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The impact of the cosmodrome «Baikonur» on the environment and human health

In article environmental problems connected with start of rockets – Proton-M carriers are considered.
Key words: pollution, environment, health.

Introduction

An assessment of the health status of ecosystems exposed to anthropogenic pollution is a vital issue for many countries. Particularly it concerns the consequences of contamination caused by the activity of the space industry. Each rocket launch is accompanied by the introduction of parts of the rocket propellant into the environment. This study aims to scrutinize the effect of the components of rocket fuel on the induction of lipid peroxidation and chromosomal aberrations on rodents inhabiting the area exposed to pollution from Baikonur cosmodrome. The results showed the increase of the level of lipid hydroperoxide and malondialdehyde in the livers of *Citellus pygmaeus* Pallas and *Mus musculus* L., which indicates an augmentation of free radical activity and DNA damage. The cytogenetic analysis of bone marrow cells revealed that the frequency of chromosomal aberrations was a few times higher in the rodents from contaminated territory. The signs of oxidative stress and high level of chromosomal aberrations indicate the environmental impact of the cosmodrome, and its possible toxic and mutagenic effects on ecosystems [1].

Main body

In 2006 from the Baikonur spaceport 16 starts of launch vehicles «M Proton» were made. The first step of the launch vehicle, separating from the ship, usually falls on the territory of the Ulytausky area. In a zone of its falling there are sites automobile and the railroads, power lines, the field camps of Kumkolsky of an oil field. The most dangerous sites where the remains of a step of the M Proton launch vehicle can fall, are in Ulytauskomi Shetsk regions of the Karaganda region: these are sites of highways Kyzylorda – Pavlodar and Yekaterinburg – Almaty, a site of the railroad Petropavlovsk – Almaty, sites of oil pipelines Pavlodar – Shymkent and Atasu – Alashankou , sites of hunting grounds and power lines. In this zone there live people, there are settlements. Sukhoputnaya Route of the Proton-M launch vehicle takes not only the territory of Kazakhstan, but also Altaiskyi Krai, the Republics of Altai, Khakassia, Tuva, Sakha of the Russian Federation, China, Mongolia, North and South Korea, Japan [2].

Population density on the route of flight at first progressively increases from 0.5-1 persons/km, and reaches a maximum – 5-7 persons/km in the territory of the Pavlodar region of RK and the Mountain Altai republic of the Russian Federation and then gradually goes down [3].

The carrier rocket of the Proton series belongs to the heavy class. It is made by the State space research and production center of M. V. Khrunichev (Russia). Since 1965 more than 320 starts of the carrier took place. Modernized «Proton-M» has three steps. Starting weight – 700 tons, length – 61.75 meters, diameter – 7.4 meters. It is equipped with the new accelerating Briz-M block and a modern digital control system. «Proton» can put to geostationary orbits

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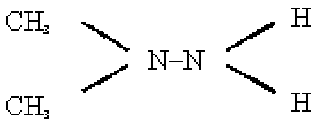
at the same time some satellites with a total weight up to 4.2 tons [4].

Even in the regular mode the risk for health of the population in areas of the space-rocket activity (SRA) exists from a point of start of ballistic missiles and carrier rockets on all route of flight. On the district at distances from a start point to 800 km at two-level removal and to 2500 km at the three-stage the «spots» of 1500-5000 km^2 covered with fragments of the ballistic missiles (BM) and rockets – carriers (RN) are formed [5].

Essential harm to natural objects is done as elements of a design of the separating parts of carrier rockets (mainby), and the remains of not developed components of fuels. The area of one pollution depending on hydrometeorological and geographical features of a place of falling very much of RN can reach some hectares, besides the LRF (liquid rocket fuel) components and products of their transformation can migrate with natural waters on distances to several hundred kilometers [6].



At the content in air of amount of heptyl of 0.01 mg/l in a few minutes there is a serious poisoning. Maximum concentration limit, in this measurement makes 0.0001 mg/l or 0.001 mg/m3 of atmospheric air. During long use of heptyl in Armed Forces of the USSR the big material testifying to an adverse effect of heptyl on health of staff of VS is saved up. It is established also that heptyl in a dose of 0.1 maximum concentration limits at contact with it in the open air within two years makes an adverse effect on a human body [7]. Therefore maximum concentration limit should consider 0.00001 mg/l. For children, pregnant women of maximum concentration limit of heptyl has to be 0.000001 mg/l or 0.00001 m^3 [8].

Nonspecific violations of health have a strong likeness with symptoms of a radiation injury (a cancer, leukoses, cytosinging, an adynamy, etc.) that becomes frequent the reason of the wrong diagnosis. Symptoms of a pseudo-radiation injury happen so expressed that compels doctors to make the diagnosis to sharp radiation sickness. However lack of a source of ionizing radiation gives the chance to exclude radiation defeat [9].

There is accurately expressed professional risk. Most often defeat of an organism the space rocket fuel (SRF) found in tabunshchik, shepherds, and often die cattle breeders who practically don't live up to pension from cancer [10].

The age risk is distinctly expressed: the age is less, the specific pathology is found (spasms, damage of a liver, blood, a laringostenoza, etc.) more often. Women have a bigger risk of diseases of blood, than at men. Newborns that are connected with pre-natal defeat of a fruit have the greatest risk [11].

The risk of defeat of an organism sharply increases at those persons who adjoin to RN fragments: the walls of fuel tanks, various small splinters which are giving in to manual processing (production of knives, handles, cigarette cases, etc.). They develop the states indistinguishable from radiation sickness (in the absence of the radiating source) [12].

In scientific literature collected enough data confirming an adverse effect of rockets – the carriers flying on toxic fuel on environment and health of the population. And this influence has catastrophic character, causing transient malignant diseases an iliinvalidization in the persons who got poisoning.

When falling a tank, the remains of fuel dissipate in air, forming the poisonous smog which is besieged on the earth on a trajectory of the movement of the first and second steps of rockets. Thus, there is a gradual pollution by all components of rocket fuel of environment along routes of flight of rockets. Pollution of huge territories accrues with each new start [13, 14].

For decades of a place of spill of heptyl turn into godforsaken places, life-threatening the person. Heptyl possesses high fluidity: having got on the earth, it at once leaves to humidity (in the dry easy soil on depth to 3 meters), is dissolved in water and that is interesting when it is raining, rises up. Besides, heptyl is incredibly «steady» to the place of its appearance. The Russian scientists investigating this substance find it within 34 years on the same places [15]. Specific physical and chemical properties of heptyl do the extremely difficult, and in practice – impossible its neutralization and decontamination of the district after chemical infection.

It is necessary to consider and a small bioproductivity of desert and semidesertic ecosystems of the areas which are exposed to pollution, their low ability to self-restoration is a consequence of that. Also, for the ecosystems having a strong climatic stress the maximum assimilation of biogenes and their inclusion in trophic chains is characteristic, the expressed biological accumulation and strengthening of derivatives of heptyl in links of a food chain will be a consequence of that [16].

Accepting toxicity of heptyl in a look, command of space troops of Russia in 2006 made the decision

not to order more industries of RN of the class «Cyclone-3», «Space-3M» and «Roar» fuelled toxic capable to put small objects to orbit. The Angara project on development and use of RN on eco-friendly fuel is also initiated.

However the reduced types of RN were started generally from the Plesetsk and Free spaceports (closed in 2007), on Proton and Dnieper launch vehicles, the most powerful of used, such decision it was accepted not. Tests of easy, Central and heavy «Angara» – are constantly removed. Now the first tests of this class RN it is planned to carry out only in 2011 [17, 18].

Thus, the mentioned steps towards ecological safety at the moment are solved nothing for Kazakhstan, and are only urged to calm the Russian public opinion. At preservation of present dynamics of starts, for the closest five years of one «Protons» 80–100 units will be started. At such selection and the available frequency of accidents the number of emergency start-up with their catastrophic consequences can exceed 15–20 cases of emergency situations of regional scale [19]. Though already now there is an alternative to old and very dangerous equipment, for example new modifications of RN «Union» flying on kerosene, the Russian side insists on further operation of «Protons» and «Dneprov», protecting the commercial interests [20].

The first start-up of «Proton», took place in 1965, and modernization was carried out in 2001. According to experts, frequent failures at starts show that numerous programs of modifications and conversion of outdated rockets were a little effective. Frequency of accidents was over the last ten years distributed as follows: on one in 1996 and 1997, two in 1999 and on one in 2002 and 2006, and one in 2007.

Despite these accidents, demand for commercial use of «Protons» continues to remain steady also for the reason that the customer, in case of accident, sustains the minimum losses which are covered by insurance. But who is insured from those who live directly under routes of dispersal of 700-ton rockets from which 649 tons are the share of extremely poisonous and chemically aggressive fuel mix of heptyl and amil. At the last accident on September 6, 2007 at the time of falling in the rocket there were 218 tons 978 kilograms of mixes. The largest fragment of the carrier rocket fell in 43 kilometers to South-west of Zhezkazgan (total of 200,000 habitants along with the cities – satellites), which escaped thanks to combination of circumstances. If switching off of engines happened for 5 – 10 seconds later, the rocket would fail within the city. Here it should be noted that so-called «deserted territories» of Kazakhstan any more not that in the fiftieth, population density in the region grew several times and, despite it, on – former it is operated in the ground mode. The people living there are defenseless before a technological initiative of the corporations, in a pursuit of profit which are irresponsibly ignoring their essential, vital interests and the right for quiet and healthy life [21].

Kazakhstan, following own strategy, will develop by all means the space program. Also time for creation on Baikonur of the open competitive environment came, technological break or as a minimum – refusal of outdated and dangerous technologies would be a consequence of that.

It is advisable to forbid immediately use (start and flight over the territory of the Republic of Kazakhstan) RN of all types and types of basing working at heptyl and similar types of toxic fuel as constituting extreme health hazard and wellbeing of the population of the Republic of Kazakhstan.

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