ARTICLE

ENVIRONMENTAL RISK ASSESMENT FOR ONCOGENESIS

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ABSTRACT

This work presents a study conducted, aimed at determining the content of carcinogens in the air and drinking water in a residential area located close to a petrochemical enterprise. This enterprise makes products from ethylene polymers and copolymers. The article also presents the results of a sociological survey of an adult population living in the study area. This work was carried out to determine the dependence of the health status of residents on the effects of the harmful effects of industrial pollution. The results of calculations of hazard coefficients of carcinogenic risk from toxic pollutants entering the human body orally or cutaneously are presented. The data obtained as a result of the study do not exceed the maximum permissible levels of risk of developing chronic diseases [1]. The article presents calculations of hazard indices, according to which the probability of developing diseases of the immune system, respiratory system, cardiovascular system, central nervous system, and blood system was established. It was also found that with the combined effect of substances on the human body, their hazard index lies in the permissible limit range [2]. The calculations necessary for conducting a risk assessment were carried out in accordance with the guidelines for assessing the risk to public health when exposed to environmentally harmful chemicals.

KEY WORDS
carcinogenic risk, technogenesis, sociological survey, petrochemical enterprise, risk assessment.

INTRODUCTION

The study on the "Identification of the characteristics of the effects on the health of the population of air and water of various pollution levels" was conducted by interviewing the adult population of the territory of interest. The study area is located 2 km away from a large petrochemical enterprise engaged in the production of ethylene, both high- and low-pressure polyethylene, ethylene oxide, phenol-acetone and polyethylene pipes. The purpose of this work was to identify the negative factors of the impact of pollutants from atmospheric air and drinking water on the organs and systems of the studied group of people.

The study area has the following characteristics:

- Borders with large housing estates;
- Has a temperate continental climate: in winter, the snow cover formed is moderate, in spring and autumn there are fogs on the territory with a total duration of about 16 days a year, the total average rainfall is 197 days a year;
- Air humidity is 75%;
- The average annual wind rate is about 3.7 m/s.

The studied area includes a diverse sphere of the consumer market and services, which consists of various shops, shopping malls, pharmacy points, food courts, etc.

Carcinogenic risks are risks able to provoke the development of oncological formations in the human body under the influence of technogenic environmental pollution. The following carcinogens were identified in the study area: cadmium oxide, chromium (VI), propylene oxide, lead and its compounds, benz(a)pyrene, nickel soluble salts, benzene, 1,2-dichloroethane, trichloromethane, tetrachloromethane, epichlorohydrin, formaldehyde, ethylbenzene, ethenyl acetate, acetaldehyde, captax, thylene oxide, carbon black, divinyl, naphthalene, tetrahydrofuran, titanium dioxide, benzoyl chloride, and trimethylcarbinol.

Risk assessment is a complex process that includes many stages and covers various information about the level of pollutants in the environment, their properties, their transformations and their impact on the human body. Using this process, it is possible to determine and predict the likelihood of development of pathologies in an individual [3].

Toxic substances thus can cause pathological changes in the structures in the body. This process depends on various factors, such as the duration of a person's contact with the toxin, its concentration and ability to accumulate in the cells of the body [4].

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MATERIALS AND METHODS

The risk assessment methodology for harmful effects of carcinogens on the studied population is described in the guideline for assessing the risk to public health when exposed to environmentally harmful chemicals. This manual was approved by the Chief State Sanitary Doctor of the Russian Federation on March 5, 2004, R 2.1.10.1920-04. The methodological guidelines presented in the work allow us to determine the sanitary and environmental status of the area of interest to us, by calculating pollution levels and comparing the results with maximum permissible values. These manipulations also allow us to predict the response from the health of residents to industrial pollution [5].

Risk assessment is carried out in 4 stages:

- Sampling (identification): according to the results of this stage, the substance is evaluated, namely whether it is carcinogenic or not;
- Exposure assessment: yes, at this stage, a quantitative assessment of the doses of the substance is carried out;
- Dose-response assessment;
- Determination of concentration thresholds.

To assess exposure in ambient air and drinking water, average estimates of daily lung ventilation (20 m3) and daily water intake (1.9 L) were used [6].

The risk to human health is determined by such a parameter as “hazard factor (HF)”, which is the ratio of dose exposure to the reference. This ratio is also true in cases where exposure concentrations and the studied toxin are used, respectively.

The sum of the hazard factor of substances complexly affecting the human body is a hazard index (HI) [7].

Interviewed part of the population was in the age range from 18 to 80 years. The study was conducted at the place of residence of the respondents. The key topics of the survey were: places visited by respondents over the past year, both on weekdays and weekends; concern for the quality of drinking tap water; the presence of various odors in the air at different times of the day.

RESULTS

The results of a sociological study found as follows:

- At least 40% of the population stay constantly in the area of residence, both on weekdays and on weekends;
- 52% of respondents are concerned about the presence of a specific taste in drinking water;
- 50% of respondents are concerned about the presence of specific odors in drinking water;
- 49% of residents make additional water treatment before drinking it, 29% use only bottled water;
- 73% of respondents are sure that the source of the unpleasant smell is a petrochemical enterprise.

With statistical certainty, it was found that the smell from the operating industrial enterprise is strongest in the morning ($p < 0.05$) and at night ($p < 0.001$). Polluting gas consists of chemicals (14.5%), burning (6%), gases (31.5%), and phenol (8%).

The samples taken contained 19 carcinogenic substances discovered that are emitted by the studied petrochemical enterprise. So, when toxins enter the human body through the skin, the risk for cadmium is 1.47*10-9, for benzene - 5.52-10-10 and for cadmium - 6.44*10-11, for benzene 7.13*10 -14 for oral route of administration.

According to the results of calculating the hazard factor for oral carcinogens, the greatest threat is posed by cadmium (HF = 2.65*10-5) and benzene (HF = 1.14*10-6) with an acceptable value of HF≤1. These values correspond to the upper limits of the permissible range and are subject to constant monitoring.

According to the calculation of the hazard factor when carcinogens enter the human body together with inhaled air, the greatest threat is posed by cadmium (HF = 2.04*10-8) and benzene (HF = 8.81*10-10) with an acceptable value of HF≤1. These values correspond to the upper limits of the permissible range and are subject to constant monitoring.

DISCUSSION

The studies revealed that residents of the territory located 2 km away from the petrochemical enterprise are concerned about the ecological condition of their habitat. This industrial enterprise annually emits about 14,313 tons of toxic substances, many of which are carcinogens and contribute to the development of

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cancerous tumors in the human body. This situation is exacerbated by the fact that at least 40% of residents are constantly in their area of habitat.

The results of the survey showed that half of the respondents are not satisfied with the quality of tap water, they point out the presence of odor and taste that are unusual for drinking water.

Also, all respondents notice the presence of specific odors in the air, among which are the smell of gases, burns, and chemicals. It was noted that the smell intensifies in the morning and at night.

Calculations performed to assess the risk indicate the presence of carcinogens in drinking water and air. The maximum hazard factors were found for cadmium and benzene; they lie at the upper limits of the threshold values, which requires constant monitoring of them when they enter the human body through the oral route [8-10].

SUMMARY

- The following harmful carcinogens have the greatest harmful effects on the human body through oral entry: cadmium (HF = 2.65*10-5), benzene (HQ = 1.14*10-6). Their hazard indices lie in the upper limits of the maximum permissible values, which requires their constant monitoring.
- The following harmful carcinogens have the greatest harmful effects on the human body when inhaled: cadmium (HF = 2.04*10-8), benzene (HQ = 8.81*10-10). Their hazard indices lie in the upper limits of the maximum permissible values, which requires their constant monitoring.
- More than half of the inhabitants of the study area is concerned about the quality of the consumed tap water: 52% complain about the presence of smells, 50% - about the taste;
- 73% of respondents complain about the smell from the operating petrochemical enterprise; they note that the smell intensifies in the morning and at night. The composition of industrial emissions with a specific smell includes gas (31.5%), chemicals and household chemical waste (14.5%), phenol (8%), and burn (6%).

CONCLUSION

This article includes a study to identify factors affecting the health status of people living in a petrochemical enterprise. The results obtained led to the conclusion that toxic emissions of the industrial enterprise affect the human body through the atmosphere, as well as drinking water, that contain cadmium and benzene as the main carcinogens.

CONFLICT OF INTEREST

There is no conflict of interest.

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None.

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