EFFECT OF THE BUILDING INDUSTRIAL MINES ON THE SUBSURFACE WATERS

Dr. Gyula Scheuer - Tóthné, Ildikó Németh
öldmérő és Talajvizsgáló Vállalat, Budapest, Pf. 2oo 1431

SUMMARY

he authors are dealing in their study with the sorts and ypes of the surface building industrial mines because hey have caused in the last years a lot of town arrange- ient-, landscape- and environmental protection-, field itilization-, hydrological and engineering geological roblems. In more cases their severe and harmful effects resented themselves. Within this group of problems the uthors write first of all about the effect on the sub- urface waters of the mines. A part of them have caused ater level settlement of greater or less degree in their nvironment during their functioning because of the ecessary dewaterings. The surface mines have generated a epression deeper with more meters than the original water evel and extending to a greater area because of the ermanent exploitation /4o-8o years/ i.e. a new hydrologi- al situation came into being. After abandoning of the ines - on effect of the stopping of the dewaterings - ith their upfilling the original higher water level which xisted before the human interference will be restored pproximately and gradually. But this causes with the uildings in the environment of the mines and built at the ime of the favourable hydrological situation cellar water inrush and building damages. The elimination of these equires a considerable financial effort. In the interest of avoiding the harmful phenomena it is expedient and easonable to implement complex engineering geological ontrols before starting with the mine backfillings and ith their recultivation. The Földmérő és Talajvizsgáló állalat /Institute for Geodesy and Geotechnics/ has ealt with problems and controls of such character in more ases.

INTRODUCTION

The rapid and extensive development of the country has required that the raw materials necessary and indispensable for the building industry should stand at disposal and

the dynamic advance of the exploitation should keep up with this. Therefore for the fulfilling of the demands concerning raw materials a lot of new mines were opened all over the country to gain building and decorating stones, clay, gravel, sand, tuff etc. in order to execute the urgent tasks, in many cases without any suitable preparation and considerations. These circumstances have indicated already beforehand all those problems which we have met.

Our country is in relation of the building industrial raw materials in a favourable position because an important part of our basic need stands at disposal. In case of a favourable geological situation within a little area different raw materials can be found and can be exploited. So for example in Budapest are such geological conditions that an important part of the building industrial raw material demand of the town - stone, gravel, clay - was standing at disposal within a shorter transporting distance /Fig. 1/.

The surface mines were opened according to the previous settlement development conditions because of economical considerations - the short transporting distance - on the surrounding areas of that times. But because of the rapid urban development of the towns /and so of Budapest/ the construction activity approached to, later on surrounded the important part of the mines. Therefore the urbanization hindered the further development of the mines, independently from the fact that these have had further corresponding raw material reserves. At the same time the mining has caused more problems too from the area utilization, landscape- and environmental protection, town arrangement, engineering geological and hydrogeological point of view. Therefore it became gradually necessary to eliminate the surface mining.

The planned passing into the landscape of the major part of the mines did not occur and was implemented resp. without any special considerations. They were filled back mostly with different waste materials not investigating that with this what sort of eventually harmful phenomena would present themselves in the nearer and more far environment. Because of the not planned activity a lot of different effects presented themselves later on. So among others a serious ground water contamination and the lifting of the ground water level. Therefore complex controls are necessary before the recultivation of the mines on the surface having supplied the building industrial raw materials before in order to avoid and to eliminate the eventual later harmful phenomena.

SORTS AND TYPES OF BUILDING INDUSTRIAL MINES

The natural and landscape conditions of the country are very rich and because of this the surface building indust-

rial mines are reflecting this manifold character and variety too. With taking into consideration of the special and general characteristics of the mines we have tried to make their classification into different types. With this we want to call the attention to the manifoldedness of the mines and to the fact that their recultivation and environmental restoring can be implemented on basis of essentially different points of view.

With the classification we have taken the main determining morphological, geological and hydrogeological conditions into consideration.

On basis of these the following types can be separated.

On basis of the morphological conditions

- mines opened on plain area
- on sloping area
- on the top of hills and mounts

On basis of the geological development

- mines of limestone
- dolomite
- marl
- sandstone
- basalt
- tuff
- gravel
- sand

On basis of rock physical characteristics

- solid /limestone, etc./
- plastic: clay
- granular: sand
  gravel

On basis of rock composition

- from homogeneous rock /separation in masses, banks, layers and blocks/
- inhomogeneous, from different rocks /layered, clastic/

On basis of the depth

- of little depth as far as 15 m
- of medium depth as far as 30 m
- of great depth over 30 m

On basis of magnitude /horizontal extension/

- little mines /as far as 50 m/
- medium size mines /as far as 150 m/
- big mines /over 150 m/

On basis of stability

- stable
- crazy
- instable and sliding
- moving

On basis of utilization

- functioning mines
- abandoned and not regulated mines
- under arrangement /backfilling/ standing mines
- recultivated mines

On basis of the above it can be stated that the surface mines are variable and different. Of course with each mine local - special characteristics can be observed too, but with their classification we did not take these into consideration. We have indicated only those essential characteristics which are general and main decisive.

MUTUAL EFFECTS OF THE SURFACE MINES AND THEIR ENVIRONMENT

It is a well known fact that every human activity gives as a result the less or greater modification of the given environment. The man utilizes the advantages of the natural and environmental conditions and makes use of these to his own advantage. But with this starts with such artificial processes which hinder or make difficult the utilization of the area in many cases. They cause transitive or remaining harmful phenomena.

Starting from this above statement we examine the effect on the environment of the surface mines during their functioning and after their recultivation.

A part of the mines - mostly on the extension area of rocks having a solid and plastic rock physical characteristics - was opened on a slope or on a top of the mount. The opening and the continuous horizontal and vertical exploitation of the mines have raised a lot of environmental protection and stability problems.

The landscape appearance of the open mine pits has reflected as a wound the raw material production of the given site, diminishing the valuable areas and limiting the construction activity.

So for instance in the mines of Buda producing the clay of Kiscell and in their environment constantly repeated movement phenomena occurred /town houses in the Nagyszombat street, training area Vasas, mines of Ujlak and Óbuda/, endangering the roads, public works and apartment houses. Therefore because of environmental protection reasons and to restore the slope stability the mines were gradually

eliminated with upfillings. With one part of the mines protective installations were established /deep sickerings, belt trenches, area regulation/ with an other part on the other hand unfortunately no objects were built, the backfillings were effected by domestic wastes and building rubbish.

The movements with the not backfilled clay mines are caused in all cases by three factors:

- the geological characteristic: sliding danger of the layers
- the undercutting role of the mine exploitation
- the forming of such a hydrological situation, where the soaking effect of the surface and underground waters is continuously acting.

The backfilling and recultivation of the mines means the solution of this triple task beside the main point of view of the passing into the environment.

The geological characteristics of the sliding danger of the layers cannot be modified basically by the human activity but can produce a row of such protectional measures with which it reduces the effect of the movement or hinders its development.

With the mines - with the advance of the production on always greater area and depth equally - the water supplying layers were cut through and explored, the water of which was collected by the mine sole always.
After the abandoning of the mines and with the area utilization it must be thought over if we want to keep up the mine pit or not. In this the morphology of the area and the fact that in the mine and in its environment if there were any movements and if they endangered any living areas has a decisive role. If the lower bank of the mine yard is passing to the area level, the mine cavity can be maintained for the area utilization but in case of movement phenomena it is expedient to regulate the terrain by footrills, stability ensuring objects and surface belt trenches. With these we can ensure such new engineering geological and hydrological conditions which are more favourable than the situation before the opening and during the functioning of the mines. Besides the stability of the slope we solve the collection, the abduction of the surface and underground waters and the passing into the landscape of the area.

In case of the considerable overpassing of the depth of the mines of the surrounding area level, the area utilization is only after backfilling possible. It would be expedient in this case too to collect and abduct the underground waters but this does not happen always. The abduction of the surface waters, the making of the belt trenches is implemented after the terrain regulation.

In case of these mines - as with the elimination of an erosion base - slowly and gradually such a new hydrological situation is coming into being which can be compared to that one before the opening of the mine.

The gravel and sand mines cause a problem of a different character. These are in the most cases deepened into the water conducting layers as far as the floor formation. The backfilling of these mines with waste material in an ill-considered way can cause very serious damages in the contamination of the ground water and layer water. If the gravel-sand composition is lying on a water permeable formation, the backfilling of the mines with contaminating material can contaminate the water of the layers not only near to the surface but of those having a deeper position too. Therefore the backfilling material of these mines has to be carefully choosen in all cases, the way of the locating process and the special protective methods are to be fixed. Therefore we deem it to be expedient and necessary - before the mine-backfilling - to carry out such detailed hydrogeological controls and analyses by which we can get a reply to these questions.

With an other part of the sand-gravel mines - because in many cases the ground water will be taped - lakes of free surface are formed, the utilization of which can be very different depending from the fact that in which part or environment of the country it can be found. They can be used for cultural purposes /sailing lake of Budakalász, the Omszk-park/, for sporting purposes /gravel mine of Csepel, shore Horgász/ or for fish-breeding /gravel mine lake of Dunaharaszt/. With these the passing into the landscape does not cause any problem and in the hydrogeological conditions no change compared to the natural state can be seen.

EFFECT OF THE MINES TO THE HYDROLOGICAL CIRCLE OF THE SUBSURFACE WATERS

With the judgement of the effect on the environment of the mine pits on the surface, their advantageous or disadvantageous features relating to the subsurface waters gain a main accent. Therefore we have to control the hydrological role of the state of a given mine before opening, during exploitation, as well as after abandoning and recultivation resp. We want to make this control again with their classification into different types because some of the enumerated hydrological characteristics is special for a given mine. The hydrological situation before the opening of a mine can be favourable /with a water level deep under the surface/ which are indicated beforehand by morphological and hydrogeological features. For its water cycle the balance state is characteristic, when the rainwater and the subsurface water of layer origin will be consumpted by the evapotranspiration of the vege-

tation as well as by the waterflow into the direction of the deeper water conducting layers. These conditions are creating a favourable possibility for the opening of dry mines.

The situation before opening of a mine can be disadvantageous too from the hydrological point of view, when on the given area waters near to the surface level /waters of different types equally/ can be found. The rainwater and the water flowing in the water conducting layers will not be consumed by the vegetation and evaporation. The opening of a mine and the exploitation can be solved is this case only by a considerable drainage or with other technical solution /grabbing from below the water/.

On basis of the connection of the functioning surface mine exploitations with the subsurface waters of different origin we can make the following classification.

Dry mines

- groundwater near to the mine floor
- groundwater in a greater depth
- carstic water near to the mine floor
- carstic water in a greater depth
- layer waters near to the mine floor
- layer waters in a greater depth

Temporarily wet mines

- groundwater on the mine floor /Fig. 2/
- carstic water on the mine floor
- layer water on the mine floor

Mines having constantly groundwater

- mining under groundwater /Fig. 3/

Mines having layer waters

- layer waters appear in the mine wall after opening of a mine

Mines having mixed subsurface waters

- layer water and groundwater appear together

When opening dry mines and during their exploitation the different waters in a greater depth under the mine floor /or near to the mine floor/ do not mean an exploitation problem. From the hydrological point of view we have to make a difference between the category of the subsurface waters near to the mine floor and the categore of those in a greater depth. Taking into consideration that the

surface mining pits or mine yard is the deepest area of the environment, as a local erosion base it directs towards itself the surface rainwaters. The water level in the vicinity of the mine floor can be lifted by this depending from the fact if the mining happens in a solid, granular or plastic rock, so in certain cases the water level near to the mine floor elevated into the mine can cause from time to time wet mines.

The waters in a greater depth have no influence on the mines neither under exploitation, nor after abandoning, the mines do not influence either the hydrological situation after abandoning resp.
Other problems are raised by the backfilling of the mines with foreign materials /wastes, chemicals/ after abandoning. These works are only after a careful preparation and control possible, in the course of which the water permeability of the original rock and of the material of the backfilling must be examined and the expectable level of the subsurface waters too. We mention it as an example that in case of limestone or dolomite mines the backfilling with contaminating material by the contact with rainwater and with its seepage in the vertical direction through the cracks of the rock contaminates the carstic water. The same is valid for the groundwater in the vicinity of the mine floor, therefore the ill-considered backfilling of granular /sand, gravel/ mines causes the contamination of the groundwater too. The situation is different if the mine floor and the rock below have an impermeable feature. In this case the choice of the backfilling material makes a less problem.

The backfilling of the temporarily and constantly wet mines needs a very careful preparation. The hydrological situation before the exploitation is in this case frequently more unfavourable than that one during the exploitation. The economical production of the mines is then given, if we keep the surface and the subsurface resp. waters far from the mine pit. This can be solved with the surface water regulation of the environment of the mine, with the catching and abduction of the source, or with a constant drainage. Of course it is an exception the exploitation from under the water e.g. of gravel and sand mines. In the previous cases the mine effects a constant depression on the subsurface waters and by this it causes a changed hydrological situation with the natural undisturbed state.

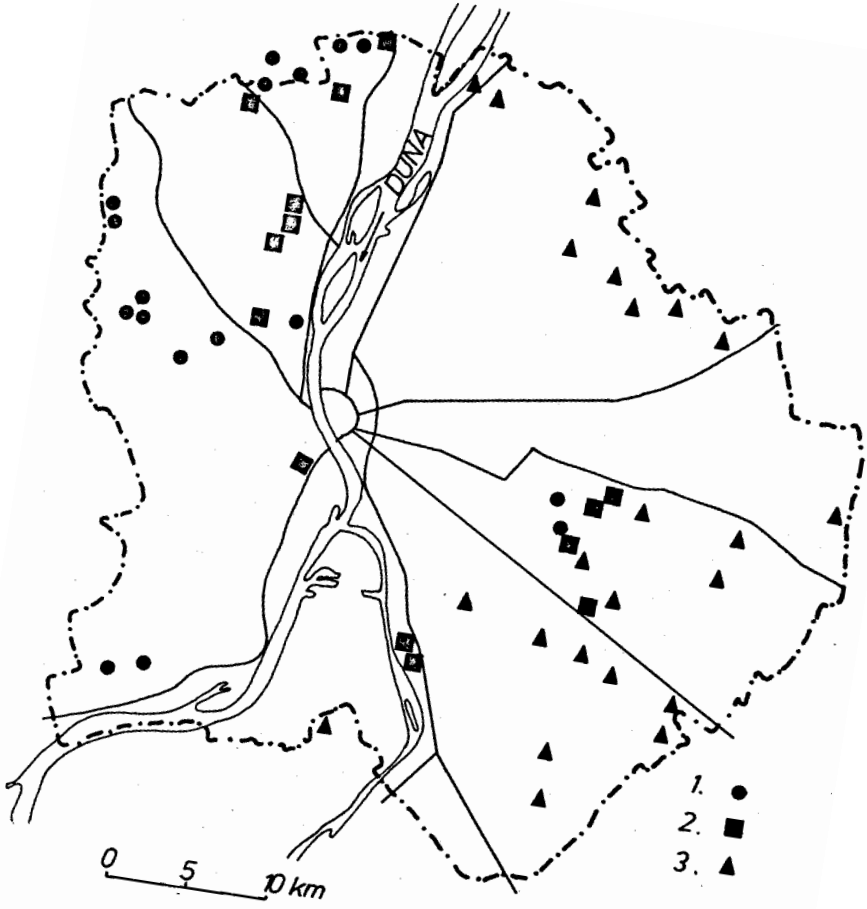
The abandoning of the mines - because of the previously enumerated reasons - raises a lot of problems. Namely during the long exploitation /40-80 years/ of the mines the more unfavourable, natural higher /often near to the surface/ water level is already forgotten. Therefore the structures around the mines and their foundations resp. are without insulation just because of the hydrologically favourable exploitation of the mines which meets fortunately in this case the favourable and cheap solutions.

Because of the abandoning of the mines the water level and hydrological situation approaching the original and forgotten already will be restored gradually.

The backfilling of the mines reaching under the water level /near to the surface/ and originally higher and the choice of the material of the backfilling requires a necessary hydrogeological and environment geological control. The aim is not only the planned and technically reasonable back-development of the mines, the choice of the material and quality of the backfilling, the pre-indication of the expectable hydrological consequences but also the protection of the fortune, as well as to propose necessary measures to be effected.

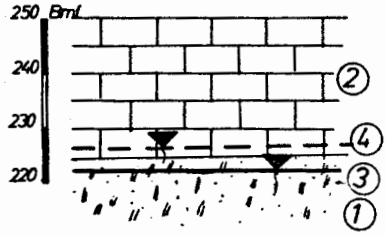
Summarizing it can be stated that the utilization of the abandoned mines on the surface has to be preceeded in all cases by detailed technical and environmental protective analytical controls because without this the harmful effect of the human interference can be diminished or eliminated only by great financial efforts.

LIST OF FIGURES

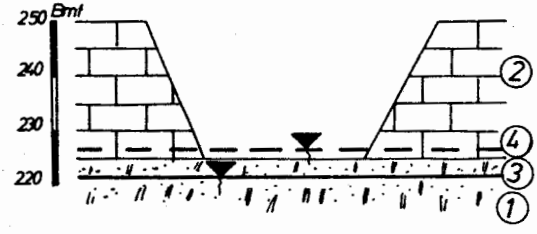


1.ábra. Fig.1.

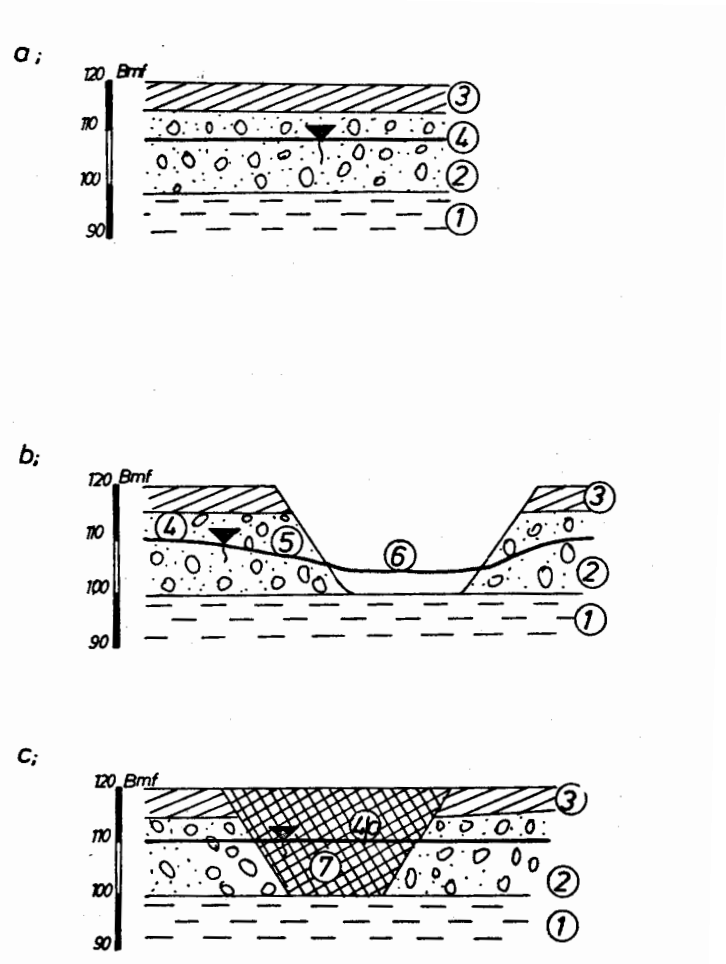
a;



b;



2.ábra. Fig. 2.



3. ábra. Fig. 3.