

Evaluation of Urban Environment Ecological Situation Using Biochemical and Physicochemical Investigational Methods.

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Abstract.

Significant increasing of the morbidity level among children and adolescents as well as a number of newborns with inborn pathology was marked during the last decades. It is a result of environment state worsening on the background of the bad socio-economic conditions. The most informative index of the public health evaluation is the correlation of children morbidity and ecological-geographical factors. Forming of the indicative biogeochemical model “ man-caused anomaly – human organism” is possible on the base of complex studying of air, soil and plants ecological state, which characterizes man-caused anomalies along with the human biosubstrates diagnostics. The present work cites the data of ecological situation of natural environment of city located in middle taiga area, in immediate vicinity of ore deposit and ore mining and processing enterprise. Physical and geographical conditions and location make the city a handy object for man-caused nature environment and man's health effect monitoring. The condition of top soil (chemical pollution, phytotoxic properties of soils), snow, gathered at the territory of city and outside, some plants species growing at the territory under analysis and heavy metal content in hairs of children at the age of 3-6 years old permanently residing in this city were analyzed.

Introduction.

Evaluation of air, growth and top-soil pollution level is one of the most important problems of man's environment study under conditions of technogenesis. Man-caused pollution of industrial enterprises, exhaust from motor transport, reduction of areas with growth, increase in house building and industrial structures effect qualitative structure of man's environment and facilitates development of different diseases. Control and evaluation of city soils condition allow timely eliminating negative factors of their use, forecasting of soils critical loads results.

The present work cites data of ecological situation of natural environment of city located in middle taiga area, in immediate vicinity of ore deposit and ore mining and processing enterprise. Physical and geographical conditions and location make the city a handy object for man-caused nature environment and man's health effect monitoring. Aero man-caused emissions of ore mining and processing enterprise, shooting operations in quarry, heat-and-power engineering complex, motor transport are main pollution sources of region.

Methods.

Physical-chemical, chemical, biochemical and spectral (atomic absorptive and X-ray fluorescent) methods have been used in analysis of soils, snow cover and plants. The hairs of children of preschool age permanently residing in this city have been studied as most informative biological substratum during evaluation of concentration extent of ecological toxicants in human organism. All samples under study have shown presence of heavy metals, soils have shown acidity and phyto toxicity, as well as micro- and macro elements.

Results and discussion.

In the result of top-soils condition investigations areas around ore deposit and ore mining and processing enterprise were discovered where content of some metals exceeds background level.

After 5 years of enterprise's operation there were marked changes in the upper parts of soils (horizon A-01) within a distance up to 5 km to the south-west and up to 10 km to north-east. At 2cm depth (horizon A-02) affected zone is traced up to 2 km to the south-west and 5 km to the north-east. After 8 years of enterprise's operation pollution zones extension remained at the same level, intensiveness of accretion increased towards north-east. Excessive contents of lead - 71-85 mg/kg, zinc - 200-300 mg/kg, arsenic - 60 mg/kg was discovered in the upper horizons of impact zone soils (6-8 km). Concentration coefficient of majority of metals in forest substrate – 2,0 – 4,6. Accumulation of metals in soil is represented in expanded form: Fe – Ni – Cr – Zn – Cd – Pb – Cu – Mn .

Analysis of physical and chemical properties of urban soils has proved significant differences from natural ones by higher variability of values within one type of landscape. The reaction of soil environment has changed to alkalization, near to normal reaction in some sections, excluding sections where potential acidity remains at background level. Exchange bases sum is within content in background soils and is 27,0-43,2 mg-equivalent/kg. Contents of calcium and magnesium differs sufficiently in some sections and is 0,8-16, sometimes - 35,8 mg- equivalent /kg, which is peculiar to soils of urban areas. The same is related to contents of organic carbon, which is within 0,69-7,77 %, and its largest amount - 7,77 % and 6,56% exceeds background content in almost 3 times.

The chemical properties character of soils under study is increased content of Fe. Analysis of data received shows that its concentration within city area varies from 15,5 to 2448,0 mg/kg of soil, at background of - 1024,5 mg/kg. The largest content of Fe – 5496,0 mg/kg is observed in soils located in impacted zone within 2 km from ore mining and processing enterprise. Content of such elements as Ni, Cr, Pb exceeds background values. However in some sections maximum indices of total relative background pollution (Zc) are of 16,57 - 22,84, which correspondent to reasonably dangerous pollution category. All other sections have shown $Zc < 16$, which is within permission values. Low potential buffer stability of soils to accumulation of chemical compounds facilitates their migration and translocation into contiguous environments. High content of Fe, Ni, Cr, Pb in sprouts of bilberries, cloudberry, etc. was found in 9 km away from ore processing enterprise. Thus, the content of Fe in sprouts of moss, comparing to the background, is exceeded 28 times, Ni - 11 times, Cr – 13 times. In connection with air pollution, condition of afforestation adjacent to the enterprise got worse, which was shown in thinning of coniferous trees crown. The amount of sound wood in average is

50%.

Samples of *Trifolium pratense* plants have shown exceed content of heavy metals comparing to background. Accumulation coefficient comparing to background is as follows: for Ni - 1,09 – 2,83; for Zn – 1,20 – 2,12; for Fe – 1,03 – 1,32. Increased content of Zn and Ni was discovered in samples of plants gathered from all areas under study. Accumulation of ferrum in plants is less significant and was shown only by half of samples being studied.

During identification of soil phyto toxicity with the use of indicated culture *Chlorella vulgaris*, a high inhibitory effect was discovered at the territories of kindergartens and car-parking. Increased soil breathing was noted at the territories with high toxicity, which indicates on activation of biochemical processes in soil. With the help of microbe spot-test of *Saccharomyces cerevisiae* culture the soils with mutagenic properties were discovered. These areas are located near highways and at car parking.

Analysis of snow in the city and outside towards the enterprise enables to conclude that concentration of main ingredients in snow water proves the average level of air pollution. δ^+ of snow has poorly acid and sometimes neutral reaction and is 5,7 - 6,6, excluding two areas, where δ^+ = 3,9 and 4,9, which characterizes some local acidation.

Content of calcium and magnesium in snow water at all areas under study is higher than background values (0,1i \bar{a} - equivalent /l) and varies within 4 - 94 mg- equivalent /l, which proves aero man-caused source (dust, soot, etc.).

Concentration of sulphate-ions in some areas greatly exceeds background values of 0,5 mg/l and are - 2,2; 2,6; 1,5 mg/l accordingly.

The presence of nitrate nitrogen in snow water and high concentrations in the areas within city as well as along highways (from 1,0 to 2,9mg/l), proves aero man-caused effect, mainly effect of motor transport.

Chemical analysis on presence of heavy metals has shown that contents of Mn, Fe, Zn, Cu in separate areas exceed background values greatly. Concentration of Mn and Fe in snow cover varies within great range (5,2 - 141,1 accordingly and 15,3 - 175,9 mg/l). Content of Pb, Cd, Cu does not exceed permitted level of fixed sanitary norms.

During analysis of chemical composition of hair of 104 people (children at the age of 3 to 6 years old, permanently residing in the city) increased content of heavy metals was discovered comparing to average content of these elements in hair of children living in Non-chernozem zone.

Table 1.

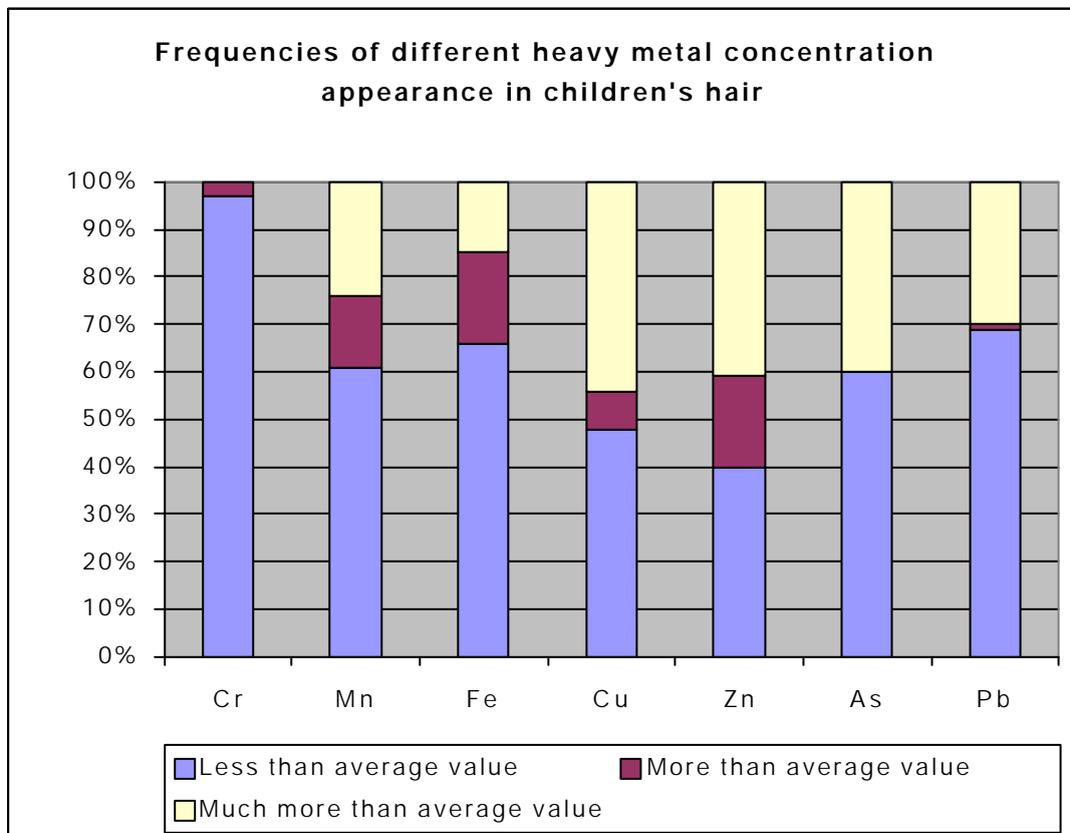
The content of heavy metals in children's hairs

Element	min. - max. value, mg/kg	average value (C ₁), mg/kg,	average value in Non-chernozem zone(C ₀), mg/kg	C ₁ /C ₀
Cr	0,2 – 7,0	0,6	0,62	1,0
Mn	0,2– 116,0	4,52	0,27	19,6
Fe	0,6-402,0	33,2	18,7	1,8
Cu	1,0-1913,0	89,05	11,0	8,1
Zn	5,3-1154,0	257,3	132,8	1,9
As	0,2-293,0	36,96	0,16	231,0
Pb	2,0-712,0	35,06	3,6	9,7

Analysis of cite data shows increased content of heavy metals in children's hair. Only in 50% of studied hair content level does not exceed average value in Non-chernozem zone and in 30% - it is greatly exceeds average values. It should be mentioned however, that biochemical situation in the region under study is characterized by increased background content of Cu, Cr, Mn, As. The diagram of different concentrations of some heavy metals in children's hair occurrence rate is shown below.

(Fig. 1)

Figure 1



Conclusions.

The soils of studied territory are in the situation of ecological intensity of different extent, which is proved by data of their chemical pollution and phytotoxicity. During monitoring the extent of man-caused load increased and at the same time weak potential buffer stability to chemical pollution facilitates migration processes and their translocation to contiguous environments. There is a high content of highly toxic arsenic in industrial zone of ore mining and processing enterprise. Content of zinc is increased along highways and manganese – along trunk railway.

The situation is getting better in winter time – chemical analysis of water-soluble compounds in snow samples, gathered at the territory of city and outside it enables to conclude that concentration of main ingredients and total pollution index still show permissible level of pollution. As for plants, ore mining and processing enterprise badly effects some species growing around.

Analysis of children hairs chemical composition shows the risk of possible diseases of cardiovascular, respiratory, nervous systems, liver, kidneys and skin diseases. Investigations of different components of nature environment and human's biological substratum prove that there is an influence of man-caused pollution source on city environment and further it may cause to negative consequences.

References.

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