

Mining and Environmental Monitoring of Closed Mines in Kuzbass

Anatoly D. TRUBCHANINOV, Olga A. YAGUNOVA, Russian Federation

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SUMMARY

Mass closing down of coal mines in Kuzbass needed to carry out the monitoring for shifting and earth's surface deformations in moulds with gap appearance; for the process of technogenic rock massif flooding and gas emissions.

According to long-term monitoring several forms, kinds and stages of coal mine fields collapse, when wholly or partially flooded, have been offered. It was revealed that toxic gas emissions and sewage water pollution had a cyclic character. The filter-capacity properties (hollow coefficient, water flows and etc.) of working mine areas were determined, as well as the time and speed of flooding.

The programme of coal mining industry restructure in Russia has been accomplished since 1993. It is tightly connected with closing of unprofitable and dangerous mines. 43 coal mines have passed through this restructure in Kuzbass.

Mass closing of unprofitable mines revealed some eco-technogenic factors in the region. These factors are connected with residual phenomena: pollution of bottom and surface water, noxious gas emissions, collapse of mine fields surface, appearing craters and cracks, and territory flooding.

The Kuzbass Industrial and Ecological Security Monitoring Center has been established in 1998. Its purpose is the assessment of geomechanical conditions and technological surroundings; monitoring for gas and water state and changes in time in Kuzbass; fulfillment of mine-ecological monitoring work.

In Kuzbass the above mentioned monitoring is carried out to determine the deformations and technological environment of closed down mines along with the following:

- the residual land shifting while the mines were flooded in the Anjersky geodynamic proof site (land shifting monitoring);
- gap appearance, obtained from advance preparation works, cleaning works and for the fixed volume of filling up works (mining fields collapse monitoring);
- the content of inert gas and carbon monoxide in special gas emission boreholes and mine workings (gas dynamic monitoring);
- the quality ground sewage water, coming out onto the surface through the immersed pumps or by self-streaming through special mine workings (hydro chemical monitoring);

- the flooding level of mines through special mine workings (ground water monitoring).

According to KCMPEB 13 coal mines are wholly flooded in Kuzbass; in 8 of them colliery water flows in the river-net by itself. In 15 mines the safety level of flooding is maintained by the immersed pumps; in other 15 partially flooded mines water comes to the ebbs of operating shafts for further flowing in the river-net.

The residual land shifting, taking place due to the flooding has been studied in a special proof ground of the liquidated “Anzherskaya” and “Sudzhenskaya” mines in the form of ground profile line of soil bench-marks. The residual ground shifting on the repeatedly exploited plots of surface, the sustainability of surface between the mines in the barrier pillars area, the residual subsidence impact on the main railroad Moscow-Vladivostok, the dwelling area have been estimated and are of a great interest. Analyzing data for the last 10-year one can determine that shifting level, occurring in ground settlements and risings do not exceed 200 mm with actual leveling error of 6.8-7.3 mm.

Besides of ecological improvement in the region (dust and methane emissions reduced to 25%; sewage water flow – to 30%) closing and flooding of mines activate such negative consequences as: getting out the settlements on the surface, coal gas exclusion, flooding of the surface, pollution of water-bearing horizon and etc.

Monitoring for the degraded mine fields of the closed mines is mainly based on the question of mine rock displacement, on gas emissions and territory flooding of different geological and mining layers.

One should distinguish forms and kinds of collapsed surface: gaps from cleaning works; gaps from preparing works, done at a little depth (before 50-70 m); from opening works; split zone adjoining to ruptured zone through which mine gas drainage is taking place; unsewered moulds, leading to season or constant flooding. According to SF VNIMI data there are 4650 collapse hazard zones in closing mines of Kuzbass; 70 % of which are conventionally hazard from opening works. Taking into consideration the information of 2006 the quantity of dwelling houses in these zones amounts 815.

Large amount of mining fields, as well as collapse hazard zones, come through splitting stage. Mainly these traces can't be fixed visually, but however through these available gaps there is a different tense contact between ground and surface water, between fire-damp and atmosphere.

In a whole the breakdown process of exploited mining surface may be defined to the following stages: at a little depth (about 150-200m) there is an active drainage of the working areas due to hydrological regime changes of surface and ground water. At the medium and large depth (about 450m and more) the breakdown character

changes: the splitting is fading or becomes local. But due to surface relief and ground covering capacity the role of the relief changing with unsewered moulds formation is raising.

According to SF VNIMI data in every closed mine in Kuzbass the forecasting collapse hazard zones accounts from 0.7 to 19% of mine allotment area, that in average is from 5 to 95 ha. Such discrepancy in area collapse depends upon many geo-mining and other factors.

High gas danger together with high surface cracking in some mines and potential gap appearance don't permit to make the most efficient use of territory for different kinds of construction. It is needed a very expensive exploration of conventionally hazard zones in gap outlet with hollow as well as the implementation of expensive liquidation methods. After recultivation of mine workings the areas of closed mines should be used for long-term pastures, haylands, green zones, gardens other type of cultural agriculture.

Special engineering and preparing work of territory is needed for country-cottage and low-storied constructions as well as mounting of security clay screens, which defend from gas emission and building closed gutters and pipes for sewage water out of construction area.

Gas emission monitoring has been conducted in 35 closed mines of Kuzbass. According to the approved programmes some air samples for methane and carbonic gas content with further analysis had been taken. The objects of test were: main mine vents with mounted gas drainage tubes; basements of social buildings and dwelling houses. By systematization and analysis of the information is revealed that mine gas concentration has a variable character and is divided due to its gas emission character: with sharp fading; with recurrent increasing of concentration and with even cycling.

The objects of hydro chemical monitoring were: mine water before and after cleaning; river water before and after sewage faulting and refining works. In 15 or 20 Kuzbass mines monthly, but in high water weekly, samples for toxic ingredients were taken. They investigated the content of suspended substances (SS), BPK, HPK, oil-products, sulphates, iron, nitrates, nitrites and others. The quality of such tests for every index consists of 230-250 pieces yearly and taken analysis of about 3300-4500. Taking into consideration the 10-year data it may be concluded that in time there is a regular cycling in most ingredients of sewage water and their unsteady character. There is a common tendency of reducing ingredient concentration to maximum allowable norms. All 43 closed mines in the region were the objects of ground water monitoring. The level of flood changing in 26 mines was inspected in time, then summarized and analyzed. The information, which fixes the dynamics of developmental flooding in those mines, is the most valuable. It helps to reveal and

determine filter-capacity properties of working areas for engineering arrangements, that provide environmental and production security.

BIOGRAPHICAL NOTES

Prof. Anatoly D. Trubchaninov is a mine surveying engineer, graduated from the Tomsk Polytechnic Institute in 1959, professor of the Kuzbass State Technical University, the author of over 180 scientific publications in surveying, geodesy and higher education, a member of the Russian Academy of Natural Sciences, awarded with the Honored Worker of the Russian Ministry of Education and Energy and a holder of the orders “Miner's Fame”.

Olga A. Yagunova, Master of Science in Mining, graduated from the Kuzbass State Technical University in 1999 and specialized in surveying. Now she is a leading specialist of the Kuzbass Industrial and Ecological Security Monitoring Center and the author of 10 scientific publications.

CONTACTS

Prof. Anatoly D. Trubchaninov
Kuzbass State Technical University
Head of the Department of Mine Surveying, Cadastre and Geodesy
28, Vesennyaya str.
Kemerovo, 650026
Tel.: (384-2)58-33-23, 58-33-80
Fax: (384-2) 36-16-87
E-mail: kuzstu@kuzstu.ru, masher87@inbox.ru
<http://www.kuzstu.ru>

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