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ROLE OF FUMIGATION IN LABOUR CONDITIONS CHARACTERISTIC OF THE GRAIN TRANSPORT CONVEYOR WORKERS

РОЛЬ ФУМИГАЦИИ В ХАРАКТЕРИСТИКЕ УСЛОВИЙ ТРУДА РАБОЧИХ ЗЕРНОВОГО ТРАНСПОРТНОГО КОНВЕЙЕРА

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Abstract

Complex investigations of working conditions of specialists, involved in the export of grain in Ukraine at all stages of the transport conveyor (elevators - freight transport - rail - enterprises for the primary processing of grain and seeds - grain terminals at sea and river ports - ships for grain transportation in bulk (bulkers)) is made. Under supervision there were 755 people, males, aged 27-56 years, with the occupational experience 3-35 years. All workers were divided into 6 groups: 1.- workers of elevators and grain terminals; 2 - workers of the enterprises for processing of grain and seeds; 3. - workers of fodder industries; 4. – truck drivers; 5 - specialists of fumigation units; 6 – workers without any contact with grain cargoes, control. The research included: analysis of occupational activities by professiografic methods (multimoment observations and self-made checking of working operations and time), assessment of hazards in the volume requirements for certification of workplaces (microclimate parameters, noise, vibration, the definition of dust, germs and fungi, chemicals in the air, including phosphine, indicators of severity and intensity of labor), the study of morbidity with temporary disability according to the company's data and symptoms of health disorders mentioned in a specially designed questionnaire. The results showed that the surveyed workers are exposed to general and specific hazards types of the working environment. It established the important role of residual amounts of phosphine and airborne dust generated during overload, moving under fumigation of grain and seeds at grain elevators, port terminals, as well as containing the germs and fungi bioaerosol as sources of harmful effects on the operators and truck drivers, which plays an important role in the etiology and pathogenesis of occupationally caused diseases in participants of grain transport conveyer. Concentrations of vegetable dust in grain elevators and terminals exceed the permissible exposure limit (4 mg / m^3) in 2-6 times, and the phosphine concentration in the breathing zone of fumigation specialists - up to 15 times. The surveyed groups of workers also greatly differ in severity and intensity of labor. On the basis of integrated work assessment of elevators, grain terminals personnel and specialists in fumigation assigned to class 3.2, animal feed mills workers of and truck drivers – to class 3.1, and workers of the enterprises for processing of grain and seeds - to the 3.1 - 2nd classes in accordance with the current hygienic classification. It is designed and implemented a range of preventive measures to improve working conditions and of the health preservation of workers the grain transportation conveyor. Further researches are needed to differentiate hygienic assessment of employees grain processing industries and the transport conveyor. The necessity for correction of grain dust PEL considering content of not deposited fractions of pesticide residues primarily fumigants.

Keywords: grain, transportation, fumigation, phosphine, workers, working conditions.

Streszczenie

ROLA FUMIGACJI W CHARAKTERYSTYCE WARUNKÓW PRACY RUROCIĄGU DO TRANSPORTU ZBÓŻ. Kompleksowe badania warunków pracy zaangażowanych w eksport zboża na Ukrainie na wszystkich etapach przenośnika transportu (windy - transportu towarowego - kolejowe - przedsiębiorstwa do pierwotnej obróbki zbóż i nasion - terminale zbożowe w portach morskich i rzecznych - statki do przewozu luzem ziarna (bulkers)). Pod obserwacją były 755 osoby, mężczyźni w wieku 27-56 lat, z doświadczeniem w

zawodach studiował 3-35 lat. Wszyscy badani zostali podzieleni na 6 grup: 1 - pracownicy windy roboczych i terminali zbożowych; 2 - pracownicy przedsiębiorstw do przetwórstwa zboża i nasion; 3 - pracownicy RSS gałęzi przemysłu; 4 - kierowcy ciężarówek; 5 - eksperci w fumigacji; 6 – pracownicy nie kontaktujący się z ładunkiem zboża, kontroli. Badaniami objęto: analiza działań produkcyjnych professjograficznych metod multimomentnych obserwacji i samofotografii czasu pracy, ocena zagrożeń w wymogami głośności dla certyfikacji zakładów pracy, badania zachorowalności o czasowej niezdolności do pracy, zgodnie z firm i objawów zaburzeń zdrowia specjalnie zaprojektowany kwestionariusz. Wyniki wykazały, że badani eksperci są narażone na ogólnych i szczególnych zagrożeń w środowisku pracy. Ustalono ważną rolę resztkowych ilości fosfinie i unoszącego się w powietrzu pyłu wytwarzanego podczas przeciążenia, przemieszczają się w ramach fumigacji ziarna i nasion w elewatorów zbożowych, terminalach portowych, a także zawierający bakterie i grzyby bioaerozolu jako źródeł szkodliwego wpływu na operatorów i kierowców pojazdów, który odgrywa ważną rolę w etiologii i patogenezie chorób spowodowanych u pracowników profesjonalnych ziarnotransportowych rurociągów eksportowych. Stężenia pyłu roślin w elewatorach zbożowych i ziarnoterminalach przekraczały maksymalnego dopuszczalne (4 mg / m3) w 2-6 razy, a stężenie fosfina w strefie oddychania odpowiedniej fumigacji - do 15 razy. Grupy pracowników ankietowanych również znacząco różniły się w nasileniu i intensywności pracy. Na podstawie zintegrowanej oceny pracy ekspertów w fumigacji przypisane do klasy 3.2, pracownicy elewatorów zbożowych, terminale zboża, produkcji pasz, kierowcy ciężkich pojazdów - do klasy 3.1 i pracownicy przedsiębiorstw do przetwórstwa zbóż i nasion - do 3,1-2.0 klasom obecnej klasyfikacji higienicznej. Zaprojektowaliśmy i wdrożyliśmy szereg środków mających na celu poprawę warunków pracy i ochronę zdrowia pracowników ziarnotransportowego przenośnika. Konieczne są dalsze badania, aby odróżnić ocenę higieniczną przemysłu przetwórstwa zboża i pracownicy rurociągu transportowego. Konieczność korekty RPP ziarna pyłu biorąc pod uwagę jej treść zawisu i frakcji pozostałości pestycydów głównie fumigacji.

Słowa kluczowe: zboża, transport, odgrzybianie, fosfin, pracownicy, warunki pracy.

Реферат

Проведены комплексные исследования условий труда работников, участвующих в операциях по экспорту зерна в Украине на всех этапах транспортного конвейера (элеваторы – грузовой автотранспорт – железнодорожный транспорт – предприятия по первичной переработке зерна и семян – зерновые терминалы в речных и морских портах – суда для перевозки зерна насыпью (балкеры)). Под наблюдением находилось 755 человек, лица мужского пола, в возрасте 27-56 лет, со стажем работы в изучаемых профессиях 3-35 лет. Все обследуемые были разделены на 6 групп: 1.- рабочие элеваторов и зерновых терминалов; 2. – работники предприятий по переработке зерна и семян; 3. – работники комбикормовых производств; 4. – водители грузовых автомобилей; 5. – специалисты по фумигации; 6 – не контактирующие с зерновыми грузами, контроль. Исследования включали: профессиографический анализ производственной деятельности методами мультимоментных наблюдений и самофотографии рабочего времени, оценка вредных и опасных факторов в объеме требований к аттестации рабочих мест, изучение заболеваемости с временной утратой трудоспособности по данным предприятий и симптоматики нарушений в состоянии здоровья по специально разработанным анкетам. Результаты исследований показали, что обследованные специалисты подвергаются действию общих и специфичных вредных факторов производственной среды. Установлена важная роль остаточных количеств фосфина и витающей пыли, образующейся при перегрузке, перемещении фумигированного зерна и семян на элеваторах, портовых терминалах, а также содержащего микробы и грибы биоаэрозоля, как источников вредного воздействия на организм операторов и водителей автотранспорта, что играет важную роль в этиологии и патогенезе профессионально обусловленной заболеваемости участников экспортного зернотранспортного конвейера. Концентрации растительной пыли на элеваторах и зернотерминалах превышали предельно допустимые (4 мг/м^3) в 2-6 раз, а концентрации фосфина в зоне дыхания специалистов по фумигации – до 15 раз. Группы обследованных рабочих существенно отличались также по тяжести и напряженности труда. На основе интегральной оценки труд работников элеваторов, зерновых терминалов, специалистов по фумигации отнесен к классу 3.2, комбикормового производства, водителей большегрузных автомобилей – к классу 3.1, а работников предприятий по переработке зерна и семян – к 3.1-2-му классам по действующей гигиенической классификации. Разработан и внедрен комплекс мероприятий по оздоровлению условий труда и сохранению здоровья работников зернотранспортного конвейера. Необходимы дальнейшие исследования по дифференциации гигиенической оценки труда работников зерноперерабатывающих производств и транспортного конвейера. Показана необходимость коррекции ПДК зерновой пыли с учетом содержания в ней витающих фракций и остаточных количеств пестицидов, прежде всего, фумигантов.

Ключевые слова: **зерно, транспорт, фумигация, фосфин, рабочие, условия труда.**

Introduction. The agricultural sector is one of the leading and most promising in the modern economics of Ukraine. Its products are in demand not only in domestic but also foreign markets. Over the last seven years, our country agricultural exports increased 3.5 times. Today, Ukraine - the world's third grain exporter after the US and the EU with an index of 35-36 mln. t and a share of the world market - 11% [1]. For analytical estimates of international experts at the beginning of the third decade of the 21th century this country can

take second place in this ranking. Further development of the strategic direction of the economy requires not only the intensification and positive dynamics of agricultural production, but also the development of the infrastructure, transport conveyor, including trucks, railway wagons (hoppers), sea and river grain terminals. Over the next two years, the capacity of grain storage in elevators and ports planned to increase on 10 mln. t [2]. The volume of Ukrainian grain export exceeded the volumes of the Soviet times to 40 times. However, the quality of Ukrainian wheat is low, we have great difficulties in the production of wheat 1-2- classes. Poor quality of Ukrainian grain (its contamination by pests, the number of broken grains and trash) impede the development of new markets. [3]. All of this results not only economic losses, but also adversely affect the working conditions of all parts of agriculture process, from grain production to grain transportation conveyor. In hazardous conditions, according to official statistics, are working up to 40% of agricultural workers [4].

Numerous studies have shown the relationship between the degree of danger of acting on the body of workers of agriculture of harmful environment factors and indicators of health of the contingent of experts [5-7]. So, for example, carried out by J. Manfreda et al. [8] investigations among Canadian farmers, have shown that the symptoms of an exacerbation of acute and chronic respiratory diseases correlates with the overall experience, the number of days per year to the grain dust exposition (planting, cleaning swath, delivery of grain to the elevators). L. Tapp and D. Sylvain [9] reported of respiratory and skin diseases cases in inspectors, performing quality control of peanuts quality during transportation.

An important factor is the presence of pathogenic bioaersol containing a wide range of microbes, elements of the fungal mycelium, spores and endotoxins. Microorganisms in organic agricultural dust include Gram-negative bacteria, which are characterized by the presence of endotoxins in the outer bacterial cell wall membrane. [10-12].

Established relationships are used in dealing with hygienic standardization, working conditions certification, development of recommendations on improvement of and sustainable production. All this determines the social and economic importance of the integrated evaluation and classification of labor hygiene [13]. Traditionally, such a classification is based on the certification of workplaces. In Ukraine, it is conducted on regulated by legislation and regulations technique. However, being very formal, it does not take into account a number of important aspects relating, in particular, the characteristics of the contact workers against harmful factors in the working environment of their list, the exposure time and the degree of deviation from the norms of hygiene. The authors of this study have revealed such shortcomings in the assessment of labor conditions grain transportation

conveyor. First of all, it came in contact with pesticides, processing which is widely carried out in growing grains and oilseeds, and especially, during the fumigation of grain and seeds of the harvest, storage and transport to consumers to control pests of plants, stocks and grain productions [14, 15].

There are more than 400 species of pests of stocks of damaging the grain and its products during storage. Of these, 116 species are found in Ukraine [16]. Grain storage pests infest the excrement, larval skins, dead specimens, rot, cobwebs. Corn sticks together in clumps, compacted, increases its temperature and humidity, which leads to self-warming, damage, deterioration of baking qualities of flour and taste the products. Brocken by insects and damaged grain more frequently will inhabit fungi causing mold, dust and human and animal poisoning - mycotoxicoses. Therefore, spoiled grain can not be used for making bread and animal feed [12, 14].

Total in the world of grain storage pests is lost every year sufficient to feed 135 million of people. Even in countries with a high level of agricultural development and agrarian science damage from pests grain and grain products during storage is very high: in the US alone, these losses are annually about 300 million dollars [17].

One of the most effective methods of preventing the spread of harmful species between and within countries is disinfection (fumigation) of agricultural, forestry and industrial products, containers, warehouses, silos, wagons, holds of ships, trucks, buildings of refineries with gaseous pesticides, fumigants [18]. The use of gaseous insecticides for pest control products and plant stock is particularly necessary in the case of quarantine significance for the importing country. Harmfulness, high viability such quarantine species as capric beetle force, regardless of the cost to conduct the fight against using fumigants in any condition to the complete elimination of the pest [19].

An ideal fumigant should have the following features: acute toxicity to immature stages and adult insects with no danger to humans; volatility and good penetration ability, low sorption capacity; have warning properties (smell) and is easily detected; noncorrosive materials, not be flammable and explosive, well-kept; quickly and completely evaporate from the product; does not affect the germination of seeds, planting material survival, quality of grains, fruits, vegetables, etc.; low cost, including the expenses of the application for an effective expenditure rate; be affordable, easy to use and cost-effective; not to contribute to the acquisition of resistance in insect pests [14, 15, 18,19]. Such fumigants are not yet created.

One of the most effective fumigant is recognized methyl bromide, which for decades has been used extensively in many countries [20, 21]. However, in the process of its

evaporation degassing atmosphere leads to the destruction of the ozone layer of the planet. Therefore, signed in 1987. The Montreal Protocol requires a complete cessation of the production and use of methyl bromide [22, 23]. Fumigation of grain and grain products began to carry out preparations based on phosphine. Phosphine is mainly for disinfection of grain under different conditions of storage and transportation. Optimal exposure contact with the fumigant is 7-11, and even 14 days. Significantly reduces the effectiveness of treatment of a gas leak in the ground docking ring segments and roof silage covers ship holds, pipelines and highways of communication. Given the high risk of phosphine for human health and life (permissible exposure limit, PEL = 0.3 ppm), the 1st class of danger) incidents that took place many times, acute, chronic poisoning, including fatal cases, this creates great complexity and high responsibility of the authorized persons in its application [8, 24, 25]. Many aspects of the actual problem of human safety and health during the fumigation exposure and postfumigatsion period remain poorly understood.

Therefore, **the purpose** of the study was to examine the characteristics of contact with the fumigant phosphine workers grain transportation conveyor of Ukraine on its various stages, establishing a connection with the incidence and development of recommendations on improvement of working conditions.

Contingents, material and methods. Under supervision there were 755 people, males, aged 27-56 years, with the occupational experience of 3-35 years. All workers were divided into 6 groups: 1 - specialists of fumigation; 2.- workers of grain terminals; 2. - drivers; 4. - workers of elevators; 5 - workers of the enterprises for processing of grain and seeds; 6 – workers without any contact with grain cargoes, control. All groups of employees were almost identical in age, work experience and demographic characteristics. The researches included: analysis of occupational activities by professiografic methods (multimoment observations and self-made checking of working operations and required time), assessment of hazards in the volume requirements for certification of workplaces (microclimate parameters, noise, vibration, determination of dust, germs and fungi, chemicals concentrations, including phosphine, in the air of the working zone, indicators of severity and intensity of labor). The concentration of dust in the air was measured with a device "Dust Measuring - GM-124" (Novotek-Electro ", Ukraine). Along with the total amount of particulate material (general dust concentration), the device can measure the fraction of airborne dust in the range of particle diameter 1.0-5.0 μm [26]. The phosphine content in the air determined by “Dräger X-am® 7000 Portable MultiGas Detector” (Draeger, Germany) and a set of test tubes that are certified in Ukraine. The study of morbidity with temporary

disability according to the company's data and symptoms of health disorders, mentioned in a specially designed questionnaire. The obtained data were statistically processed using the software package in Microsoft Excel [27].

Results and discussion. Analysis of the received data showed that the employees occupational activity of the main divisions of the grain-processing enterprises and transport system occurs under conditions of the action of harmful factors, which parameters in the performance of the most manufacturing operations or almost constantly during the working shift act on the workers organism and may reach or exceed the permissible levels (Table 1).

Table 1. Hygienic assessment of working conditions and the labor process and transport workers grain processing conveyor

No.	Harmful factors, marker of the labor process	Groups of workers*, operating factors **					
		1	2	3	4	5	K
Occupational harmful factors		3.2	3.1	3.2	3.1	3.2	2.0
1.	Air temperature	+	+	+	+	+	
2.	Noise	+	+	+	+		
3.	Whole-body vibration				+		
4.	Air dust	+	+	+	+	+	
5.	Biological aerosol	+	+	+	±	±	
6.	Oil aerosol			+	+		
7.	Hydrocarbons		+	+	+		
8.	Exhausting gases	+			+		
9.	Phosphine	±	±	±	±	+	
The labor severity		3.1	3.1	3.2	3.1	3.1	2.0
1.	Lifted cargo weight		+	+			
2.	Working pose		+	+	+	+	
The labor intensity					3.1	3.2	2,0
1.	Perception and evaluation of signals				+		
2.	Personal risk				+	+	
3.	Responsibility for other people				+	+	
4.	Shift system	+	+	+			
5.	Exceeding 8 hours working day				+	+	
Total assessment of working conditions		3.2	3.1	3.2	3.1	3.2	2.0

Notes: * / 1.- workers of elevators and grain terminals; 2 - workers of the enterprises for processing of grain and seeds; 3 - workers of animal feed mills; 4. - truck drivers; 5. - specialists in fumigation; 6 - no contact with grain cargoes, control; ** / operate continuously (+); occasionally exist (±)

Summarized in Table 1 the results of the study indicated that the surveyed workers are exposed to general and specific hazards of the working environment. The first include

microclimate, noise, vibration, exhaust gases, fuel vapors and oil spray, the second (specific) – dust, biological aerosol and chemical component (the presence of trace concentrations of phosphine in the working area, migrating from fumigated grain). As to the track driver working conditions assessment, in the first group of harmful factors only whole body vibration significantly exceeds the permissible level in drivers' cabins (determined by the corrected equivalent values of vibration velocity exceeds the maximum permissible levels KAMAZ 53215 in 5-9 dB, MAZ-6501A8 - 11-14 and MAN TGA-18/840 – 2-7 dB). With regard to the parameters of the microclimate, noise and exhaust gases components, they also exceed acceptable levels, yet in relatively short time (loading, unloading, agile regime in the territory of elevators and grain terminals). The potential negative health effects are partly compensated by long-term parking with the engine off in the queues at the entrance the objects of the destination (port or elevator, farm or mill).

Much less information was obtained about the levels of phosphine in the cabins air. The documents, accompanying the transported grain, are not contained any references to an earlier performed fumigation. Drivers notice the presence of a light smell of garlic in the column "rare" in no more than 20% of the number of completed questionnaires; and the special instrumental measurements of phosphine when accepting grain cargo does not exceed.

It should be noted that in the characteristic of the working conditions of other groups of grain conveyor workers specific factors (total and vital dust, bioaerosols, presence of phosphine in air of working zone) clearly are dominant. Characteristics of grain and vegetable dust, the species composition of microflora and related toxic danger consist in a large number of studies [7, 12, 23]. However, the relationship between the intensity and exposure time in the vast majority of publications consider only work experience in their respective professions. At the same time the main motive of this approach to the issue of safety and health of workers is determined, as a rule, the discovery of chronic diseases of the respiratory, digestive systems, skin and subcutaneous tissue [28]. At the same time, in the employees of the grain complex there are also cases of acute occupational conditioned diseases [29, 30]. The problem is not limited only to their clinical significance. To address issues of regulation, to ensure safety, the development of measures for its improvement and social compensation such an approach is necessary, but not sufficient. Therefore, we used a fairly simple way to assess the degree of integrated exceeding the permissible level (S) and the total time of exposure (t) to harmful factors of the working day, determine the integral value of the impact of the formula:

$$K = S \cdot t \qquad (1)$$

Its values for all major groups of workers surveyed are shown in Fig. 1.

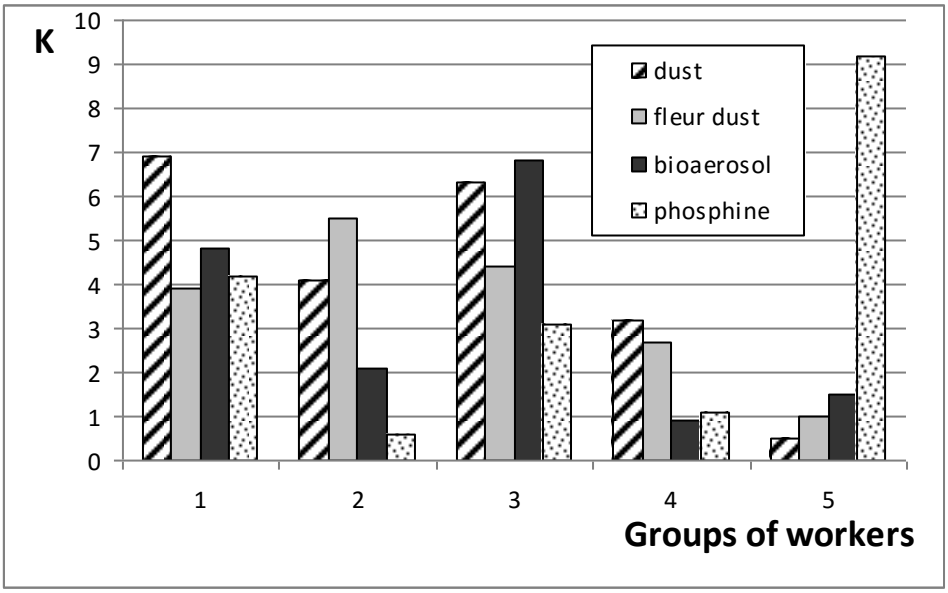

Fig. 1. Integral index of the leading harmful factors significance in the hygienic assessment of working conditions in the grain transport conveyor (1- workers of elevators and grain terminals; 2- workers of the enterprises for processing of grain and seeds; 3- workers of animal feed mills; 4- truck drivers; 5-specialists in fumigation

As it can be seen from the represented in Fig. 1 data, the first three groups of grain conveyor workers demonstrated practically similar values of existing specific environmental factors. This reflects the similarity of technologies and materials of receipt, storage, primary processing of grain with a high dusting. Attention should be paid to higher levels of fleur dust on the grain processing enterprises (especially flour mills) and most pronounced air pollution by microbes and fungi in animal feeds production. It is corresponds with the quality of grain below and contamination by microorganisms and fungi higher, than that of food grain.

It should be also taken into account the significant differences in certain indicators in the workplace truck drivers and fumigators from defined hereinbefore. In these groups influence of specific "grain" factors is not so typical. The integral assessment of these groups of workers play an important role. Simultaneously with the harmful physical and chemical factors, markers of labor process (difficulty and intensity of labor) play an important role. Track drivers and fumigators display signs of emotional stress, personal risk and are responsible for the lives of others.

The performed researches enable us to give a comprehensive hygienic assessment of working conditions and labor process of the surveyed the main groups of participants of the

grain production and transport conveyor. It corresponds with the materials of the performed analysis of the health status of workers according to human resources and accounting departments enterprises' (temporary disability indices), and empirically designed questionnaires. Although these employers, as a rule, significantly underestimated the ratio of the incidence of both groups were not statistically significantly different ($p < 0.05$) for some classes of diseases such as respiratory, skin and subcutaneous tissue, allergic diseases (2.1, 1.3 and 1.75 fold, respectively). Differences in disease of the gastrointestinal tract and the cardiovascular system manifested only in the form of a tendency.

Data on occupational diseases among the examined contingent workers is practically absent. However, one of the confirmations of the relationship existing hazards and health of workers is an official information about the three cases of vibration disease in drivers of observed specialized auto park of heavy vehicles.

Noteworthy is the presence of relatively high levels of phosphine in the air (by 2-5 times, and even much higher of PEL in 5-7% of analyses). This points to the need for requiring a mandatory notification to suppliers of fumigation, as well as of instrumental measurements of the phosphine presence in the air of the trucks cover space, open railroad cars (hopper) hatches to prevent poisonings and functional changes in workers organism.

In our studies, signs of the respiratory system disorders were somewhat different from those described in the literature. It concerns mainly two features: first, they are quantitatively higher than the published data; secondly, they do not arise naturally (regularly) at each subsequent contact with the dust and bioaerosols, but occasionally. Although a direct connection between these manifestations of the harmful effects of production factors on workers organism with phosphine is virtually impossible to establish, some grounds for this conclusion are taking place.

Among the predominant symptoms are noted such as chest tightness, cough, tinnitus, weakness, nausea and even vomiting, loss of appetite, which do not relate to the dominant under the influence of dust and bioaerosol. In some cases, it was preceded by a garlic smell and taste in the mouth. In some cases, symptoms appear after the end of the working day (shift). These symptoms are observed almost exclusively working elevators and grain terminals, where contact with the fumigated grain is more likely. Only in a few cases (5.2%) are recorded at the truck drivers and workers feed production. In the grain processing such complaints were not. Finally, an important feature of the described violations is their similarity with the complaints professionals fumigation units, although the latter are marked by almost 1.5 times more likely.

These data, according to the authors, represent interest is not only in terms of direct health hazards, but also the possibility of modulating (combined) actions with other harmful factors in the working environment. Although the phosphine is not a poison with cumulative action, this reflects, as a rule, a lack of ability to material cumulation. This summation of toxic and sensibilizative effects followed by more sensitive to repeated exposure workers not excluded. Still in 1990 T.S. Hurst and J.A. Dosman [31] stressed that "the grain dust should be regarded as a dust with toxic properties, not just a nuisance dust". The possibility of migration from grain mass and dust in the air of industrial premises residual fumigants fully confirms this position.

Conclusions

1. The work of representatives of all major professional groups specialists of grain transport conveyer for the export of agricultural products from Ukraine is connected with physical, chemical, biological and psycho-physiological factors action, the levels of which reaches hazardous to health values.

2. In addition to such relatively well-studied dominant factors, like high levels of particulate air pollution, the presence of bioaerosol (microbes, molds, fungal spores, endotoxins), one of the leading by frequency and levels of exposure factor is phosphine in the air of the working area. It stands out from fumigated grain in concentrations above PEL in some workplaces and during certain periods of the production process in 10-150 times (up to 1.0-15.0 mg / m^3).

3. Analysis of the available data on the incidence of workers, the survey results and comparing them with literature data showed that exposure to phosphine containing fumigants and contact with occupational complaints results functional disorders of the respiratory, nervous and digestive systems, skin and subcutaneous tissue is higher than in the control group and in the periods of absence of contact with the phosphine. Although isolate the impact of the fumigant exposition of workers health is not feasible, its contribution to the incidence of exposed contingents can be considered as an established fact.

4. Carried out in progress of work researches allowed to prove a more clear assessment of working conditions of basic groups grain transport conveyor workers, taking into account the levels of production and due to the exposure time of the fumigant in combination with other harmful factors of the occupational environment and labor process: fumigation units workers and drivers of heavy vehicles should be classified as 3.2, employees of grain elevators, mixt fodder mills and specialized grain terminals of marine and river ports - 3.1, milling and vegetable oils plants - to the 2nd class of the existing hygienic classification

of work. Due to the heterogeneity of the examined groups of workers, the technological features of production, these studies should be continued in the future.

5. On the basis of studies it was developed and implemented a set of preventive measures A set of preventive recommendations measures was developed and implemented, which includes indication of phosphine concentrations in the air at all stages of grain transport conveyer, control over the use of personal protective skin and respiratory protective means, in-depth periodic medical examinations in view of the leading risk factors, as well as introduction of advanced technologies of grain transportation, including sealed transport systems, soft containers of "Big Bag" tipe e.a.

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