд «Халык» уделяет образовательным программам, считая это направление одним из ключевых в своей деятельности. Оказывая поддержку отечественному образованию, Фонд вносит свой посильный вклад в развитие качественного образования в Казахстане. Тем самым способствуя росту числа людей, способных менять жизнь в стране к лучшему – профессионалов в различных сферах, потенциальных лидеров и «великих умов». Одной из значимых инициатив фонда «Халык» в образовательной сфере стал проект Ozgeris powered by Halyk Fund – первый в стране бизнес-инкубатор для учащихся 9-11 классов, который помогает развивать необходимые в современном мире предпринимательские навыки. Так, на содействие малому бизнесу школьников было выделено более 200 грантов. Для поддержки талантливых и мотивированных детей Фонд неоднократно выделял гранты на обучение в Международной школе «Мирас» и в Astana IT University, а также помог казахстанским школьникам принять участие в престижном конкурсе «USTEM Robotics» в США. Авторские работы в рамках проекта «Тәлімгер», которому Фонд оказал поддержку, легли в основу учебной программы, учебников и учебно-методических книг по предмету «Основы предпринимательства и бизнеса», преподаваемого в 10-11 классах казахстанских школ и колледжей.

Помимо помощи школьникам, учащимся колледжей и студентам Фонд считает важным внести свой вклад в повышение квалификации педагогов, совершенствование их знаний и навыков, поскольку именно они являются проводниками знаний будущих поколений казахстанцев. При поддержке Фонда «Халык» в южной столице был организован ежегодный городской конкурс педагогов «Almaty Digital Ustaz.

Важной инициативой стал реализуемый проект по обучению основам финансовой грамотности преподавателей из восьми областей Казахстана, что должно оказать существенное влияние на воспитание финансовой грамотности и предпринимательского мышления у нового поколения граждан страны.

Необходимую помощь Фонд «Халык» оказывает и тем, кто особенно остро в ней нуждается. В рамках социальной защиты населения активно проводится

работа по поддержке детей, оставшихся без родителей, детей и взрослых из социально уязвимых слоев населения, людей с ограниченными возможностями, а также обеспечению нуждающихся социальным жильем, строительству социально важных объектов, таких как детские сады, детские площадки и физкультурно-оздоровительные комплексы.

В копилку добрых дел Фонда «Халык» можно добавить оказание помощи детскому спорту, куда относится поддержка в развитии детского футбола и карате в нашей стране. Жизненно важную помощь Благотворительный фонд «Халык» оказал нашим соотечественникам во время недавней пандемии COVID-19. Тогда, в разгар тяжелой борьбы с коронавирусной инфекцией Фонд выделил свыше 11 миллиардов тенге на приобретение необходимого медицинского оборудования и дорогостоящих медицинских препаратов, автомобилей скорой медицинской помощи и средств защиты, адресную материальную помощь социально уязвимым слоям населения и денежные выплаты медицинским работникам.

В 2023 году наряду с другими проектами, нацеленными на повышение благосостояния казахстанских граждан Фонд решил уделить особое внимание науке, поскольку она является частью общественной культуры, а уровень ее развития определяет уровень развития государства.

Поддержка Фондом выпуска журналов Национальной Академии наук Республики Казахстан, которые входят в международные фонды Scopus и Wos и в которых публикуются статьи отечественных ученых, докторантов и магистрантов, а также научных сотрудников высших учебных заведений и научно-исследовательских институтов нашей страны является не менее значимым вкладом Фонда в развитие казахстанского общества.

С уважением,
Благотворительный Фонд «Халык»!

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RESEARCH AND ASSESSMENT OF THE STATE OF OCCUPATIONAL INJURIES AT THE DON MINING AND PROCESSING PLANT

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Abstract. The purpose of the study is to study injuries at the Don Mining and Processing Plant (hereinafter referred to as DMPP) in the period 2011–2020 to identify the main traumatic workshops and, based on this, to develop recommendations for the prevention and reduction of injuries. The methodology of the study was based on the statistical method of injury research using statistical data on injuries for the study period. It has been established that mines account for the largest part of all accidents in terms of mortality and severity, i.e. mines are the most traumatic sites of the production of DMPP. Among the mines of the combine, the DNA mine is the most traumatic, where 37 accidents were recorded, including 18 serious, 5 fatal.

Keywords: injuries, combine, mine, labor protection, hazard forecast, risk

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ДОН ТАУ-КЕН БАЙЫТУ КОМБИНАТЫНДА ӨНДІРІСТІК ЖАРАҚАТТАНУДЫҢ ЖАЙ-КҮЙІН ЗЕРТТЕУ ЖӘНЕ БАҒАЛАУ

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Аннотация. Зерттеудің мақсаты 2011–2020 жылдар кезеңінде Дон тау-кен байыту комбинатында (бұдан әрі – ДТКБК) жарақаттануды негізгі жарақаттандырушы цехтарды анықтау және осыны негізге ала отырып, жарақаттанудың алдын алу және азайту жөніндегі ұсынымдарды әзірлеу мақсатында жарақаттануды зерделеу болып табылады. Зерттеу әдістемесі зерттеу кезеңіндегі жарақат статистикасын қолдана отырып, жарақаттануды зерттеудің статистикалық әдісіне негізделген. Шахталар өлім мен ауырлық тұрғысынан барлық жазатайым оқиғалардың ең көп бөлігін құрайтыны анықталды, яғни шахталар ДТКБК өндірісінің ең қауіпті учаскелері болып табылады. Комбинат шахталарының ішінде ең жарақаттысы ДНҚ шахтасы болып табылады, онда 37 жазатайым оқиға тіркелді, оның ішінде 18 ауыр, 5 адам қайтыс болды.

Түйін сөздер: жарақаттану, комбайн, шахта, еңбекті қорғау, қауіптің болжамы, тәуекел

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ИССЛЕДОВАНИЕ И ОЦЕНКА СОСТОЯНИЯ ПРОИЗВОДСТВЕННОГО ТРАВМАТИЗМА НА ДОНСКОМ ГОРНО-ОБОГАТИТЕЛЬНОМ КОМБИНАТЕ

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Аннотация. Целью исследования является изучение травматизма на Донском горно-обогатительном комбинате (далее – ДГОК) в период 2011–2020 годы с целью выявления основных травматизирующих цехов и, в дальнейшем, разработки рекомендаций по профилактике и снижению травматизма. В исследовании использовался статистический метод с привлечением статистических данных о травмах за указанный период. Было установлено, что на шахты приходится наибольшая часть всех несчастных случаев, влекущих смерть или тяжелые увечья, т. е. шахты являются наиболее травмоопасными участками производства ДГОК. Среди шахт комбината наиболее травматичной является шахта ДНК, где зафиксировано 37 несчастных случаев, в том числе 18 серьезных, и 5 со смертельным исходом.

Ключевые слова: травматизм, комбинат, шахта, охрана труда, прогноз опасности, риск

Introduction

DMPP was founded in 1938, located in the city of Khromtau, Aktobe region of the Republic of Kazakhstan. The plant is part of the Joint-Stock Company "Transnational Company "Kazchrome" (JSC "TNK "Kazchrome") Eurasian Resources Group (ERG). It is the second deposit in the world in terms of confirmed reserves of chromium ores after the Republic of South Africa. From the point of view of quality, the chrome ore

extracted and processed by the Don Combine has no analogues in the world. Most of the ore extracted at DMPP is supplied to ferroalloy plants in Aksu and Aktobe. Ore with a high content of chromium oxide (up to 62 % Cr2O3) is used for the smelting of ferroalloys in ferrous metallurgy, the manufacture of refractories and in the chemical industry for the production of chromium compounds.

There are 27 structural divisions within the DMPP, the number of employees is on average more than 7000 people. The main production is concentrated in five divisions: the Molodezhnaya and 10th Anniversary of Independence of Kazakhstan mines (DNA), the Donskoy mine (quarry), the ore dressing and pelletizing factory (ODPF) and the crushing and processing plant No. 1 (CPP). Other divisions ensure stable operation of the enterprise: transportation, repair, automation and other auxiliary processes (Khakimzhanov et al., 2008; Lazarenkov et al., 2004).

Occupational injuries (hereinafter referred to as OI) as a result of accidents and accidents has long been an urgent problem in all countries of the world. Every year, according to the International Labor Organization (ILO), more than 2 million people die from injuries, which is almost 5% of the total mortality rate on the planet and 270 million people are injured, 160 million people suffer from various diseases related to production (Akovleva et al., 2017; Emelyanov et al., 2017).

Materials and methods

The level of injuries at the Don Mining and Processing Plant (hereinafter referred to as DMPP) was analyzed for the period from 2011 to 2020 by statistical method.

During this period, 148 accidents occurred at the plant

(Table 1), including 11 fatal, 73 severe cases. A total of 137 people were injured.

The average number of accidents during this period is about 15 cases per year, of which 1.1 cases per year with a fatal outcome. The share of severe cases is 49.3 %, the share of fatal cases is 7.4 % of the total number of victims during this period.

*To assess the level of injuries, a statistical method was used based on the study and processing of statistical material based on the results of the accident investigation for the specified period. This method allows us to determine the comparative dynamics of a number of coefficients, which are relative indicators of the level of injuries in the enterprise. This allows us to get a complete picture of the level of injuries, moreover, only according to the absolute number of accidents that occurred at the enterprise during the time period under study. These include: injury frequency coefficient Cf; the severity coefficient of Cs injuries; the hazard coefficient of Ch or the indicator of general injuries; the indicator of fatal injuries of Cf (*Gershgorin et al., 2015; Imangazin et al., 2014*).*

Table 1. Data on injuries at the DMPP for the studied period of time.

№	The name of the indicator	The studied years									
		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
п/п	1	2	3	4	5	6	7	8	9	10	11
1	Average number of employees, B, people	7019	7029	7072	7098	7149	7199	7225	7278	7393	7445
2	The number of victims of accidents, people	20	19	11	19	8	11	12	15	17	16

3	Number of person-days of disability, C	605	369	328	459	166	302	324	425	465	470
4	The total number of accidents, A:	20	19	11	19	8	11	11	15	16	16
	with a severe outcome	11	3	8	8	3	6	8	10	7	9
	with an easy outcome	7	13	3	9	5	4	3	5	9	6
	with a fatal outcome	2	3	-	2	-	1	1	-	1	1
5	Frequency coefficient, Cf	2,84	2,70	1,51	2,67	1,12	1,52	1,66	2,06	2,29	2,14
6	Severity coefficient, Cs	30,25	19,4	29,8	24,15	20,7	27,45	29,45	28,33	29,06	29,3
7	The indicator of total injuries, Ct	85,91	52,4	45	64,5	23,2	41,9	48,9	58,4	66,55	62,9
8	Mortality rate, Cm	0,28	0,43	0,00	0,28	0,00	0,14	0,14	0,00	0,14	0,13

The injury frequency coefficient Cf characterizes the number of accidents at work per 1000 employees for a certain period of time (month, quarter, year), and is described by the formula:

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

where A is the total number of victims for a certain period of time; B is the average number of employees for this period (Merchalova et al., 2016; Poletaev et al., 2015).

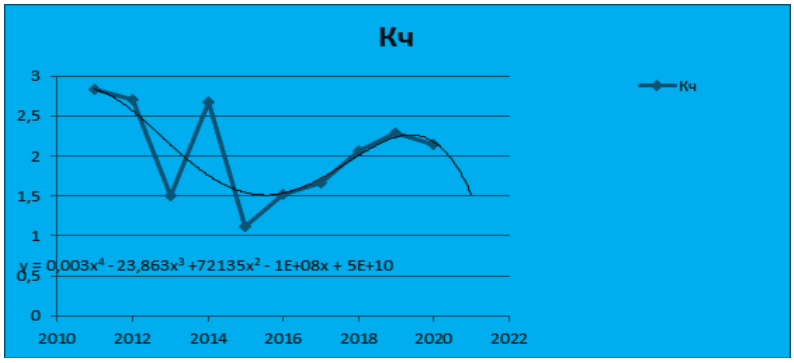

Fig.1 Graph of the polynomial dependence of the frequency coefficient Cf (y) on the study time T (x).

When determining the Cf, all registered accidents with disability are provided for. However, the frequency coefficient does not provide for the severity of injuries, which is characterized by the average duration of disability per accident. As a result, the Cs injury severity coefficient is introduced, which characterizes the average disability in days per victim during the reporting period and is determined by the formula:

$$K_т = C/A \quad (2)$$

where C is the total number of working days of disability for all injuries (accidents) (Poletaev et al., 2015; Uakhitova et al., 2022).

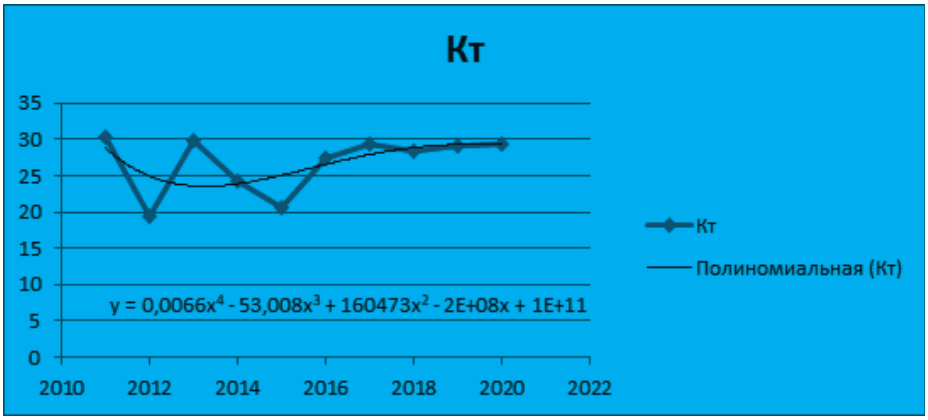

Fig.2. Graph of the polynomial dependence of the severity coefficient of Cs (y) on the time of studies T (x).

The injury severity coefficient does not take into account deaths. And for a full assessment of occupational injuries, the indicator of total injuries of the Ct and the indicator of fatal injuries of the Cf are calculated:

$K_o = (C/B) \cdot 1000,$ (3)

or

$Kc = (L/B) \cdot 1000,$ (4)

$K_o = K_ч \cdot K_т,$ (5)

where L - the total number of workers who died at work during the study period; C – the average number of employees of the plant (Uakhitova et al., 2022).

Figures 3, 4 show graphs of the corresponding dependencies on the indicators of Ct and Cf.

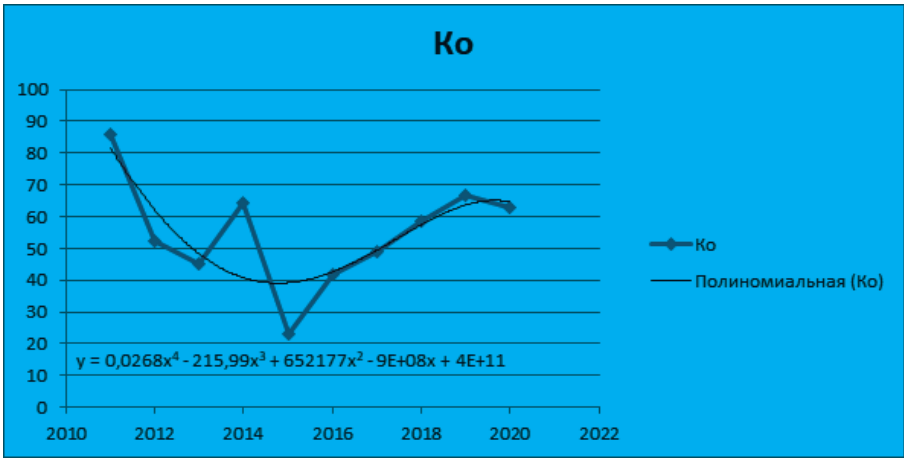

Fig.3. Graph of the polynomial dependence of the indicator of total injury Co (y) on the study time T (x).

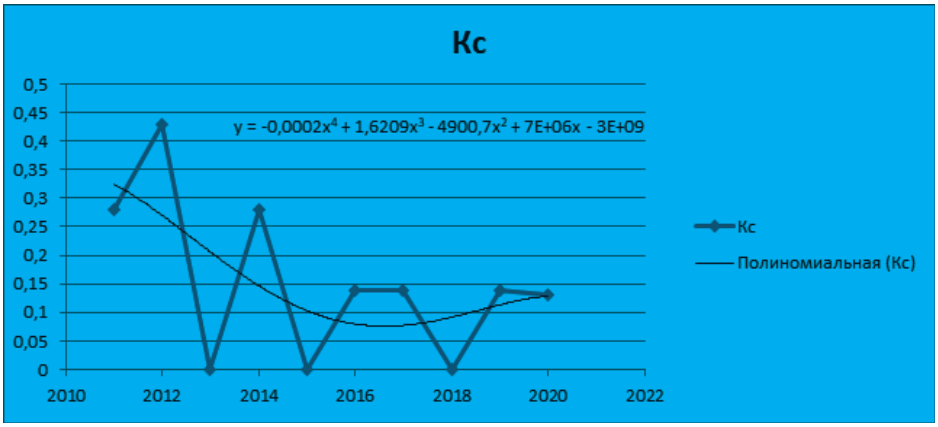

Fig.4. Graph of the polynomial dependence of the mortality rate of Cm (y) on the time of studies T (x).

Comparison of all these indicators made it possible to analyze the state of injuries over the studied period of time in dynamics. Table 1 shows all the data on injury rates (Uakhitova et al., 2022).

Figure 5 shows the dependence of the distribution of the total number of accidents A on the DMPP in the period 2011–2020 in the form of a polynomial of the 4th degree: y = 0,0192x4 - 155,03x3 + 468656x2 - 6E+08x + 3E+11 with an approximation coefficient R2 = 0.5412. The approximation is satisfactory, close to 54 % convergence.

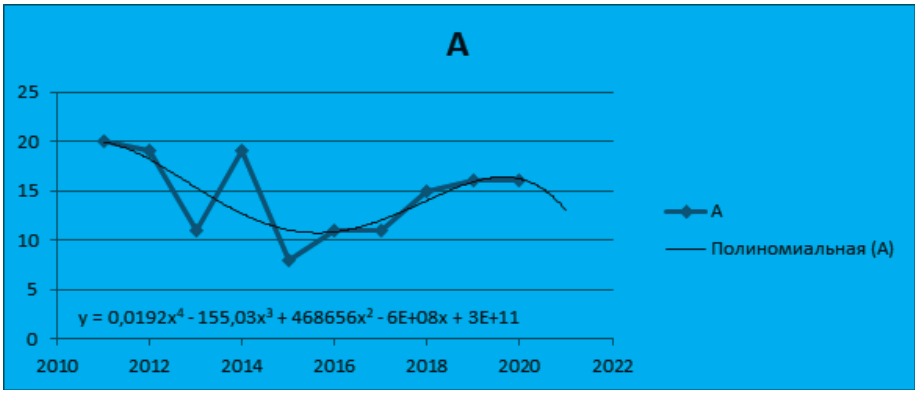

Fig.5. Graph of the polynomial dependence of the total number of accidents A (y) on the time of research T (x).

In 2011 there was the largest number of accidents, from 2012 to 2015 it has a zigzag character and further, since 2016 there has been an increase in accidents. The largest number of accidents was observed in 2011, 2012 and 2014. The average number of accidents per year for this period of Asr = 14.8.

The dependence of the distribution by the frequency coefficient of the Hf (see Figure 1) is similar to the dependence of the distribution of the number of accidents, with almost the same peaks of maximum and minimum over the years. The coefficient of approximation of the dependence is quite high R2 = 0.536, which indicates the reliability

of the described dependence of the frequency coefficient of the Cf on the time in the study period, with the average value per year of the Cf = 2.05.

Figure 2 shows a graph of the distribution function of the Cs severity coefficient for the study period. The approximation of this polyline gives a polynomial function of the 4th degree with a coefficient R2 = 0.334. Evaluating this function, one can observe the highest Cs value for the entire study period in 2011. The average value of Cav for the study period is Cav = 26.79

Figure 3 shows the distribution of the indicator of total injuries of the Ct on the DMPP in 2011-2020. The actual statistical data presented on the graph by a blue polyline with highlighted points are well approximated by a polynomial of the 4th degree y = 0,0268x4 - 215,99x3 + 652177x2 - 9E+08x + 4E+11, since the approximation coefficient R2 = 0.630.In general, we can say, based on the presented graph (see Figure 3), that at the beginning of the study period, the Co had a maximum value of 85.91, then there is a decline in 2013 and 2015 (45 and 23.2), in 2014 it has an indicator of 64.5 and in 2016. the indicator is being increased until 2019. The average value of the index of total injuries for the study period of the Ctav = 54.97.

Figure 4 shows the distribution of the Cm – mortality coefficient for the study period, the actual values of the points were also approximated by a polynomial of the 4th degree (using Microsoft Excel): y = -0,0002x4 + 1,6209x3 - 4900,7x2 + 7E+06x - 3E+09. There is one peak of the maximum occurring in 2012. In general, the distribution of Cm is uneven with periods of sharp rise and sharp decline, so the function is nonlinear and its description is due to a polynomial of a sufficiently high degree. The average value of Cm = 0.154.

Figure 5 shows a graph of the dependence of the number of accidents in the study period. This dependence is presented in the form of a polynomial model. Analysis of this model shows that the number of accidents in recent years tends to increase. One of the objective reasons for this process is also the indicator of the growth in the number of employees at enterprises in recent years, which are shown in Table 1.

Table 2,3 presents data on injuries in DMPP by main and auxiliary workshops and mines. Mines accounted for 89 accidents out of 148 during this period, i.e. more than 60% of all cases during the study period, including 7 fatal accidents (63 % of fatal accidents from the total number in the whole plant). 40 heavy out of 73 in the whole plant, or 54.7 %

Table 2. Data on injuries for the study period in the context of the workshops of the DMPP.

DMPP workshops	Years										In just 10 years
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	
ФООР		3(л)	1(т)	1(л)		1(т)	1(л)				7(5л,2т)
ш. Молодёжная	1(л) 6(т)	3(л)	2(л) 1(т)	1(л) 3(т) 1(с)	1(л) 1(т)	2(л) 1(с)		2(л)5(т)	2(л) 1(т)	1(л) 1(т)	35(15л, 18т, 2с,)
ш. ДНК	3(л) 2(т)	1(т) 2(с)	1(л) 3(т)	5(л) 1(т) 1(с)	1(л)		1(л)	1(л)4(т)	1(л) 3(т) 1(с)	1(л) 4(т) 1(с)	37 (14л, 18т, 5с)

ДОФ№1	1(л) 2(т) 2(с)					1(л) 2(т)	1(л)	1(т)			10 (3л, 5т, 2с)
Donskoy Mine		1(т)		1(л) 1(т)		1(т)					4(1л,3т)
Other workshops	2(л) 1(т)	7(л) 1(т) 1(с)	3(т)	1(л) 3(т)	3(л) 2(т)	1(л) 2(т)	1(с) 8(т)	2(л)	6(л) 3(т)	4(л) 4(т)	55 (26л, 27т,2с)
Total	20 (7л, 11т, 2с)	19 (13л, 3т, 3с)	11 (3л, 8т)	19 (9л, 8т, 2с)	8 (5л, 3т)	11 (4л, 6т, 1с)	12 (3л, 8т, 1с)	15 (5л, 10т)	17 (9л, 7т, 1с)	16 (6л, 9т, 1с)	148 (64л, 73т,11с)

Note. Designations in the table: m – minor injury; s – severe injury; c – fatal injury; d – occupational disease; PODF – pelletizing and ore dressing factory; CPP №1 – crushing and processing plant №1; m. - mine.

Table 3. Distribution of accidents by profession.

Profession	2016	2017	2018	2019	2020	Total number
The sinker	5	1	5	8	7	26
Scraper winch driver			2	1	2	5
Electrician on duty and equipment repair	1	1	1	1	1	5
The bomber		1	2			3
Conveyor operator		2	1			3
Locksmith on duty and equipment repair		1	1			2
The fastener		1		1		2
Miner				1	1	2
Driver of pumping units (underground)	1	1				2
The Tippler's Apprentice				1		1
Feeder Driver			1			1
The driver of an electric locomotive			1			1
Kitchen worker					1	1
Driver					1	1
Plumber					1	1
Locksmith repairman				1		1
Electric and gas welder				1		1
Power engineer of the EMS-2 site		1				1
Electrical engineer				1		1
Security officer				1		1
Thickener Apparatchik	1					1
Crusher	1					1
Apparatus for the preparation of briquette mixture	1					1
Surveyor		1				1
Car repair mechanic		1				1
Plasterer-painter	1					1
Railcar driver		1				1
Loader driver	1					1

Acting mining master			1			1
Freight Forwarder					1	1
Drilling rig operator					1	1
	12	12	15	17	16	72

Based on Table 2, the distribution of accidents by profession for 2012–2020, it can be seen that the most committed to injury are workers of dangerous professions such as tunnellers (36.1 %), a scraper winch operator (6.9 %), an electrician for equipment repair (6.9 %), an explosive (4.6 %), a conveyor operator (4.6 %), locksmith on duty and repair of equipment (2.8 %), fastener (2.8 %), miner (2.8 %), pump operator (underground) (2.8 %) and other professions have isolated cases (Vasilyeva et al., 2014; Vetrov et al., 2019).

Conclusions

As a result of the study, the dynamics and nature of changes in the main indicators of occupational injuries have been established. It is established that the prevailing factors of changes in injury rates are the severity coefficient and the coefficient of the indicator of general injury, which in recent years has tended to increase. The dynamics of the change in the effective indicator from the main factors is investigated, a mathematical model of the change in the frequency coefficient y = 0,003x4 - 23,863x3 +72135x2 - 1E+08x + 5E+10: the severity coefficient y = 0,0066x4 - 53,008x3 + 160473x2 - 2E +08x + 1E+11: the indicator of general injury is obtained y = 0,0268x4 - 215,99x3 + 652177x2 - 9E+08x + 4E+11. The analysis of the obtained models showed a close correlation between the effective feature and the studied factors.

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