DAMAGE OF SUBTERRANEAN /MINE/ WATER RAISED AT TATABÁNYA COAL MINES TO THE ENVIRONMENT, NECESSARY MEASUREMENTS OF THE ENVIRONMENTAL POLLUTION CONTROL, AND THE EVALUATION OF EXPERIENCE SOFAR OBTAINED

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SUMMARY

The author describes subterranean waters from qualitative and quantitative aspects, in connection with coal mining at Tatabánya Coal Mines. Experience obtained in the last decades in the field of country planning and waterway correction, further surface damages caused by subterranean /mine/ waters are discussed. Difficulties encountered in the restoration work of the landscape and waterway correction in the area subsided as a consequence of caving and backfilling mining methods, and the well proved and successfully used local purification methods of water contaminated with mineral pollutants are described in detail.

In the Eocene Program water damages to be expected in the region of Nagyegyháza-Mány are dealt with in detail, taking into consideration economy. In connection with planning and realization of the prevention of water damages, planning shall meet the specification of the environmental pollution control. It is important that the areas restored and watercourses, streams corrected be utilized. It is emphasized that environmental pollution control requires a complex approach, the waterway-correction and - utilization is only one part of it.

INTRODUCTION

Our attitute to mine waters has changed significantly in the last decades; previously the primary goal was considered to be the drainage of water raised, which presented itself as a cost factor in country planning, whereas today, we consider it to be a concomitant factor of coal production and handle

mine water as a valuable raw material which play an important role in industrial and communal development all over the world.

Depending of the fundamentals of the region, it is important to reckon with mine water constantly during exploitation, which can be utilized many times in case of rational water management. In our country, this attitude to mine water is not general and the utilization of mine waters - including drinking water - does not attain 20 per cent. Mine-water raising increases the production costs of coal and the parties involved do nottake into consideration that the utilization of mine water raised can be solved at a relatively slight excess-costs.

In the following we are going to discuss this question on basis of experience obtained in the last 20 years at Tatabánya Coal Mines. In each case, damages to the environment and benefits of water utilization to be expected, obtainable by methodical and rational economy have been examined.

GRADING OF MINE WATER

Mine waters raised in the region of Tatabánya Coal Mines area of various grade, polluted mostly by mineral impurities and coal dust. According to Act IV of Environmental Pollution Control of 1964, mine waters raised can be led into water courses, streams, if water meets water standard specifications, otherwise ecologists /authorities/ bring suit agains violators and impose fines and in addition violators have to restore damages to environment caused by water polluted.

Mine water raised can be classified as follows:

1./ Mine water in contact with coal stopings containing mainly coal dust and mineral pollutants. As it can be reckoned with a pollutant content of 1000 mg/Lit, compared to the permissible 100 mg/Lit, the purification of the mine water before discharge of the water intake, is necessary.

2./ Slurry water, in connection with settling of sand used for backfilling and fire prevention, which contains 5-10 000 mg/Lit mineral pollution and can be led into live water courses after a successful settling. This type of water pollution is less significant at Tatabánya, as exploitation from the built over area has shifted to the external region where caving method can be used.

3./ After the completion of filling and fire prevention work, pump sumps have to be cleaned; the sump water raised can be discharged into live water courses only after careful settling because of its high pollutant content.

4./ Mine water raised from shafts of the active water prevention system, located outside the mine, does not contain pollutants, it is of drinking water quality and we need not bother about its mechanical purification. It can, directly be used for drinking water or industrial water or can be discharged to live water courses.

The utilization of mine waters

In order to judge mine waters, quantitative data has to be taken into consideration. Neglecting the listing of detailed annual data, water raising data in the period 1960-1970 and 1980, as well as data on water raising in the year showing maximum values must be studied. During this period, coal production can be taken roughly identical until the middle of the 70-ies, the decrease in coal production began in the second half of the 70-ies. Further on it can be seen, that in the second half of the 70-ies, coal production reduced and the quantity of water raised increased, which points to the fact that in the coal production difficulties were encountered. In 1960 the quantity of mine water raised to the surface amounted to approx. 62 m³/Min, out of which 29 m³/Min were used for drinking/industrial water and filling purposes. The remaining quantity of 55 m³/Min was discharged into Általér through Galla-stream. During this period, the industrial water utilization did not attain 50 per cent of the mine water raised and if "small-water-discharge" /water power/ of Általér is assumed to be 5 m³/Sec, the flow-off water represents 10 per cent. On the Conference of Mine Water Utilization held at Tatabánya on 1962, several lecturers and persons taking the floor called the attention to the importance of agricultural utilization of mine waters. In order to make a headway in this field, Tatabánya Coal Mines started a vegetable gardening in the drained off area of Farkastó, using irrigation. This activity brought excellent crop-yield but very bad economic parameters, for this reason the Mine stopped this activity.

In 1970, the quantity of mine water tapped amounted to 90 m³/Min, out of which the quantity of water utilized as drinking water, industrial and filling water, amounted to 36 m³/Min and the flow off water purified increased the supply of live watercourses by 54 m³/Min, which is about 20 per cent of the "small-water quantity".

As an interesting data, it was stated that the maximum quantity of mine water raised in 1974, amounted to 150 m³/Min, as at that time water shafts of the active water prevention system were already in operation, which produced 100 m³/Min water quantity, totally. In addition to the industrial utilization, purified water of satisfactory quality /grade/ was discharged into Általér in a quantity of 120 m³/Min approximatelly, which was nearly 40 per cent of the "small water discharge", but, at this time, there was not any agricultural water utilization.

In 1980, the quantity of water raised dropped to 105 m³/Min, the drinking water utilization increased to 30 per cent, the utilization of industrial water decreased and the filling water utilization was negligible, because at that time, almost everywhere, caving method was used for getting coal out of the ground. 20 per cent of the quantity of mine water raised was used to supply live water courses.

According to forcasts, the quantity of water to be raised in the region of Tatabánya in 1985 can be expected to be 80 m³/Min, but in 1987, it can be reckoned only with a quantity of 5 m³/Min. At that time, water shafts will raise water in a quantity of 20 m³/Min for the regional water supply, in addition to that mentioned above, but normally, out of this, no water will be discharged into live water courses, for this reason, the agricultural water-utilization is not possible.

Similarly, water supply for internal fish-ponds and standing waters will also be missing and only rain water can mean the "making up", as the considerably reduction of caver water level, has made springs run dry earlier. It is to be regretted that we have to make it clear, and face facts that from 1985 on there will be no possibility for utilizing mine water in the agriculture in the region of Tatabánya, because the raising of mine water in this region comes to an end.

DESCRIPTION OF DAMAGE TO THE ENVIRONMENT

Before starting mining activities to get coal cut of the ground, each region, territory has, in general, an established river system, which according to the morphology of the region provides for the drainage of surface waters. Coal mining - especially wet mines -, alters this situation; some water courses are subjected to heavy mine water loads which are - as a consequence of their size - unsuitable for such loads, and as a result they cause river bad damages, and on the other hand, the mine water discharged is contaminated mostly with mineral pollutants, coal powder, causing deposits at river sections having a slight gradient, river bed deteriorations, all these mean devastation to new farmlands. Special problems arise from stoping methods used, sizes of bedplate, kinks are smaller in size if back filling is used, and as a consequence standing waters are also smaller and the river bed deterioration caused is also of smaller extent. On the other hand, slurried water flowing off from the filling material storage yard and mine spaces is higher in quantity, and deposits and bad siltation increase. With this exploitation methods pollution of live water courses, streams is higher and consequently restoration costs are significant. A good example for this is the damage to Tata-Öregtó caused by the mining activities of Tatabánya Coal Mines. In the first half of the century, until the end of the 60-ies, backfilling was used to get coal out of the mine and the consumption of backfilling material used occasionally amounted to 6-800.000 m³ annually, which, accord-

ing to measurements, represented a 15 per cent - sand flow off in form of slurried water and caused a mineral pollution deposition of 80.000-100.000 m³, the great part of it got to Lake Tata via Általér, and the remaining part was discharged into live water courses and flooded areas in the region of Tatabánya.

According to measurements made in 1959, the stretch of water of the Lake extending over 230 hectares, reduced to about 170 hectares due to siltation. In order to undo damage to environment and to establish recreation and sport centers, restoration/reclamation projects have forseen the dredging of 750.000 m³ mineral materials, representing a cost factor of 50 Million Forints in the Coal Mines budget at the price level of the 60-ies.

In case of coal mining by caving, sizes of the soil subsidence, soil slops - naturally depending on the thickness of coal layer exploited - are bigger and the damages to riverbed following the tracks of water routes and standing waters are also greater, thus, the costs of reclamation and draining are considerably higher, while mineral pollution of the mine water discharged and consequently siltation are of smaller extent.

If waterway-beds are not "prepared" carefully for mine waters raised, damage due to erosion occurs and contrary to erosion caused by rain, it must be reckoned with a continous damage of mine waters, until water discharge from the mine alters, or the mine stops production. Coal mining by caving causes a bigger erosive damage than backfilling.

In wet mines, water inrush is frequently encountered, which causes the biggest river bed and erosive damages in the relevant areas - due to water overload - irrespectively wether backfilling or caving method is used for coal production. As water in this case is to be discharged to "unprepared" area, riverbed correction can be made subsequently, at a later date only, at high costs and inefficiently. At the begin of the 60-ies mine water in a quantity of 20 m³/Min had to be raised from a shaft unexpectedly, which caused erosion at the nearby loess banks /dunes/ at an area of several thousands m² and siltation at some remota places.

It a region extending over 1500 hectares, exposed to the mining activities of Tatabánya coal mines a partial erosive damage of about 20 per cent, - soil deterioration - occured inwaterways'beds and in the agricultural and sylvicultural landscape in the last decades. According to a subsequent calcualtion, soil shifted by erosion during this period attained a yearly value of 10-15.000 m³. Data mentioned, show that damage due to mine water can be considerably even at one mine and can change the landscape. Given this knowledge and ex-

perience, we have developed at Tatabánya the attitude, according to which the first steps in country planning must be the water system planning, bed restoration, drainage and only then when no further water damage is to be reckoned with, we can carry out country planning and agricultural and sylvicultural utilization of the region.

It is very important to take into consideration the ultimate condition /state/ of surface subsidence irrespective which method /caving or backfilling/ is used for getting coal out of the ground. At the subsided areas water damages go together with surface soil movements, sliding, soil slip, creep or flow depending on soil type and ground water level, which throw difficulties in the way of water system planning/correction.

Mine waters, as mentioned previously, not only devastate but build as well, unforutnately not always there where it would be useful. At Tatabánya we can find erosive deposits at several places, first of all in river beds, water courses section of low gradient, which causes damage to farmland or sylviculture, too. In case of erosive depositions, there is the possibility to control partly the process of deposition and here, as a local possibility, old pits, sand pits, abandoned open pits and deep seated areas may come into consideration, in this case slurried water and erosive silt do a useful job. This procedure has been used with good results and this type of siltation contributed to the work of country planning and of reclamation/restoration of the landscape as water can, economically be used for material transport, thus for patching landscape disfigurement up.
Experience and results described above can be used at the location of the new mine in the frame of the Eocene Program. According to experience, operators of mines do not deal thoroughly with the quality and utilization possibilities of water raised from the mine, with the damage to be expected and control there of. We deem it advisable to draw the engineer dealing with the regulation of surface waterways into this work, to make it successful.

The utilization of experience obtained sofar

When planning the site of a new mine, pump stations - depending on the potentialities of the mine - are planned as well, which determines already the discharge point of the subterranean water /mine water/ at the surface. The previously planned abstraction of mine water raised causes a lot of trouble and difficulties, if it is led into an existing /available/ water course /waterways/, because in this case objects planned for small water power of the waterway, and the bed sections thereof are to be reexamined and expecially in densely inhabited areas, at continous water discharge, rebuilding of objects and beds of the waterway is difficult. Generally at Tatabánya, but in other hilly countryside as well, drain-off-valleys are

located relatively near one another, thus through the better utilization of the delivery height of the built-in pumps - in many cases an excess-delivery height of 20-30 m is available - the subterranean /mine/ water can be discharged via pipeline, without significant excess-cost into the water course of the neighbouring valley, where previously preventive and support work can be done under "free of water" conditions. On basis of the cost-estimate, it may come into consideration a partial complete cut-through and if possible an arrangement must be selected by which the settling of the polluted mine water can be solved, too.

After planning of the water-drain-off, the effects of caving and backfilling methods upon the surface have to be examined, too. On basis of these data, sites of standing waters, ponds, can be marked and possibilities of bed corrections can be studied. At the quantitative and qualitative determination of water-raising, the prevention and control of unexpected water inrushes cannot be planned, this, however, is a quantitative question, because the water is discharged through the pump chamber available and it occurs very rarely that a new borehole is to be drilled, and a ditch for water run off is to be built, but in this case there is some time available for building the necessary water run-off ditch of adequate size.

Sofar we have discussed the quantity and quality of subterranean /mine/ waters, but it is necessary to deal with the utilization of mine water from point of view of country planning and environmental pollution control, too. This type of work, similarly to that of river system planning is to be carried out in harmony with the relevan Water Conservancy Authority, as this authority keeps records on water requirement and supply available. The Water Conservancy Authority must know about the free water quantity, quality thereof, and what is also very important, the period of water-raising to be expected. In possession of these information, the Authority can decide on water utilization.

The study deals with the question of subterranean water /mine water/ control and water household from point of view of quantity and mineral pollution; the basic principle and guiding thread were given by the Mining Act of 1960, Water Conservancy Act IV of 1964 and the Environmental Pollution Control Act II of 1960.

We have pointed out earlier that from point of view of environmental pollution control, water and subterranean /mine/ water cannot be picked out alone, we have to study and review the whole ecological system, i.e. the complex of air-water--land /soil/, as they cannot be separated, there is a close interrelationship between them. As long as we considered waterway correction as a mechanical task to be solved, partial results were obtained, but as soon as we discuss the possi-

bilities of utilization, biological aspects come to the fore, which consider mine /subterranean/ water as a raw material, which especially in case of multiple use require a more complex and thorough examination that grows too big for the present study.

The man becomes the centre of our aspect, who husbands sometimes irrationally the resources and raw material reserves of Nature - as a consequence of inproper husbandary, water looses its protective power, in many cases, and in some instances, when the pollution is greater than the possibility of self-purification, water gets spoiled and suffocates living creatures. Thus, a complex approach is necessary when discussing questions of waterway correction and water household.