Life Environmental Assessment of Housing Safety as a Necessary Condition for Technosphere Human Security

V V Glebov¹, O M Rodionova¹, V V Erofeeva¹, E V Anikina¹, R Yu Mikhailichenko¹, D B Solovev²,³

¹Peoples Friendship University of Russia (RUDN University), Miklukho-Maklaya Street, Moscow, 117198, Russian Federation
²Far Eastern Federal University, Engineering school, Vladivostok, Russian Federation
³Vladivostok Branch of Russian Customs Academy, Vladivostok, Russian Federation

E-mail: vg44@mail.ru

Abstract. The paper gives an environmental assessment of frequently used building materials, which are widely used in the construction of modern houses and apartments. The data of chemical composition of building materials, their fire danger, toxicity and quality, as well as the level of threat and danger to human health living in such apartments and houses are presented. Recommendations are given to improve the quality of life of people to improve the overall technosphere human security.

1. Introduction
Ensuring the safety of modern apartments is one of the most important components of technosphere safety and human health. Currently, the relevance of this problem has increased due to the intensive introduction of polymeric, fire-hazardous building materials containing various chemical additives, often in the form of industrial waste [1]. This is due on the one hand to a relative increase in the comfort of human habitation, and on the other hand to a decrease in the cost of building houses and apartments [1]. However, all this has significantly increased the total chemical load on the human body and often makes the living environment dangerous for human health [2]. Therefore, the problem of negative impact of finishing materials on human safety and health in Russia is today one of the most acute [3].

According to experts of the world health organization, urban residents spend almost 80% of their time indoors[3]. This fact is one of the factors that significantly affect the fire and explosion safety of housing and human life safety. In addition, human health is affected by the quality and environmental friendliness of the internal and external environment of the building [4].

Specialists of different professions (hygienists, ecologists, designers and others) have long come to the conclusion that many diseases are determined by the quality of living conditions. For about 20 years in the world there is such a thing as the syndrome of sick buildings. The reason for this disease is the unsatisfactory influence of the internal environment of the room on human safety [1].

To this end, we have given an environmental assessment of their level of danger and impact on human health on the example of the following building materials.
2. List of hazardous building materials

**Paints.** Paints are the most popular material for decoration of walls and ceiling surface. A special danger to the environment and human health are types of paint materials containing lead [5].

A small concentration it negatively affects the brain. For children of any age it is especially dangerous, mental and physical development slows down, hearing of all family members deteriorates significantly, headaches appear [5].

The use of such paints is unacceptable in a residential area. Solvents used in the production of paints and varnishes are also a major health hazard. After the repair work, the solvent continues to stand out; harmful vapors accumulate in the air, which are the cause of allergic diseases and respiratory diseases [6].

For repairs in residential areas should be selected alkyd, latex, polyester and water-dispersed paint.

The materials used for suspended ceiling structures pose a threat to the kidneys and liver. It uses a large amount of plastic and glue. Phenol and styrene vapors are released into the air, which are considered to be very dangerous for health substances, even in minimal quantities [7].

For a ceiling covering it is better to use a material for plaster with natural ingredients. It is recommended to paint the surface with safe paints [8].

**Linoleum.** The source of harmful fumes are also floor coverings (Fig.1, a). The most dangerous is known to all builders linoleum. It consists of a huge number of toxic elements: phenol, benzene, formaldehyde, etc.

![Figure 1 (a). Linoleum.](image1)

An unpleasant smell emanating from the material is a sign that indicates the toxicity of the building material. Evaporation from it can cause skin and allergic diseases, and provoke cancer [9].

**Laminate.** Laminate is a beautiful floor covering with excellent technical properties (fig. 1,b), for its durability, manufacturers cover with a plastic film, and it becomes the cause of the release of harmful substances [10].

Parquet or solid wood are the most environmentally friendly and natural flooring materials.

**Windows (Plastic).** Plastic Windows perfectly retain heat and protect the house from street noise, but for their production use polyvinyl chloride, which is harmful to human health (fig. 2,a). High impermeability of window designs reduces natural ventilation. After repair, hazardous substances accumulate in the room [11].

**Wallpaper.** For modern types of Wallpaper using synthetic substances (fig. 2,b): vinyl, benzene and others. Such substances create conditions of evaporation of styrene, urethane, vinyl chloride. Fashionable Wallpaper phosphorescent secrete deadly radioactive radon [11].
Heaters. Heaters are a source of such toxic substances as styrene, society, hexabromocyclododecane. Heat-insulating plates, polyurethane foams, foam [12] are considered dangerous (fig.3, a).

Silicate brick. It is necessary to choose with care a brick at construction (fig.3,b). Often it releases a dangerous gas - radon, which can cause cancer [13].

Very dangerous for us concrete slabs. Concrete when solidified becomes strong and dense. This is good from a practical point of view. However, it does not pass air and amplifies electromagnetic waves[14].

Plasterboard. There are two types of drywall: conventional (for residential premises) and technical (for non-residential premises). Unfortunately, it happens that under the guise of safe and environmentally friendly drywall, sold technical, the performance of which is much worse (fig.4, a).

Technical drywall is made of poorly cleaned gypsum, and, accordingly, has low quality and more favorable cost (fig.4, b). To be in close proximity to such material for long hours is categorically not recommended.

Ceramic tile is a durable, reliable, environmentally safe material. It is not a source of danger in its power. What cannot be said about the adhesives, which often are used for its fasten. It can be flammable and contain toluene and phenol [15].
Figure 4 (a). Plasterboard.  
Figure 4 (b). Technical drywall.

**Stretch ceiling.** The newest finishing material is made of polyvinyl chloride which releases unpleasant odors, allergens and toxic substances into the environment [15].

**Suspended ceilings** - the design of metal, chipboard plate medium density. Plates that are made of mineral fibers are not quite honest manufacturers can pose a threat to life and health, cause allergies, asthma and poisoning [15].

**Chipboard (chipboard).** Most of the furniture (cabinets, chairs, beds, kitchens, etc.) is made from chipboards. The danger of chipboard is that this material is released formaldehyde, which is considered the strongest carcinogen.

Experts strongly advise not to put furniture made of chipboard near the batteries, because the heat increases the release of toxic substances. New furniture has been shown to release formaldehyde strongly during the first two years. Total danger from formaldehyde persists for 14 years [15].

It is recommended to buy furniture without chipboard materials, it is considered expensive, but more environmentally friendly. For those who have already purchased furniture from chipboard need to ventilate your home more often.

3. **Electrical and fire safety in the apartment**

Electrical appliances have a known level of fire hazard. Around the world, hundreds of thousands of people die every year due to disregard for the simplest safety standards for the use of household appliances [6].

Short circuit, fires are the spectrum of the main causes of accidents in human life. They may occur when using a limited range of electrical or gas appliances. Often in the reports of incidents noted by the perpetrators of fires irons, heaters, gas or electric stove [9].

We conducted research on the quality of materials, fire and explosion hazard of construction and finishing materials that were used in the repair work in living apartments and their own homes among students and teachers of RUDN. A survey of 620 respondents (320 women and 300 men aged 19.7 to 58 years) showed that for the most part, many respondents (89.9%) were guided by the cheapness of the construction material, rather than environmental friendliness.

4. **List of toxic substances and related diseases**

A list of toxic substances that may be part of poor-quality building materials that can lead to various diseases is presented

**Paints.** There are such toxicants as toluene, xylene, cadmium, lead, polyvinyl chloride. These pollutant can cause toxicity to the liver, kidneys; bones become brittle; cardiovascular disease, skin diseases, impaired functioning of the nervous system [12].

**Chipboard** is usually phenol formaldehyde, which can cause cancer. Violations of the gastrointestinal tract, vomiting, and allergic reactions were noted. Phenol also irritates the upper
respiratory tract, has a bad effect on genetics, disrupts the work of human reproductive organs, can lead to infertility [17].

**Linoleum.** Polyvinyl chloride (benzene, xylene, toluene, amines) is released. These volatile toxicants can cause cancer, blood diseases, lung, liver and kidney disorders; the immune system is destroyed [18].

**Wallpaper** is usually styrene, benzene. Cause dizziness, loss of consciousness, irritation of the mucous membranes of the throat and nose, eye irritation [18].

**Silicate brick** can emit radon (inert radioactive gas) and cause cancer.

Insulation (insulation boards, polyurethane foam, and polystyrene foam) is often isolated styrene, society. The presented toxicants cause a violation of the respiratory system, allergic reactions, asthma, violation of the cardiovascular system, thrombosis, heart attack [19].

**Laminate secretes** formaldehyde, which affects the Central nervous system, reproductive dysfunction. Often there are possible skin diseases and allergic reactions [8].

**Plastic window** frame isolated polyvinyl chloride, which can cause cancer [19].

5. **Recommendations**

Use only certified building materials for repairs.

- Be sure to ask the seller to present a certificate of quality and fire safety certificate when buying.
- Use natural finishing materials.
- If possible, replace synthetic materials with environmentally friendly materials, such as wood, stone, natural glue, ceramic tiles, roof tiles, paper Wallpaper, water-based paints, natural varnishes, etc.
- Indoors, use building materials that are designed exclusively for interior work.
- It is necessary to strictly follow the recommendations of manufacturers on the use of materials.
- Carry out repairs every 5 years.
- Refuse to use chipboard, PVC.
- Buy materials exclusively in specialized construction stores.
- Frequent ventilation of the room after repair is recommended.
- Periodically, air measurements should be carried out on the level of harmful substances in your apartment or house.

In order to reduce the risk of fire it is necessary to carry out fire retardant flame retardants. These substances prevent the access of oxygen, which protects the wood from fire.

It is necessary to give priority to the use of non-combustible materials or difficult to ignite.

6. **Conclusion**

1. When choosing construction or finishing materials should carefully examine the manufacturer's company, quality certificates. Use environmentally friendly building materials.
2. Conduct fire-retardant treatment of materials.
3. Exclude combustible and explosive materials in the construction of housing.
4. At the legislative level, establish requirements for the issuance of a certificate of quality of construction, finishing materials used in the construction of housing.

**References**

[1] Arlian L Q, Alexander A K, Fowlor B E 2000 Lowering humidity in homes reduces dust mites and their allergens *I. Allergy and Clin. Immunol* 105 1 pp 269-270

[2] Popov K N, Kaddo M B, Kulikov O V etc 2004 Assessment of the quality of building materials: textbook (M.: Higher school) 287 p

[3] Ezratty V 2001 Ces maladies dites environnementales Premiere partie. Le syn_drome des batimentsmalsains *Energ_sante* 12 2 pp 201-218

[4] Gildenskold R S, Aksenova L P, Kuznetsov G M 2002 Polymeric and polymer containing materials and structures, approved for use in construction (Moscow: Ministry of Health of
Russia) 140 p

[5] Gubernskij Yu D, Ivanov S I, Rahmanin Yu A 2008 Ecology and hygiene of the living environment: for the specialists of Rospotrebnadzor (Moscow: GEOTAR-Media) 208 p

[6] Gubernskij Yu D, Kalinina N V, Mel'nikova A I 1998 Ecological and hygienic assessment of influence of factors within the housing environment for the Allergy of population Hygiene and sanitation 4 pp 50 -58

[7] Gubernskij Yu D, Skobarev Z A, Teksheva L M 1987 Application of the principles of system analysis in the hygienic assessment of the living environment Hygiene and sanitation 2 54 p

[8] Gusev B V, Dement'ev V M, Mirotvorcev I I 2009 Norms of maximum permissible concentrations for building materials of housing construction Building materials, equipment, technologies of the XXI century 5 pp 99-118

[9] Kapralova D O 2009 Environmental inspection of residential premises as a criterion of safety for human health Author. Cand. Diss. (M.) 25 p

[10] Kuznetsova G M, Styazhkin V M, Aksenova L P 1997 Polymers in hospital construction Health of Russia 3 pp 36 - 41

[11] Lewtas Joellen 1989 Toxicology of complex mixtures of indoor air pollutants Annu. Rev. Pharmacol. and Toxicol. vol 29 pp 415-439

[12] Malysheva A M 1997 Regularities of transformation of organic substances in the environment Hygiene and sanitation 3 pp 5 - 9

[13] Smirnov V A et al. 2006 Materials for finishing construction works: a textbook for beginning prof. of education: textbook for environments. prof. education 3-e Izd., erased. (M.: Academy) 288 p

[14] Novikov Yu V 2000 Ecology, environment and man: textbook for universities, secondary schools and colleges (M.: Fair-PRESS) p 550

[15] Severin A E, Rosanov V V, Batotsyrenov I E, Sushkova L T, Makeeva O V 2016 The body's ability to adapt and functional reserves of the body In the book: Agranovskii reading materials of all-Russian scientific-practical conference pp 117-119

[16] Severin A E, Kasyanov S Yu, Torshin V I, Sushkova L T, Batotsyrenova T E, Rozanov V V 2016 Application of vector approach for the analysis of functional reserves of the organism XII Russian-German Conference on Biomedical Engineering Proceedings of the 12th Russian-German Conference on Biomedical Engineering pp 138-139

[17] Sheftel V O, Dyshinevich N E 2007 Toxicology of polymeric materials (Kyiv) 245 p

[18] Wahlgren D R, Meltzer S B 2000 Residential mold exposure among latino families with an asthmatic child J. Allergy and Clin. Immunol 105 I pp 334-337

[19] Zarubin G P, Dmitriev M G 1987 Hygienic forecasting of indoor air pollution by harmful substances released from polymeric materials Hygiene and sanitation 4 pp 51 - 54

Acknowledgments

This paper was financially supported by the Ministry of Education and Science of the Russian Federation on the program to improve the competitiveness of Peoples' Friendship University of Russia (RUDN University) among the world's leading research and education centers in the 2016-2020.