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## PROTECTION OF HUMAN RESPIRATORY SYSTEM FROM THE NEGATIVE EFFECTS OF ENVIRONMENT

*Abstract - Industrial emissions and automobile exhaust gases of air pollutants are harmful to health, so protecting people from the harmful influence of the environment is extremely important.*

*The article describes the basic classification of respiratory protection, as well as general advice to the selection filters. Were carried out analysis of influence of environment on the human respiratory system and the body as a whole. Were studied properties of materials that are used in the manufacture of filters for the protection of the human respiratory, depending on the mode of exploitation.*

*The Article describes the rules for the selection of personal protective tools. Based on the analysis were made conclusions and recommendations to the use of protective tools of human respiratory, depending on the range of these products.*

*Keywords: respiratory system, filters, protection, transport, ecology, cycling, textiles.*

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## ЗАХИСТ ОРГАНІВ ДИХАННЯ ЛЮДИНИ ВІД НЕГАТИВНОГО ВПЛИВУ НАВКОЛИШНЬОГО СЕРЕДОВИЩА

*Викиди промислових підприємств та автомобільні вихлопні гази забруднюють повітря речовинами, які шкідливі для здоров'я, тому питання захисту людини від шкідливого впливу навколишнього середовища є надзвичайно актуальним.*

*У статті наведена базова класифікація видів респіраторного захисту, а також загальні поради до вибору фільтрів. Проведено аналіз впливу навколишнього середовища на органи дихання людини і організм в цілому. Проаналізовано властивості матеріалів, які застосовуються при виготовленні фільтрів для захисту органів дихання людини, їх властивості залежно від способу експлуатації.*

*У роботі описані правила підбору засобів індивідуального захисту людини. За результатами проведеного аналізу зроблено висновки та надано рекомендації до застосування засобів захисту людини залежно від асортименту даної продукції*

*Ключові слова: органи дихання, фільтри, захист, транспорт, екологія, велоспорт, текстиль.*

### Introduction

Air pollution from industrial plants and motor vehicle fumes causing irreparable harm to the human respiratory. Particularly affected are residents of megacities, cyclists, traffic police, people whose work is directly connected with the constant movement of the city. Insufficient range of respirators and the amount of information about respiratory protection leads to multiple human respiratory diseases. Today the consumer has no reasonable choice of respiratory protection, although the demand for these products grows.

Today the human respiratory system is not adequately protected from exposure to the environment [2].

Quality of consumer protection rights is heavily depends on material and manufacturing technology. In the field of technology and materials have been studied properties of various materials that are used for filters. Many prominent scholars, such as KD Mikhailova, LF Kharitonov, AA Gusev, VN Yesipenko, DM Potemkin EP Dregulyas, OD Galanin, IA Lipkova, MM Dianicha, BD Semak, NP Vasilishin, FA Moiseenkov, VV RYBALCHENKO, PD Balyasova, MV Tsebrenko engaged in the problem of studying the properties of materials to create filters. Thus, the aim of this work is to analyze the information about new types of raw materials and building methods of textile materials with desired properties that provide a full respiratory protection and competitiveness respirators.

The aim of this work is:

- analysis of the environmental effects on the human respiratory system and the body as a whole;
- study of the assortment of the world's respiratory masks;
- a basic classification of respiratory protection, features of the selection of filters, depending on the type of exploitation;
- practical advice for use of materials, design and textiles in the manufacture of filters for respiratory protection.

To fulfill the purposes of the work is necessary to solve the following problems:

- analyze the information about the dangers of air pollution on the human respiratory system;
- to classify the different types of respiratory protection, as well as how to use them depending on the method of exploitation;
- explore consumer properties respirators made of various types of textile materials, which increases the range of the filtering means, for the protection of human respiratory organs.

Industrial emissions and car fumes pollute the air with all sorts of substances that are harmful to health. In some big cities it's very difficult to breathe because of air pollution.

Clean air is the key to our good health and good physical condition. It is known that the air consists of oxygen (O<sub>2</sub>) and nitrogen (N<sub>2</sub>) at a ratio of about 1:3. At rest, we breathe about 10 liters of air per minute. When we are actively working or doing sports, the amount of inhaled air increases many times. However, the air we breathe can contain many dangerous substances, which we do not even suspect. [4]

Hazardous materials may be in the form of solid or liquid aerosol particles, gases, vapors or fumes. The

smaller dust particles, the longer they are in the air in suspension and the higher the probability that they will fall into the air, will penetrate into the lungs. Mist consists of micro- droplets are formed by spraying different liquid materials. When we breathe, fine solid or liquid particles cause irritation of the upper respiratory tract, prolonged exposure cause inflammation. Very dangerous fine particles of toxic dust that can penetrate into the lungs and having a very large contact area with the tissue of the lung, and can rapidly be absorbed in large quantities, causing the intoxication of an organism. [4]

In 2005, British scientists found that the majority of early deaths and referrals to hospitals with complaints of respiratory disease is a result of air pollution. Many pollutants when mixing is irritating to the respiratory system. Masks help prevent many serious diseases, as it is known that compounds such as pyrene and benzene, which are contained in exhaust gases are oncogenic.

Fumes and gases cannot be seen, even when they are in very high concentrations. In contrast to solid particles and liquid aerosols, virtually no body opposed to gases and vapors. When gases and vapors inhaled directly into the lungs and thence smoothly penetrate into the circulatory system. Coming through the circulatory system they are damaging internal organs and the brain. [4]

Gases can be subdivided according to their impact on the human body:

- Simple asphyxiates for example methane, carbon dioxide and helium replace oxygen in the air, causing anoxia;

- Chemical asphyxiates for example, hydrogen cyanide, carbon monoxide and hydrogen sulfide affect the absorption of oxygen and cause oxygen starvation of the body's tissues.

Irritating gases usually have a strong smell; they can cause eye irritation and severe irritation of the upper respiratory tract.

Non-toxic dust particles getting into the lungs, can linger there for a long time. Around each speck gradually grows connective tissue, which can no longer participate in the process of gas exchange body. The process of proliferation of connective tissue takes place slowly, usually over many years. Overgrown connective tissue replaces a large area of the lung tissue and this leads to the fact that a person lacks oxygen during physical exertion, even a small - shortness of breath when walking fast or moderate physical activity. Prolonged lack of oxygen leads to a weakening of the body, decreased performance, reduced resistance to infectious and other diseases, changes in the functional state of organs and body systems. Dust exposure to respiratory causes specific disease called pneumoconiosis. [4]

Today more and more cyclists are exposed to this kind of disease, because the air on the road does not get cleaner and only some of the athletes protect the respiratory system by wearing respiratory masks (Fig 1).

To provide adequate respiratory protection, it's necessary to have information on the composition and concentration of air pollutants hazardous substances, as well as a clear understanding of the purpose and limitations of use respiratory protection. It is necessary to take into account such factors as the state of health of the user, the degree of physical activity, time spent in the contaminated area, the need for freedom of movement, temperature and humidity, the individual characteristics of the user's identity, ability to handle remedies. Nonperforming Respirator made entirely or mainly of filter material. May have an exhalation valve. Requirements for these respirators described in standard DSTU EN 149:2003. May be marked FFP1, FFP2 or FFP3. [3]

Thus, the question of human respiratory protection is important.

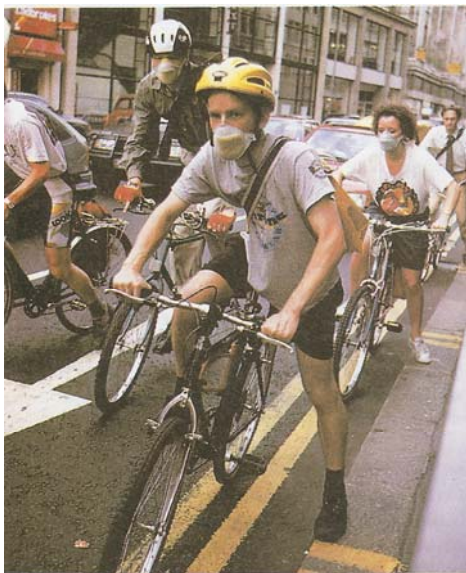


Fig 1. Cyclists use respiratory masks

Masks and half masks with replaceable filter elements close forehead, nose, mouth and chin of the user. Requirements masks described in standard DSTU EN 136:2003. Masks and half masks must adhere perfectly to your face. Requirements for the particle filter, which can be used with masks and half masks contained in the standard DSTU EN 143:2002. Requirements for gas and combination filters described in standard DSTU EN 141:2001. Particulate filters can be marked P1, P2 or P3 depending on the filtering efficiency. Gas filter is marked with a corresponding color code and number, which indicates the filter class (1, 2, 3), depending on the capacity of the filter. [3]

The most common means of filtration of gases or vapors is activated carbon, which have a great inner surface and capable of retaining molecules of organic vapors. In order to keep the molecule or inorganic acid gas or ammonia is subjected to activated carbon suitable chemical treatment. [1]

The filter elements with activated carbon have no validity indicator and should be used only to protect against gases or vapors which have pronounced identifying characteristics (the ability to determine the taste or smell at a given concentration in air). Filters to protect against gases or vapors are marked with the letters A, B, E and K.

A - protection against organic vapors; B - protection against

inorganic gases;

E - protection against acid gases; K - protection from ammonia and its organic derivatives.

Also, with an appropriate color code and a number, which indicates the class of the filter (1, 2, 3) depending on its capacity.

If air present in the gas or vapor in conjunction with solid or liquid aerosol particles, it is necessary to use the combined filter elements.

All elements of the particle filter respirators, work until the rise of resistance to breathing. Time of gas filters should be limited to the advent of smell or taste substances from which protects antigas respirator. A good practice is to calculate the total operating time of gas filters and replace them before the breakdown. The filter elements cannot be cleaned and re-use. [4]



**Fig 2. Three-layer structure of neoprene: 1 - the inner layer (in contact with the skin) - 100% cotton or nylon, 2 - middle layer - micro porous rubber, 3 - outer layer - nylon textile**

contiguity to the face and serves as a frame for the filter. The most commonly used carbon filter. In the case of neoprene fabric as a mask material to display some disadvantages such as fabric does not pass through air and water. Has a low absorbency - less than 2 % of its own weight. As a result of this, the high physical activity and perspiration sports activity becomes uncomfortable. Nowadays are developed different modification of neoprene, having microscopic holes of air, i.e. material breathes.

There are also plastic mask. The basis of such masks is statistically charged fibers. Plastic mask can be washed and worn for years. But there are also some disadvantages. Leaking mask fit to face leads to a distinct feeling of smoke as well as the fact that the skin on the face is drawn into the mask, and within 10 minutes there is a trace. [4]

Due to insufficient study of the problem, lack of materials, lack of sufficient number of specialists in this field, only a few companies in the world produce remedies cyclists, especially with the ability to change filters. The most common filters are made of eco-friendly and high-tech materials such as statically charged fibers that trap microscopic particles, as well as the addition of activated carbon in the weave, which clears the air of toxic gases. The design sports filters exist valves that allow withdraw from respiratory carbon dioxide and wet steam. For the cyclist important that the respirator is well fixed on the face and does not interfere with air to breathe. Caring about safety on the roads, the company also added on some models reflectors that let you see a cyclist at night.

Now more and more people leading sport lifestyle, thereby increasing the demand for protective masks, because their use will reduce the possibility of damaging the respiratory system. These masks can be applied in everyday life. Indeed, many residents of megacities, where they explicitly feel air pollution, also suffer from the effects of the environment.

#### Summary

Due to the urgency of the issue of human respiratory disease were examined responses of scientists about the cause and methods to prevent respiratory inflammation. Also was carried out test of range of sports protective masks and domestic purposes.

For today there are set targets to design protection of human organs, to improve existing models on the market, by the application or proposal developed weavings and new raw materials.

#### References

1. J. Vincent Edwards «Modified fibers with medical and specialty applications»: uchebnoe posobie/ J.Vincent Edwards, Gisela Buschle-Diller, Steven C. Goheen. – Netherlands, 2006. – 239 p.
2. Sajt «Localhost», stat'ya Lili Dojlenko «Zashhita organov dy'xaniya velosipedista», [Elektronny'j resurs]
3. Sajt «Ukrprofzashhita», stat'ya redaktora kompanii «Respiratornaya zashhita», [Elektronny'j resurs]
4. Sajt «Ukrprofzashhita», stat'ya redaktora kompanii «Respiratornaya zashhita na proizvodstve», [Elektronny'j resurs]
5. Sajt «Plast ekspert», stat'ya Evgeniya Logoneva «Neopret», [Elektronny'j resurs]
6. Dianich, M. M. Sy'r'e dlya trikotazhnoy promy'shennosti: spravochnik/ M. M. Dianich, B. D. Semak, N. P. Vasilishina – K.: Tekhnika, 1981. – 120s.



**Fig 3. Respirator with exhalation valve**