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About priority nature-technogenic factors associated with the wastes of DTMM that affect people's health in Zakamensk

The research undertaken in 1990-2014 identified zones of natural (seismic, radon, and radiation induced, etc.) and technogenic pollution (of air, soils and waters) with toxic heavy metals whose concentrations exceed the maximum permissible levels and which has led to environmental disaster area formation on the territory of Zakamensk.

Assessment of the levels of morbidity and association of diseases with risk factors was quite tough (difficult) because the state agency did not have enough money, and the synergy of 30 different influencing factors was not easy to measure. The research funded by off-budget (grant) money was directed in three ways:

1. There was established a verifiable dependence of diseases with pollution among children and aboriginal population in the environmental disaster area, but it did not become a real proof for compensating people on health damages. 2. Heavy metals were used as markers in residents' biomedica, although the dynamics of influencing factors was rather difficult to measure/consider. Both approaches to problem solving, would not, however, result in finding a solution, as people, having obtained compensation, would have had to live in their houses, not suitable for living, in the environmental disaster area. 3. Therefore studies on suitability for living/safety of the houses in the environmental disaster area were started.

To do this it is advisable to make assessment of main influencing factors for the whole period of the town history. Basically, there should be assessed natural and technogenic factors. Social and economic risks will be studied as part of sanitary hygienic monitoring operations in 2015 (requested/ordered by the Ministry of Natural Resources, Buryat Republic).

It is important to notice that the main and key influencing factor – notably extra/super-fine dust – was understudied. It can partly be explained by the absence of a meteorological station in Zakamensk; it is only now this factor is being prioritized in Russia (5).

Relying on the obtained data it is possible to propose three administrative solutions (management solutions). 1. One solution is to issue a Russian Federation Regulation/Law on assigning the area a status of environmental disaster area and developing a program of social remediation/rehabilitation for the population. Such an initiative was undertaken, but lacking funds prevented it from success. 2. The other solution is to obtain evidence by establishing cause-and-effect links between negative factors and diseases that could be done by direct measuring of biomarkers in people's biomedica; and that turns out to be almost impossible. 3. One more solution is to employ the existing programs on resettlement of people from the slum dwelling unsuitable for living; to implement this we need to elaborate an environmental criterion of defining a dwelling/house unsuitable for living and work out changes for regulations and standards.

It is possible to identify 3 principal kinds of damages for the overall period of the town history of Zakamensk.

1. Accumulated (past) environmental damages – 1936 – present time

The reasons	Problems *	Operations	Results	Influence
There is no status of environmental	Environmental disaster area	Sanitary hygienic monitoring and	Evidence of pollution is	People are paid health damages

disaster area, and possibilities to solve the problem are scarce	covers 2/3 of the town soils	retrospective analysis should be conducted to identify pollution	collected in order to go to court	(compensation)
The export duty should be 10 % beginning 2013	Profitability of W extraction from DTMM's sands (tailings)	Measures are taken to "fight" with those who process hubnerite from the Russian Federation	Duty cancellation	Hubnerite is exported
Poor doctors and the authorities	People experience diseases and get no compensation for health damages	Complaints are sent to different state agencies (local, republican, etc.)	Sanitary hygienic monitoring receives state funding.	New risk groups are revealed.

Comments

* - Problems are viewed from the point of view of different state agencies (including science), businesses, and ordinary people. Perm's approach is based on proving/finding evidence of the existing health damage. This is the most difficult/complicated way to follow, and if we take into account the synergy issue, this approach is not very effective. This is probably more preferable to rely on the existing program of people's resettlement from slum dwellings. Hubnerite processing products have high added value. This is what Russian companies do, and it is them who lobbied the export duty. Hubnerite first product (concentrate) costs less than what OAO Zakamensk gets when it exports the mineral abroad. The existing data make it possible to suggest that the main health risk comes from dust inhalation. Dust is superfine, and its physical characteristics are understudied. That research should be implemented in places where dust affects peoples' health – their houses.

1. Present factors of influence and types of damages (material, financial, moral)

The reasons	Problems	Operations	Results	Influence
Violations during mine operations	Negative impact caused by the project on accumulated damage liquidation	Penalty sanctions	Judicial proceedings/Trials	Not very clear/Insignificant
There is no approval of works from the State expertise and state environmental expertise	Illegitimate work of the mill operated by OAO "Zakamensk"	Making preparations for the State expertise and organizing public hearings for the state environmental expertise	Adverse resolution of the project by the state expertise and public hearings resolution on the EIA of the project	Not very clear / insignificant (the mill will continue its work)
The city is affected by the	Dust reaches the town from the	The project to assess levels of	Materials for elaborating a	Changes to state standards and

tailings	three tailings	contamination in the houses	critterion of houses' unsuitability for living	regulations that will provide for resettlement
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Comments

Because of transportating/moving old tailings in 2011 significant dusting and its health impacts have been admitted. The Prosecutor's office penalized the violator with a relatively small fine, and the trial has been lasting for 2 years already. When the mill is dismantled in 2015, dusting will recur, and the trials will resume. In the project of the mill proposed by the OAO "Zakamensk" the hazard of dusting from old tailings has been recognised. Although constant costs on keeping the tailings wet lead to the mill being unprofitable. It implies that dried (drained) tailings will always cause risks and damages. The hazard of living in the environmental disaster area has been recognized, and funds for resettlement have been allocated (212 mln roubles). Those funds can be taken in accordance with the program on slum dwelling. The issue is that there is no environmental criterion in the program which could be applied to houses in the environmental disaster area. So, the criterion should be elaborated and legitimized.

3. Prospective factors of influence and damages

The reasons	Problems	Operations	Results	Influence
Complaints from the population affected by the tailings	Agreeing on a place for tailings at Kholtoson-Inkur	Discussing proposals on a new location of tailings	Creating a working group for decision-making	Preventing social conflicts with the population
Expenses on watering the tailings or on their closing in a different way	Problems of using Barun – Naryn area for new tailings	Discussing proposals/suggestions tailings reclamation	Creating a working group for decision-making	Preventing conflicts with the authorities and the population
Exploitation period will last for a long time	Impacts from the drained sands (tailings) of Barun and Zun - Naryn	Assessing risks of relocating tailings in a valley of the Dzhida River	Creating a working group for decision-making	Preventing and eliminating health risks

Comments

Hubnerite reserves constantly increase when they are more explored (it is being currently explored). Therefore an issue of tailings location will be urgent in the future when the exploration works are completed. It is evident that the tailings can not be placed at Baryn-Narun, although other places are not available either. The area of Barun – Naryn tailings is more than 1 sq. km, and its capacity is 30 years. It is also clear that it will not be possible for OAO "Zakamensk" to keep it safe for 30 years long. The mill project will not be approved by the state environmental expertise, and irrespective of this, it will continue its operations causing risks. It is important to build a new tailings pond by using the funds from Phase 11 of accumulated damage liquidation project. To do this, we need to justify the expenses for the main construction works, and search for opportunities to eliminate heavy metals concentrations in rivers Modonkul and Gudzhirka.

Conclusions

1. The obtained evidence suggests that super-fine (extra-fine) dust originating from the tailings serves the main factor that affected people's health in the past, and the factor has remained understudied.
2. That makes use of biomarkers aimed to establish cause-and-effect links ineffective. By assessing the accumulated damage, that can lead to risk understating, wrong estimations of risk groups among the population and inadequate view of real health damages in Zakamensk.
3. Superfine (extra-fine) dust as the main factor that affected people's health has remained understudied.
4. Considering that factor while estimating air quality in houses in Zakamensk which should be conducted together with semiquantitative spectral analysis (for revealing the source of dust) will allow to identify risk groups and houses unsuitable for living with more accuracy.
5. Dust from the old (drained) tailings will remain the factor that will affect people's health in the future, until the tailings are moved to a new place at a distance far enough to keep the town safe.

Recommendations

1. The primary goal of sanitary hygienic monitoring program should be assessment of dust factor in houses *.
2. One of the sanitary hygienic monitoring program results should be elaboration of an environmental criterion that could be applied to evaluating unsuitability of houses for living in the environmental disaster area.
3. The project on liquidation of the accumulated damage could be considered effective/successful if tailings are planned to be moved to a new place at a distance far enough to keep the town safe. To ground this idea a working group of all stakeholders should be created.

* - a possible technique/method and a project on assessing the dust hazard of living in houses and apartments and elaboration of a new criterion that could be applied in evaluating unsuitability of houses for living – see below

1. Estimating dust components

Dust characteristics	Influence	Methods and executors
1. Mineral components (including % of soluble forms of toxic heavy metals)	Impacts on biomedica and accumulation in the barrier media	Microscopy, extracts, Geological Institute
2. Composition based on particles sizes (%PM _{2,5}) <u>and their geometry</u>	Taken from the literature studies – its influence on genome	Submicroscopy? Geological Institute?
3. Comparison of old and new dust (in new houses), and also seasonal dust (winter/summer)	Large fraction of hazardous components?	See 1 and 2 of the above

Dust samples are better to be collected at snow survey, in the attics, apartments (e.g., by using a vacuum cleaner). In the snow dust there are likely to be found all of dust kinds. In the attics dust from cars will be excluded. In the apartments fractions of local dust (e.g., from the oven, etc.) can be found, samples of aerosols could be useful too.

2. Dynamics of dust accumulation

To make assessment of intraannual dust dynamics it is enough to have two places/spots of dust collection in houses. They should be located close to each other and have enough space for dust collection. For a spectral analysis 100 mg of dust is needed, as well as for microscopy. For calculating their technogenic load those places should be of a specific size (1-2 sq.m.). For making dust collection convenient it will be possible to use glass or plastic sheets (the former for collecting dust within a year period). Dust collection can be performed by a wet napkin whose chemical composition is known. The control is conducted by summing monthly dust collections and annual ones and comparing their weights. Monthly collections will show dynamics of dust sedimentation (including winter period). That will allow to conduct an analysis of old dust sedimentation dynamics in houses (for decades)

3. Assessing dust factor and its health damages

All important and sufficient (?) materials and the legal document can be found in the appendices. Dust is listed in the contaminants catalogue/index which is currently being developed by the Ministry for Natural Resources, RF, and the catalogue/index will be used in the state regulation and nature protection areas. This index/catalogue will be also be employed in working out standards on air emissions. The document is presently undergoing public discussion. In particular, the index/catalogue includes fine particles PM10 and PM2,5. In Russia suspended/weighed particles PM10 and PM2,5 that can be found in the air cause main pollution and affect people's health. Judging by the indicator of cumulative human losses (premature death/mortality) in Europe those particles are more dangerous than ground-level ozone. In Zakamensk that priority factor is understudied, and thus, should be one of the primary tasks of the sanitary hygienic monitoring in 2015. The index/catalogue includes substances which exceed hygienic standards of air quality in many Russian cities/towns; substances which make part of international commitments/agreements Russia has signed; substances the cumulative/total emission of which accounts for 90%; substances which can be measured by approved/validated methods.

4. Elaboration of an environmental criterion that can be applied to identify the hazard of living in a house (formula/indicators)

It can consist of three indicators of health risk:

- 1) specific technogenic load (g/sq.m/days) to compare with the norm/standards
- 2) mineral composition of significant impact (fibrogenic, etc.)
- 3) physical and mechanical composition (sizes and geometry) of significant impact

5. Elaborating changes to the legislation on slum dwelling

Relying on research data air quality assessment in houses/apartments will be performed. Specialists from the FBIS will work out a report on the air quality being inconsistent with the standards and unsuitability of houses for living in view of impossibility to provide air quality. Lawyers will study the notion of "slum dwelling" and its legal provisions. A newly developed criterion will be applied to determine a house unsuitable for living. Further on important changes to regulations and standards will be worked out and submitted to the Prosecutor's Office of the Buryat Republic. Sanitary hygienic monitoring should include snow geochemical survey to assess risks of contamination from the tailings. It is also crucial to evaluate risk of heavy metal

transpiration by trees on the environmental disaster area, and conduct radioactive and heavy metal analysis of the apartments on the environmental disaster area (by analyzing lime coating).

Appendices

1. Consultations on housing unsuitable for living in the Internet. Resource
<http://www.un.org/russian/news/story.asp?NewsID=22666#.VGjxT2jorJw>
3. State Standard (ГОСТ Р 54578-2011) Air at a working zone. Aerosols of mainly fibrogenic nature. Basic principles of hygienic control and impact assessment
4. The Order/Legal Act of Rostehnadzor (Technical Oversight Agency) from 10/14/2014 N 462
5. Atmospheric air pollution in Russia
6. Federal Target Program «Liquidation of the accumulated damage» 2014 – 2025