CODEN [USA]: IAJPBB ISSN: 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES

http://doi.org/10.5281/zenodo.1467375

Available online at: http://www.iajps.com Research Article

PECULIARITIES OF FORMATION OF CARCINOGENIC RISK UNDER THE INFLUENCE OF TECHNOLOGICAL EFFECTS OF PETROCHEMICAL TYPE

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Abstract:

This paper presents the results of a study of the quality of drinking water and atmospheric air in order to identify the concentration of hazardous substances and their effect on human health. To assess the risk, a territory located 1990 m from a petrochemical enterprise, the main source of pollution, was chosen.

The activity of the industrial facility is the manufacture of various products of petroleum feedstocks, which entails the emittance of non-carcinogenic substance, namely ethylene and carcinogens, including benzene, epoxyethane, chrome VI, divinyl, cadmium into environment.

The paper also presents the results of a sociological survey of residents of the study area, whose purpose was to identify the characteristics of the impact of pollutants on them. Thus, it was found that the majority of respondents noted deterioration in the quality of water consumed the presence of odors in the air, as well as the detrimental effects of the activity of the plant on their well-being and health in general.

During the research work, the main risks were identified and evaluated; their indices and hazard ratios were calculated. This analysis established the groups of danger the detected elements belong to and how they affect the organism of the population. The most vulnerable systems of the body of the surveyed residents are cardiovascular and nervous.

Keywords: *ecology, environmental pollution, non-carcinogenic risk, carcinogenic risk, risk assessment, technogenesis, petrochemical enterprise, sociological survey.*

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Please cite this article in press Ekaterina V. Vasilyeva et al., ***Peculiarities of Formation of Carcinogenic Risk under the Influence of Technological Effects of Petrochemical Type.,*** *Indo Am. J. P. Sci, 2018; 05(10).*

INTRODUCTION:

Currently, there is an intensive increase in the number of patients whose disease is caused by environmental pollution, which is a consequence of scientific and technological progress, namely the development of chemical industry enterprises [1].

The objective of this paper is to study the specific features of the formation of carcinogenic risk under the impact of petrochemical technogenesis.

For the study, an area located 1990 m from the largest petrochemical enterprise was chosen.
This plant produces up to 14,313 tons of pollutants per year emitted into the atmosphere. This means that the residents of the investigated area are affected by many negative factors.
Carcinogenic risk is the possibility of the onset of various chronic diseases that lead to the formation of malignant cells, and are caused by the exposure to humans of various toxic substances.

To determine the risk, it is necessary to evaluate it, i.e. carry out a series of studies, the results of which will allow us to predict the possibility of certain occupational diseases that may arise in the course of labor activity and are caused by the influence of pollutants [2].

Microelements toxic to the body penetrate in different ways into human systems. Thus, these substances can enter the body through inhaled atmospheric air, drinking water, percutaneously [3].
Thus, it is obvious that people are daily exposed to contaminants, the effects of which can lead to chronic diseases, as well as to death as a result of prolonged contact with the toxins [4].

METHODS:

To assess the risk, it is necessary to calculate such criteria as the hazard ratio and index [5].
The hazard ratio (HR) is the ratio of the level of the external pollutant, namely its dose and concentration, to its allowable (safe) level.

The hazard index (HI) is the sum of the hazards of various toxic substances.
The risk assessment for the action of chemicals is carried out in accordance with certain stages [6].

Traditionally, the work on risk assessment involves four stages: identification of priority pollutants; identification; evaluation of the dose-response system; and risk profile.
Sampling takes place to determine the degree of risk and an assessment of the exposure (qualitative and quantitative analysis of pollutants) of workers on the level and time of contact to pollutants and their ratio to the maximum permissible values.

Thus, the first step is to identify the health hazard, then, depending on the carcinogenicity, either a dose-response estimate or thresholds, concentrations, and uncertainty coefficients are determined.
Estimation of MPC in a residential area is carried out according to the following formula:
$R=C/MPC$,
Where R is the coefficient of potential hazard, C is the actual concentration of the pollutant in the air and drinking water, MPC is the maximum permissible concentration of the same element.
Since the residents of the settlement are exposed to multiple factors, the risk factors will be summed up.
In order that the potential danger of a set of substances is not higher than under the action of one substance, the sum of these coefficients should not exceed unity:
$C_1/MPC_1+ C_2/MPC_2+\ldots+C_n/MPC_n\leq 1$.
Children's opinion was obtained through their parents interviewed in pre-school educational institutions (kindergartens / nurseries) for respondents from 1 to 7 years old, as well as in secondary schools by directly asking children aged 7 to 17 years.
For questioning in preschool institutions and schools, permission was received from their directors on the basis of an information letter from the Chief Physician of the Center for Hygiene and Epidemiology of the Republic of Tatarstan.
The survey of the adult population aged 18 to 80 years was carried out by a personal interview at their place of residence (in the apartments).

RESULTS:

As a result of the study of the hazard level of the potential impact of toxic emissions of a petrochemical plant on the health of the adjacent population, it was found that the most dangerous components of emissions are 7 trace elements, namely ethylene, chromium VI, divinyl, ethylene, cadmium oxide, lead, and chloroform.

Carcinogenic dangerous substances were also detected, including benzene, epoxyethane, chromium VI, divinyl, cadmium oxide, lead, and chloroform.

The main ways of penetration of toxic substances into the body are inhaled atmospheric air and drinking water.
As a result of the calculation of risks to public health, a total carcinogenic hazard indicator was obtained for the most dangerous element in atmospheric air – benzene, which was $2.24*10^{-5}$ for the study area.

The inhaled air also carries a non-carcinogenic element into the body, which is not inferior to

benzene by danger. This substance is ethylene, which hazard index for two human body systems - cardiovascular (0.55) and nervous (0.45) - was calculated.

The risk assessment for drinking water has shown that the second most dangerous carcinogen - cadmium - enters both through the skin and orally and its values are $2.67*10^{-8}$ and $0.33*10^{-6}$, respectively.

Thus, the results of the risk assessment showed that chemicals entering through inhalation, orally or percutaneously provide an acceptable level of carcinogenic risk, and the values of chronic non-carcinogenic risk correspond to the acceptable level.

Analysis of the results of a sociological survey showed that about 70% of respondents are concerned about the quality of water they consume. It has been statistically reliably established that the main causes of concern when consuming tap water are odor ($p < 0.05$) and taste ($p < 0.05$). The structure of the distribution of anxiety is as follows: the smell of water – 56% of the respondents, the taste of water – 50% of surveyed. 29% of residents of the study area use bottled water and 42% – after additional treatment, only 32.51% of respondents use tap water.

The main problems of water supply remain the wear and tear of the facilities and equipment. Excessive service life of the main water conduits and water supply networks is the reason for secondary contamination of drinking water. 42% of networks require reconstruction. The technology of water disinfection with chlorine is also used, which is unsafe for the life of the city [10].

According to the results of the questionnaire, all respondents note the growth of an unpleasant smell in the morning, in the evening and at night. Also, according to the results of the survey, it was revealed that people more often complain about the smell of gas ($p < 0.001$), chemicals ($p < 0.001$). In percentage terms, these data look as follows: gas (25.2%), smell of chemicals and household waste (15.2%).

DISCUSSION:

It is known that residents of villages adjacent to large industrial enterprises are most strongly affected by the negative impact of the emissions. A high level of concentrations of heavy metals and harmful gases form the conditions favorable for the development of certain diseases [8]. Among the priority pollutants are ethylene, chromium VI, divinyl, ethylene, cadmium oxide, lead, chloroform. In addition to emissions into the atmosphere and water bodies, among the harmful factors can be identified unfavorable microclimate against the background of operating enterprises, increased noise and vibration.

For the studied settlement the most dangerous elements are: benzene, ethylene oxide, chromium VI, divinyl, ethylene, cadmium oxide. The following descriptions of each pollutant are provided.

Cadmium oxide belongs to carcinogenic extremely dangerous substances (hazard group I). The toxic effect of this microelement on the human body is associated with the phenomenon of leaching calcium from bone tissue and the detrimental effects on the entire nervous system. The danger of this chemical lies in the fact that cadmium, getting into the human body through the skin with water, is retained in the kidneys and liver and is excreted for several years [9].

Chromium VI also belongs to extremely dangerous carcinogens, but in contrast to cadmium its main way of penetration into the body is inhaled air. Prolonged contact with this microelement can cause severe intoxication, which extensive stages can lead to death. Chromium VI can cause jaundice, peptic ulcer, and also the appearance of ulcerative formations on the mucosa of the respiratory tract [10].

Benzene - a carcinogenic element, belonging to the second group of danger. Like chlorine VI, it enters the body through the respiratory tract. Benzene can provoke a complex poisoning that can develop into a chronic one and cause diseases such as anemia, sexual dysfunction, dysfunction of the central and peripheral nervous systems, etc.

Ethylene belongs to the third group of danger and is the only non-carcinogenic substance. Entering the body through the atmospheric air, ethylene gets affects the mucous membranes, causes their irritation, inhibition of cardiac activity and vascular tone decrease. Long-term exposure to ethylene leads to disturbances in thermoregulation of psychoemotional disorders.

Ethylene oxide - a carcinogen, belonging to a moderately dangerous group. When inhaled, it causes intoxication, namely, the person begins to feel dizziness, drowsiness, vomiting, sore throat, etc.

Divinyl is a group IV carcinogen. This element enters the body through the respiratory tract and can cause respiratory paralysis, loss of consciousness and the appearance of spots in the field of vision.

The conducted survey made it possible to determine the level and causes of pollution of water and the

atmosphere in the opinion of the residents of the locality. The analysis allowed us to determine that most people are concerned about the deterioration of the quality of life due to the neighborhood of the settlement with the oil industry enterprise.

SUMMARY:

1) Living close to industrial enterprises is associated with the impact of a number of hazardous production factors, such as exposure to chemicals. Priority environmental pollutants were ethylene, chromium VI, divinyl, ethylene, cadmium oxide, lead, and chloroform.

2) The conducted survey made it possible to reveal that the main source of smell in the territory under study, mostly noticeable in the mornings, evenings and at night, comes directly from the oil industry enterprise.

3) According to the results of the study, the main pollutant entering through the skin is cadmium, which belongs to the danger group. The risk value of this toxic element is $2.67*10^{-8}$.

4) According to the results of the study, the main pollutant entering with inhaled atmospheric air is benzene, epoxyethane, chromium VI, divinyl, which total risk is $2.24*10^{-5}$.

5) The air inhaled contains also ethylene entering the human body, the hazard index of which for the cardiovascular system is 0.55, and for the nervous system - 0.45.

6) The results of the calculation of the hazard factor from the research data for the cutaneous supply of toxins have shown that the risk levels correspond to the permissible values (HR≤1).

7) The results of calculations of the hazard factor from research data on the toxins entering through inhaled atmospheric air have shown that the risk levels correspond to the permissible values (HR≤1).

CONCLUSIONS:

Assessment of the impact of pollution factors coming from the enterprise located close to the community showed that all residents of this area are subject to daily disastrous effects. Such an effect results in a number of chronic diseases that, under long-term contact with toxic elements, can lead to disability.

ACKNOWLEDGEMENTS:

The work is performed according to the Russian Government Program of Competitive Growth of Kazan Federal University.

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