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FIRE ON BOARD: HYGIENE, TOXICOLOGY, PSYCHOPHYSIOLOGY

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Among the emergency situations on board ships and oil platforms fires are among the most frequent and dangerous, both for people's lives, and the tangible assets (ships, cargo, port equipment and facilities), as well as in terms of environmental pollution. The value of the risk of fire on board by the properties of cargo, type and age of the vessel, the quality of training (in accordance with the IMO International Convention STCW 78/95), and experience of the crew, sailing conditions and other factors.

Therefore, implementation of fire protection, including toxicological and hygiene, activities, is an actual problem of modern shipbuilding and shipping. Designed and implemented a system of toxicological-hygienic and medical and psychological security, which is being promoted in the transportation industry. It includes both normative and methodological framework, evaluation criteria and Hygienic Regulation of polymeric materials, as well as psycho-physiological selection, training and auditory training of seafarers and passengers. Introduction of the developed measures in the shipbuilding and shipping practice has significant social, economic effect.

Keywords: fire on board, hygiene, toxicology, psychophysiology

Introduction

Among the emergency situations at sea going passenger, cargo, fishing vessels and drilling platforms, fires are among the most frequent and dangerous, both for human life and material assets (ships, cargo, port equipment and facilities), as well as in terms of environmental pollution.

Fire is an uncontrollable process of burning (exothermal oxidizing reaction with the release of a considerable quantity of heat), characterized by unpredictability (suddenness), prompt in the development, arising under condition of interaction of three necessary elements: combustible substance, an oxidizer and a source of ignition [1].

According to the statistics, the world fleet loses in fires are up to 10 % of suffering disaster ships [2]. This concerns not only the big material losses, but also of human life. The value of the risk of fire on board is defined by the properties of cargo, type and age of the vessel, the quality of training (in accordance with the IMO International Convention STCW 78/95), and experience of ship officers and crew, sailing conditions and other factors. However, in all their diversity, more than two-thirds of all fires on ships is determined by the human factor, i.e. such action (or inactivity) of the ship staff and passengers, who expressly or by implication became the reason of ignition and distribution of fire in ship premises.

Therefore, implementation of fire protection, including toxicological and hygienic measures, on the stages of design, construction and operation of the vessel, as well as primary and the subsequent training of seafarers, driven to automatism individual action and interaction, as well as permanent training of all crew members and passengers, is an urgent problem of modern shipbuilding and navigation [3].

Joint efforts of scientists, engineers, technologists, hygienists, under

the supervision and with the participation of the IMO, shipbuilders and ship owners, was created the legislative base defining the requirements for ship systems of fire safety. These requirements are based on the provisions of ISO, IEC standards, EU directives, WHO, ILO and IMO conventions, codes, recommendations, as well as national regulations and standards harmonized with international documents [4].

Along with the technical, technological, organizational measures to ensure fire safety of ships and cargoes, the system includes hygiene, medical and psychological elements that solve the problem of preservation of life and health of people in fires on ships.

Creating and implementing a quality management system in the area of fire safety, the experience of its use on vessels show positive results, confirmed by the practice of emergency response in the sea. Nevertheless, the risk of fires occurrence on ships is high, and the threat to life and health of seafarers, passengers and tourists, crews of drilling platforms, ports, is real and requires a system of effective measures for its reduction.

The purpose of the performed during several years in the Ukrainian Scientific Research Institute of Transport Medicine researches was developing a set of hygienic, toxicological, physiological and medical measures and methods to reduce the risk of fires on ships, prevention, aimed at increasing psychological tolerance to stress, formation of readiness to respond adequately to emergency situations, maintaining the health and lives of seafarers.

Materials and methods

The researches were performed during the trips on 7 ships of Ukrainian shipping companies and 4 ships after taking place emergencies (retrospectively). Under supervision there were 112 seamen, who passed as minimum double psychophysiological examinations on board or during permanent (each 5 years) testing in the Simulator Training Centre, and also 3-4 year studied cadets from the Odessa National Maritime Academy (ONMA) before and after the practice on sea going ships (during 4-6 months). For the psychophysiological status estimation, degree of professionally important qualities (PIQ) formation, first of all, stability to stress, surveyed seamen and cadets solved set of tests with the computer psychophysiological complex «MORTEST» in updating «SPAS-8» [5-7], and also blank tests and specially developed questionnaires [7].

According to requirements of national and international standards [8, 9], there hygienic and toxicological researches of combustion products of 186 polymers, paints and varnish materials of transport appointment were perfirmed. The used tests were in agreement with recommended methodical documents [10], made on installations, which are modified in our laboratory (including though to the two step tests of cable production installation) [11], that opens new possibilities for more reliable hygienic certification of electrotechnical production, including ship-building appointment. In tests of polymeric materials to definition of qualitative and quantitative structure of products of burning applied methods of a gas chromatography, the chromato-mass spectrometry, the inductive-connected plasma and atom-absorptive spectrophotometry [12]. Toxicological researches were performed on white mice weighing 22-24 g with definition of derivatives of blood hemoglobin (carboxy - COHb, sulfo - SHb and methemoglobin - MtHb), and an integrated indicator of combustive products toxicity - HCl_{50} (this is the sample weight of polymer in grams, which produces toxic combustive products on the Cl_{50} level in the white mice [8,10,13]). All results were treated with the methods of variations, correlation and factor analysis using

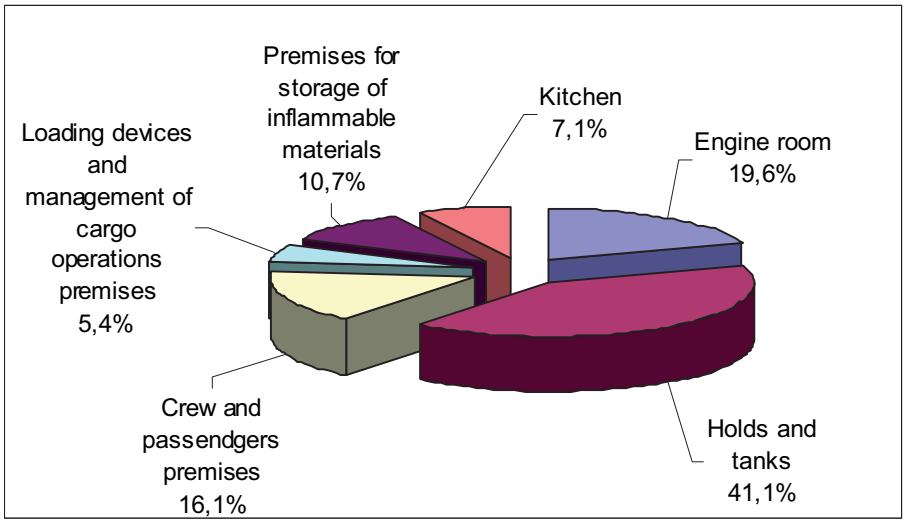

Fig. 1. The frequency of fires in the different ship premises

standard software package in Microsoft Excel [14].

Results of researches and discussion

Part 1. Toxicological and hygienic characteristics and simulation of ship fire

Despite the existing restrictions on access to information about fires on ships, we have over the years accumulated and analyzed data on cases of fire occurred and the subsequent development of fires on ships and oil platforms. Identified the main sources of fire on board and places their preferential origin (Fig. 1).

As can be seen from the figure, the ignition in ships' holds and tanks take place 2 times more frequent than in the engine room, 2.5 times – in residential cabins and 6 times – in a galley facilities. However, fires in cargo holds are mainly observed during the transport of dangerous goods, while other sources exist on all types of the vessels.

Danger to the life and health of crew

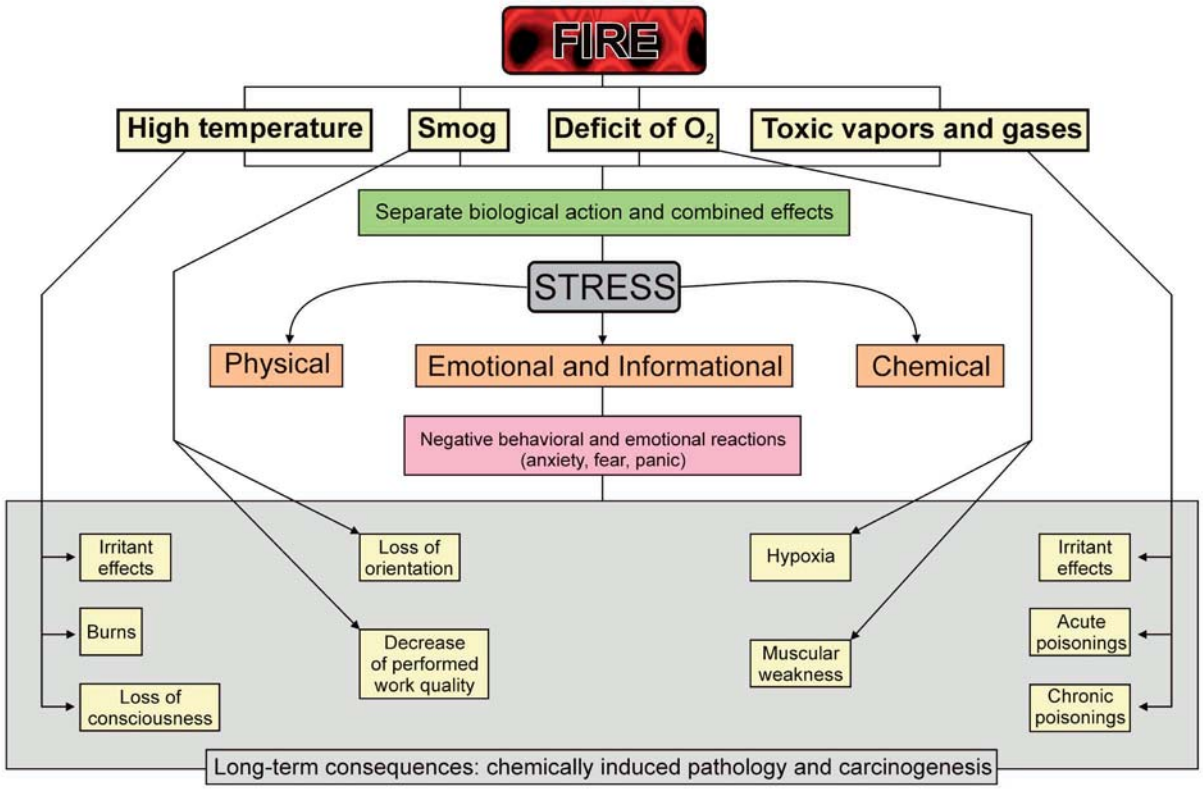

Fig. 2. The main dangerous factors of fire on board and their effects on human health

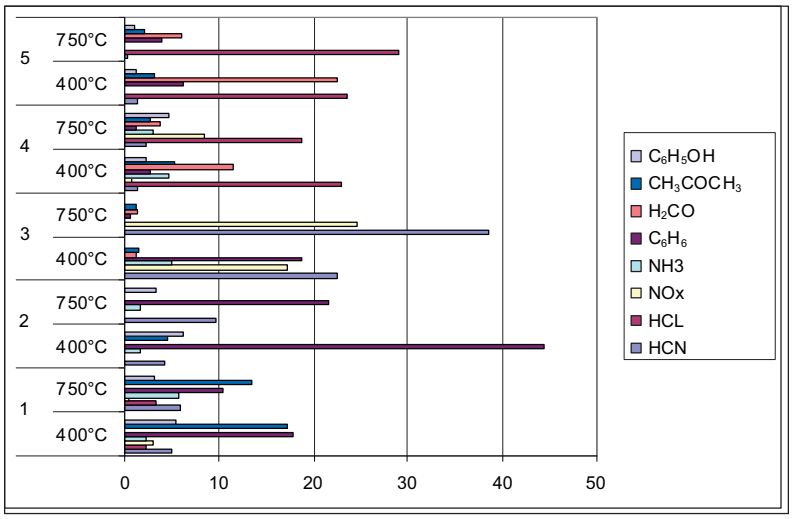

Figure 3. The maintenance of minor components in representatives of polymers different classes of transport appointment. On an axis of ordinates - temperature of tests and a material (the notation in the text), on an axis of abscisses - the contribution of substance to toxicity in relation to the general contribution of all minor components, %

and passengers depends on the ship type, physical and chemical properties of the burning dangerous goods, used in the construction and decoration of ship premises polymeric materials, the scenario of fire, access of air (oxygen) in the ship premises captured by fire [15]. However, as the global practice extinguishing fires and the results of our researches shows, this danger is defined by four leading factors: heat, smoke, a lack of oxygen and toxic vapors and gases (Fig. 2).

While each component is inherent in its own distinctive set of danger signs, usually they have a combined effect, reinforcing each other's action (potentiation). Moreover, the dominant value in a highly saturated by polymer materials ship spaces, including evacuation routes and the crew and passengers cabins (up to 6-8 m^2 of polymer surfaces for 1 m^3 of the indoor air), acquire the toxic combustion products, that under modern conditions are the cause of death of more than 70% of people in fires [16].

The made researches have shown, that the basic toxic products of burning in fires on ships is the carbon oxide II (CO) and carbon oxide IV, that corresponds to data of the literature of fires on other objects [17]. However, in the indoor air, in the chambers of experimental installations, even after fire extinguishing or the exposition termination, there is a considerable enough assortment токсикантов which concentration reach dangerous levels is found out. Among them chemical compounds (HCN, HCl, NO_x, HCHO, allyl aldehyde, isocyanates, polyarelenes, dioxins, polybrominated diphenylethers), which are 2-3 orders more toxic of magnitude from dominant components (CO and CO_2) [18, 19].

As an example, which illustrates the contribution of minor components in the overall toxicity of combustion products in Fig. 3 are shown the 5 most common, studied in our laboratory, the typical materials (1 - Polycarbonate, 2 - Polyolephine, 3 - Polyurethane; 4 - Polyvinylchloride, 5 - Polyester fiber glass).

The situation is extremely dynamic and contradictory, because the composition of minor components is complex, andtheir contribution to the toxicity of combustion products of polymers there is no doubt at least 55-58% of cases. The demand increase fire resistance and non-combustibility of polymers used in the shipbuilding industry at the expense of creating new and filled with heat-resistant plastics and composites, exclusion of their halogen components - sources of HCl and other irritating and highly toxic compounds. Nevertheless, flammability of new plastics and synthetic materials, unfortunately, remain quite high and, in some positions, even has tendency to grow. Therefore, it is necessary to enter or carry out surface treatment with flame retardants,

Table 1

The hemoglobin derivatives content in white mice's blood after toxic combustive products of polymers exposition, n=10

№	Polymer name	The hemoglobin derivatives blood content, %		
		COHb	MtHb	SHb
1.	Polyurethane	40,0 ± 2,1	7,2 ± 0,25	2,1 ± 0,12
2.	Polyvinylchloride	38,4 ± 3,1	1,8 ± 0,11	0,3 ± 0,05
3.	Fibreglass polyester	58,5 ± 3,8	1,1 ± 0,08	0,1 ± 0,05
4.	Rubber covering	54,8 ± 2,8	4,5 ± 0,15	4,8 ± 0,22
5.	Control	1,0 ± 0,06	0,8 ± 0,04	0

which often leads to increased toxicity [20]. Not easier is the position with the smoke production, which is often a limiting factor in risk of danger, especially on the ways of evacuation [21].

Therefore, both national and international standards stipulated by conducting small-scale laboratory testing of new polymers. The staff of our laboratory in the past decade conducted certification testing of polymers more than 1,000 items, including 186 compositions of transport and ship-building appointment. The received data have shown that along with chemical, informative biological markers, first of all, hemoglobin derivatives (COHb, MtHb, SHb) in blood exhibited by toxic combustive products on white mice are productive (Table 1).

The presented in the table data shows that, depending on the structure and chemical properties of the studying polymer the content of hemoglobin derivatives in the peripheral blood of animals varies considerably (up to 60 times as COHb, up to 10 times - on MtHb and up to 5 times - on SHb). Their levels in the blood of white mice correlates with the integral marker of toxicity (HCl_{50}), which corresponds to the mass in grams of material, the burning of which causes the death of 50% taken into the test animals. Comprehensive assessment of chemical and biological markers significantly improves the quality of examination and certification of polymer products.

It is the important argument in favor of the combined toxic action on an organism of polymer combustive products, which cannot be described only as a CO poisoning. The complex estimation of chemical and biological markers essentially raises the quality of examination and certification of polymeric production.

Studies on mechanisms of toxicity of polymer's combustion products in experimental models in vivo et in vitro, the complex clinical and physiological examination of affected patients during a fire, and firefighters and rescuers in the medical and psychological rehabilitation, showed that at the heart of poisoning are hypoxia and oxidative stress, and the leading type of specific action (selective toxicity) are neurotoxic and behavioral effects of intoxication, including individual and personal responses and specific forms of collective behavior [22, 23].

This brings to the fore, along with toxicological and hygienic studies on material's certification, studying the mechanisms of toxicity and the finding of treatment and prevention of poisoning, a problem more in-depth study of psychophysiological aspects of the problem, as most relevant to solving problems and improving seamen readiness and effectiveness of the crew and passengers actions at fires and other emergencies on board.

Part 2. Psychophysiology of emergencies and safety of people in a fire on board

Fire in its power, biological and socio-psychological significance belongs to the category of emergency stressors. Moreover, all its four major hazardous component (smoke, heat, toxic fumes and gases, oxygen deficiency) have an impact on the relevant receptors and analyzers functions, causing significant changes in sensory, motor and regulator (the nervous, endocrine, autonomic) fields and physiological systems of the organism, forming an integrated psychophysiological response to stress.

Of a great importance are also the physical, individual psychological and personality characteristics of a person. They define emotional and behavioral status, degree of activation of physiological functions, the ability to support them as long as necessary for the mobilization of adaptive reserves, which integrally manifests itself in readiness to act in a complex emergent situation. The last one (readiness) is associated with the activity, i.e. process of implementation of human activity aimed at achieving this goal deliberately [24]. In these circumstances, stress tolerance is not only occupationally, but also vital to the quality, the basis of individual responses and behavior during the detection, localization and extinguishing the fire. It provides a maximum concentration of efforts to overcome the dominant elements of the stressor (fire) under control of the central nervous system and the implementation of a number of responsibilities at the expense of subconscious, vegetative and emotional components [25].

Formation of the occupational dynamic stereotype (ODS), as a functional adaptation system to some concrete type of work, provides a clear psychophysiological reactions in sailor, a member of the salvage party, fire rescue in an emergent situation, while respecting the principle of minimizing the cost of physical and courage strength, control deficiencies emotive behavior. This is particularly important in the socio-psychological terms, as a number of people in emergency situations is found not only imitative behavior, but also have amplification of negative emotional and behavioral elements to the level of continued, uncontrolled reactions (negative sociologisation behavior). The main dangerous manifestations of stress in the fire include anxiety and fear, which in the individual psychological terms can be manifested in increased anxiety, emotivity, affective behavior, or the predominance of inhibitory processes in the CNS with symptoms of hypo- and areactivity, stupor, torpor.

In accordance with the conceptual model anxiety is understood as the emotional state of acute painful meaningless anxiety to be associated in the consciousness of the individual with the expectation (prediction) risk in terms of pragmatic uncertainty. The intensity of emotional reaction to the stress situation disproportionately higher than the value of objective risk [26].

Unlike anxiety, fear – is a reaction to a specific (real) danger to life and health situation In its genesis fear is based on a protective biological reaction, has a certain emotional and physiological mechanisms include. In the social-psychological level of anxiety and fear, covering a group of people, who are at the heart of panic [27]. The latter is a group phenomenon of human behavior that have no clear idea of the strategy and how to avoid and reduce its risk. Because the risk is generally associated with stress, the level of individual and personal stress management and group behavior are the most important indicators for the detection, localization and liquidation of a fire on board. This is clearly seen in the simulation of emergency situation in the training of ship's alarms.

The reaction of the crew in the performance of training assignments depends on the individual typological properties of higher nervous activity in a particular seaman (genetic component), and

Table 2

The results of factor analysis of received psychophysiological data during the training, reflect to the degree of PIQ tension

№	Markers	PIQ Factors			
		1	2	3	4
A.	A. The Raven test productivity,	0,84			
	The time of Raven test performing	0,81			
	Dubbing lines in Benton test	- 0,57			
	The deviation from the autogenous norm in Lusher test	- 0,53			
B.	Errors in the test «Tracking the target»		0,82		
	Expert rating		0,79		
	Post-stress reaction		- 0,58		
C.	Psycho-emotional stress			0,83	
	Situational anxiety by Spielberger			- 0,73	
	The deviation from the autogenous norm in Lusher test			- 0,53	
D.	The level of urinary epinephrine excretion				0,88
	Ratio of K^+ / Na^+ in the mixed saliva				0,86
	Errors of visual retention in Benton test				- 0,58
	Systolic blood pressure				-0,69

the source of fire scenarios (technical, ergonomic and hygienic component), the level of competence (training and experience), individual and collective stress (physical and psychological endurance, coherence and cohesion of the group - the individual-personal, social and psychological components). They have roughly equal representation in assessing the effectiveness of functional responsibilities during the training sessions.

More informative were the results of studies of professionally important qualities (PIQ) on the scales that are based on analysis of individual-personal qualities of seafarers. The results of the before and after the training psychophysiological researches the correlation matrix was performed on the base of defined markers. Also factor analysis was conducted to study the structure of the internal connections of various elements of the system. This analysis allowed to identify four groups of personality traits and four groups of PIQ (Table 2).

From the data, summarized in the table, it is shown that there are quite regular, statistically significant markers of the psychophysiological functions mobilization, which are responsible for the success of operational activities of firefighters.

The 1st personal factor includes markers of quality, which determine the expression of anxiety, emotional stress and emotivity. Generalized, this factor is designated as a factor of “emotional expressivity.”

The 2nd factor is designated as “psycho-vegetative”, as it combines markers of the functional state of the organism, and may reflect the type of coping strategies for stress loads.

The 3rd factor is designated as the “psychosomatic”, and it defines avoidant type of behavior in stressful situations and the emergence of anxiety and tension on the somatic type.

The 4th factor is designated as the factor of “vegetative anxiety.” It reflects the disregulative disorders in the most

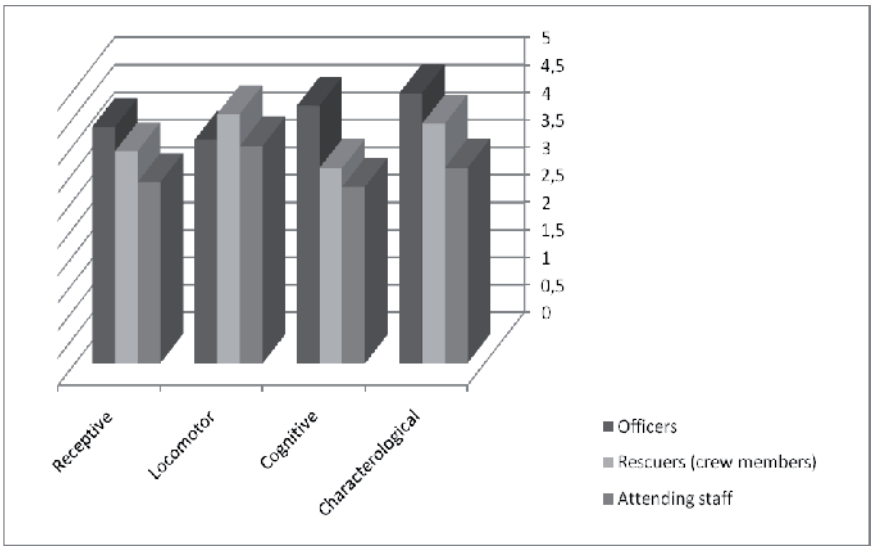

Fig. 4. The level of the main classis of PIQ manifistation in different groups of seafarers, involved to the rescue parties of firefighting on board of sea going ships

dynamic mechanism of psychosomatic homeostasis - neurovegetative functions, that are already in the first stage of the pathological process manifested in the form of neurocirculatory dystonia.

These results play an important role in studying the mechanisms underlying such a key PIQ, as tolerance to stress. They also open up the new possibilities for solving the problems of psychophysiological selection of seamen. Along with periodic medical examination occupational psychophysiological selection forms the first compulsory stage and is a key element in the system of seafarers psychosomatic health preservation [6, 28, 29], including possibility to predict their occupational activity and quality of work in emergency situations.

Based on these studies it was possible to identify the most informative markers of psychological tests to assess the PIQ. All factors on the base of PIQ were grouped around the following parameters: A - Raven test passes or fails, B - error on the test "Target tracking", C - psycho-emotional stress, D - the level of epynephrine excretion in the urine and the ratio K^+ / Na^+ in the mixed saliva (almost equal in importance).

According to leading markers, the selected factors determine the PIQ of logical thinking, spatial perception, stress, occupational health and adapta-

Table 3

Correlation matrix of individual-personal qualities of a ship's officers (commanders of emergency parties) as a function of individual personality traits and work experience on ships

Personal properties	**Tolerance to stress**		**Experience**	
	1*	2**	Up to 5 years	Over 5 years
Aggressiveness	0,621	0,707	0,718	0,676
Demonstrativeness	0,538	0,789	0.735	0,642
Propensity to risk	0,492	0,698	0,614	0,459
Addiction to communication	0,572	0,598	0,662	0,497
Activity	0,711	0,629	0,741	0,596
Expert evaluation	r = 0,83; p < 0,01	r = 0,65; p < 0,05	r = 0,58; p < 0,05	r = 0,75; p < 0,01

Notes: * / - tolerant to stress; ** / - neuroticism

tion to professional activity. This is confirmed by the correlation analysis to the grade of PIQ manifestation

in the groups of ship officers, crew members, who involved in the rescue parties, and other staff (fig. 4).

From the presented data in the figure is seen, that the greatest degree of PIQ mobilization occurs in commanders of rescue parties. Moreover, if the rank and file members of parties dominated by emergency of locomotor and characterological quality (4,53 ± 0,39 and 4,35 ± 0,32, respectively) then the officers - the cognitive and characterological quality (4,56 ± 0,61 and 4,89 ± 0,54, respectively).

Last one closely related to individual personality traits (Eysenck test on), stress tolerance and experience of work on the vessels (Table 3). Because most high performance and their professional importance occurred in marine officers and commanders of other rescue units at a later stage was compared between the correlation matrix of individual-personal qualities of the representatives of the contingent and stress tolerance (Table 3).

From the presented data in the table shows that the basis of the reaction vessel officers in stress situation ("fire on board") are individual-personal qualities that are only partially optimized with the experience. Moreover, the tightness of correlation for all defined parameters was statistically significant ($r > 0,4$; $p < 0,05$). In respondents with the signs of neuroticism there were higher aggressiveness, demonstrative behavior and appetite for risk, which is already under fire drills, in some cases leads to a decrease in the quality of assignments and the negative psychological reactions.

Studies results have shown that tolerance to stress is an important quality in the system of PIQ for seamen. It is closely linked with other PIQ and general psycho-physiological status of the crew members, whose behavior in emergency situations has a significant impact on the young sailors, cadets and passengers, preventing anxiety, fear and panic on board of ship.

This corresponds with the results of factor analysis of psychophysiological functions, which indicate the dominant role of individual-personal qualities of a sailor in reactions to extreme situations, including such as a fire on board.

Conclusion

Thus, a fire on board is particularly hazardous to the health and lives of seafarers and passengers the emergency, which is much easier to prevent than to locate and eliminate. Therefore, to solve the problem requires a comprehensive systems approach.

Based on these studies was developed and implemented in maritime transport and in offices of the Ministry of Emergency Situations integrated security system that consists of the following units:

1. Normative and methodical documentation of the toxicological and hygienic and psychophysiological aspects of fire safety in transport.
2. Methodological basis for toxicological and hygienic tests of new polymer materials for transportation purposes (certified installation for small-scale tests, standardized fire simulation scenarios specific to the object, certified chemical analytical methods and toxicological researches, evaluation criteria (three of normative-methodical documents and 7 patents of Ukraine).
3. Standardized protocols of polymer materials hygienic studies with full-bench and field trials to assess the fire safety of materials and objects.
4. Developed and implemented comprehensive computerized psychophysiological selection of seafarers, firefighters and rescuers

of entrants to study in the specialized institutions of higher education.

5. Substantiated scientific and methodological approaches and conducted three-stage medical and psychological rehabilitation of contingent workers involved in dealing with emergencies, including fires at the facilities of transport.

In general, the combustion toxicology is relatively new and successful developing branch of modern toxicology. Many of its problems are only identified and marked. They require further epidemiological, experimental and clinical studies. Psychophysiological aspects in addressing these issues in maritime transport plays an important role.

References

1. [Dictionary of terms on fire safety] (rus). - Moscow, 2003. – 226 p.
2. Bulletin of the State Inspection on Sipping Safety of Ukraine, 2008. – No. 2-3. – P. 72-75.
3. Burman B.S. STCW and Beyond Minims. Requirements and Additional Knowledges for Marine Engineers // World Maritime Excellence. Proceedings of the 8-th Annual General Assembly and Conference of the International Association of Maritime Universities. Odessa, Ukraine. 17-19 September, 2007. – Odessa: AO BACHVA, 2007. – P. 377-386.
4. Shafran L.M., Harchenko I.A. [Harmonisation of Methods of an of the Combustive Polymer Products Toxicity Estimation with the International Requirements// Modern Problems of Toxicology] (rus). – 2003. – No. 3. – P. 10–15.
5. [Psychophysiological Professional Selection on Marine Transport. Test Methods. - Kiev: Ministry of Public Health of Ukraine] (ukr), 2002. - 27 pp.
6. Shafran L.M., Psjadlo E.M. [Theory and Practice of Professional Psychophysiological selection of seamen] (rus). – Odessa: Phenix, 2008. – 292 pp.
7. Golikova V.V. [Psychophysiological features of professionally significant qualities formation in the maritime universities cadets. // Dissertation for the candidate of medical sciences degree in speciality 14.02.01 – hygiene and occupational pathology. – M. Gorky Donetsk National Medical University of Public Health Ministry, Donetsk, 2011] (ukr). – 207 pp.
8. [Fire and Exposive Danger of Substances and Materials. The Nomenclature and Methods of their definition: GOST 12. 1.044-89] (rus), – Moscow: Standards Publishing House, 1990. - 143 pp.
9. Plastics Flammability Handbook. Principles, Regulations, Testing, and Approval. – 3rd ed. / Ed. by Jurgend Troitzsch. – Munich: C. Hanser Verlag, 2004. – 718 p.
10. [Definition and Hygienic Estimation of Toxicity Markers of Polymeric Materials Combustive Products. Methods of Testing 8.8.2.4-127-2006] (ukr). - Odessa, 2006. - 128 pp.
11. Shafran L.M., Sviridov V.N., Leonova D.I., Tretyakova E.V. The patent of Ukraine for useful model No. 55137 (UA MPK 2009 G01N 21/00). “The Device for the Researches of Combustive Products Toxicity”// Bull., 2010. – No. 23/ - 6p.
12. Antonovich V.P., Bolshoy D.V. [The Problem of Definition of Small Dozes of Yaevy Metals in Hygiene of Transport //Actual Problems of Transport Medicine] (rus), 2006. – No. 3 (5).- P. 20-29.
13. Tretyakova E.V. [Toxycologically-hygienic estimation of polymeric materials burning products (mechanisms of action, experimental ground of facilities of poisoning prophylaxis) // Thesis on the degree

of candidate of biological sciences by speciality 14.02.01 – Hygiene and Occupational pathology. –Institute for Occupational Health of the Academy of Medical Sciences of Ukraine] (ukr). - Kyiv, 2010. – 196 pp.

14. Lapach S.N., Gubenko A. V., Babich P.N. [Statistical Methods in Medical and Biological Researches with application of Excel] (rus), – Kiev, : MORION, 2000. – 320 pp.
15. Shafran L.M., Vasilyev G.A. [Hygiene of polymer materials application in shipbuilding // Handbook on Hygiene of polymers application] (rus). - Kiev: Health, 1984. - With. 48-52
16. Alarie Y. Toxicity of fire smoke / Y. Alarie // Polym. Adv. Technol.. – 2002. – P. 66–79.
17. Turrina S. Effect of combined exposure to carbon monoxide and cyanides in selected forensic case / S. Turrina, C. Neri, D. De Leo // J.Clin.Forensic. Med.. – 2004. – Vol. 11, – P. 264–267.
18. Hertzberg N. Isocyanates in fire smoke can be more dangerous as carbon monoxide / N. Hertzberg // Brand Posten. – 2003. – № 28. –– P. 8–9.
19. Leonova D.I. [Identification of combustive products of polyvinylchloride materials] / D.I. Leonova, M.R. Kopa, N.G. Selivanenko // Actual Problems of Transport Medicine (rus). – 2006. – № 4. – P. 65–73.
20. Leonova D.I. [Comparative analysis of toxicity of the major groups retardants (review)] // Actual Problems of Transport Medicine (rus). , 2008. - № 3(13). – 117-129
21. Lung Function in Rescue Workers at the World Trade Center after 7 Years / Aldrich T.K., , Jackson G., Hall, C.B. // The New England J ournal of Medicine, 2010. - Vol. 362. – No. 14. – P. 1263-1272.
22. Chaturvedi A. K. Blood carbon monoxide and hydrogen cyanide concentrations in the fatalities of fire and non-fire associated civil aviathion accidents, 1991-1998 / A. K. Chaturvedi, D. R. Smith, D. V. Canfield // Forensic Sci. Int. –2001. – Vol. 121. – P. 183–188.
23. Costa L.G., Gennaro G. Developmental neurotoxicity of polybrominated Diphenyl ether (pbde) flame retardants // Neurotoxicolog,. 2007. - Vol. 28. – No. 6. – P. 1047–1067.
24. Hanzu-Pasara R., Arsenie P. Shipping Companied Policy to Improve the Seafarer's Competecy // World Maritime Excellence. Proceedings of the 8-th Annual General Assembly and Conference of the International Association of Maritime Universities. Odessa, Ukraine. 17-19 September, 2007. – Odessa: AO BACHVA, 2007. – P. 377-386.
25. Emotions at Work. Theory, research and application in management / Ed. By R.L. Payne and C.L. Cooper. – Chichester: J. Wiley & Sons, Ltd, 2001. – 544 p.
26. Spilberger C.D. Conceptual and methodological researches of anxiety // Stress and anxiety in sports - Moscow, 1983. - P. 12-24 (rus).
27. Meuret A.E., Hofmann S.G., Rosenfield D. Catastrophic Appraisal and Perceived Control as Moderators of Treatment Response in Panic Disorder // Int. J. Cogn. Ther., 2010. - Vol. 3. – Iss. 3. – P. 262–277.
28. Saarni H. Medical Examinations of Seafarers and Training for Medical Doctors in Maritime Health // Actual Problems of Transport Medicine, 2005. – No. 1. – P. 124-129.
29. Verbist B.C. Maritime Fitness Examinations – a Challenge to Equty? // 9th International Symposium on Maritime Health. 3-6 June 2007. Esbjerg, Denmark. Book of Abstracts (Keynote 2-2). - P. 33.

Резюме

ПОЖЕЖА НА БОРТУ: ГІГІЄНА, ТОКСИКОЛОГІЯ, ПСИХОФІЗІОЛОГІЯ

Шафран Л.М.

Серед надзвичайних ситуацій на морських суднах і морських свердловин пожежі відносяться до числа найбільш частих, небезпечних, як для здоров'я і життя людей, так і для матеріальних цінностей (суден, вантажів, портового устаткування і обладнання. Величина ризику виникнення пожежі визначається властивостями вантажу, що транспортується, типом і віком судна, якістю підготовки і рівнем компетентності суднових офіцерів підготовки (згідно Міжнародної конвенції ІМО ПДНВ 78/95), досвідом роботи і єдністю екіпажу, умовами плавання тощо. Тому здійснення системи протипожежних, в тому числі токсиколого-гігієнічних заходів на транспортних об'єктах і серед члені екіпажів морських суден є актуальною проблемою сучасного суднобудування і судноплавства. Розроблено і впроваджено систему токсиколого-гігієнічної і медико-психологічної безпеки, яка включає нормативну і методичну базу, критерії оцінки і гігієнічної регламентації полімерів транспортного призначення, небезпечних вантажів, а також психофізіологічний відбір, тренінг і аутотренінг моряків і пасажирів. Впровадження розроблених заходів в практику суднобудування і судноплавство має вагомий соціальний, економічний і медичний ефект.

Ключові слова: пожежа, гігієна, токсикологія, психофізіологія

Резюме

ПОЖАР НА БОРТУ: ГИГИЕНА, ТОКСИКОЛОГИЯ, ПСИХОФИЗИОЛОГИЯ

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Среди чрезвычайных ситуаций на морских судах и буровых платформах пожары относятся к числу наиболее частых и опасных, как для жизни людей, так и материальных ценностей (судов, грузов, портового оборудования и сооружений), а также в плане загрязнения окружающей среды. Величина риска возникновения пожара на борту определяется свойствами перевозимого груза, типом и возрастом судна, качеством подготовки (в соответствии с Международной Конвенцией ИМО ПДНВ 78/95) и опытом работы судового экипажа, условиями плавания и другими факторами.

Поэтому осуществление системы противопожарных, в том числе токсиколого-гигиенических, мероприятий, является актуальной проблемой современного судостроения и судоходства. Разработана и внедрена система токсиколого-гигиенической и медико-психологической безопасности, которая активно внедряется в транспортной отрасли. Она включает нормативную и методическую базу, критерии оценки и гигиенической регламентации полимерных материалов, а также психофизиологический отбор, тренинг и аутотренинг моряков и пассажиров. Внедрение разработанных мероприятий в практику судостроения и судоходства имеет весомый социальный, экономический эффект.

Ключевые слова: пожар, гигиена, токсикология, психофизиология

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