

**A CONTRIBUTION TO THE INFLUENCE EXERCISED BY THE
SUPERIOR MINING AUTHORITY ON THE SCIENTIFIC
PREPARATION OF OPEN-CUT DRAINAGE**

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ABSTRACT

The development of lignite mining in the GDR is characterized by a constant worsening of geohydrological conditions, the use of more and more efficient open-cut high-capacity machines, and an enormous earthmoving. Complicity and versatility of hydrological conditions force to proceed more scientifically on the stipulation of drainage measures. In this context, the hydrological calculations are of special importance for drainage measures. For the future, these calculations will be carried out by persons certified as experts on this subject by the Superior Mining Authority on the basis of special qualification criteria. Together with the installation of the state of an expert, the Superior Mining Authority also put a special guidance schedule into operation for the establishment of hydrological calculations in order to guarantee a uniformity in kind, extent, and time of these calculations. The most important aspects with regard to content and substance of this guidance schedule are presented and explicated.

Coal and energy industries are faced with the task of using the own resources, especially those of raw lignite to such a degree that a stable and dynamic development of national economy is guaranteed.

The minable reserves industrially explored up to now give security for the progressive rise of raw lignite-extraction, the increased use of raw lignite for carbo-chemical processes and above all for the generation of electric energy.

The development of lignite mining is characterized by a constant worsening of geophysical conditions, the concentration process of open-cut high-capacity machines, and an enormous earthmoving.

The complicacy of hydrological conditions becomes evident from the increase of soils difficult to drain within the mining area of Leipzig/Halle on one hand, and from the increasing shifting of open-cut developments to the areas with high water raising (glacial spillways) in the mining area of Cottbus, on the other hand.

Drainage and stress-relief problems, respectively, of ground-water-bearing beds in the bottom which only played an inferior part up to the end of the sixties, gained more and more in importance, especially in large-scale open-cuts with overburden conveyor bridges, type F 60.

The necessary share of drainage elements in mined areas to be over-excavated is still increasing.

Due to the steady advance of mining depths, the extraction ratio water : coal is expected to rise from 7.8 : 1 at present to 10 : 1 in 1990. Increased mining depths involve increased reaches of sink holes and must hence result in an intensification of the influence upon the territory. Moreover, the fact must not be underestimated that in the mined deposit areas, drainage elements have to be used over a far longer period than in the past in order to avoid any danger from the opencuts in the neighbourhood.

Deep-well drainage which has almost exclusively been used since the beginning of the sixties yields decisive advantages also under to-day's conditions of lignite mining as compared with the underground roadway drainage. Deep-well drainage guarantees a substantially higher labour productivity, increases labour safety and removes hard physical work underground. Nevertheless, the use of roadway drainage is believed to be economically advantageous in definite particular cases also for the future. This will especially be true for certain areas, where a drainage effect must be guaranteed over a very long period.

In this context, grouting curtain technology becomes an important factor, too. This technology is not proposed as an alternative to the conventional drainage methods, but is intended to supplement them and to improve simultaneously the environmental protection. The mining costs of open-cut mines are at present charged by drainage measures with about 15 to 20 %. Efforts have to be intensified for the increased use of the raw material water accumulated during open-cut drainage for drinking and process water supply. Water which is qualified as most important raw material in the advanced industrial countries occupies a special importance just in the GDR as the poorest country in water in Europe.

At present, water consumption is about $8 \cdot 10^9 \text{ m}^3/\text{a}$ in the GDR and calls for use of about 60 % of the mean annual water quantity available in the GDR. The water quantity raised by lignite mining comes up to about 25 % of the water needed by national economy for industrial purposes, to about 2/3 of potable water supplied in the central water supply network or to rounded 10 % of the annual precipitation on the territory of the GDR /2/. Thus, it becomes evident what enormous intervention means open-cut drainage to the water balance of the GDR.

These facts underline the increasing requirements to be met by an optimum open-cut drainage. Complicacy and versatility of the drainage problem consequently force to improve the scientific foundations on the stipulation of drainage measures.

In conformity with the legal safety-in-mines regulations in the GDR, drainage measurements for open-cut mines must be established on the basis of hydrological calculations. The hydrological calculations have a decisive influence on the moment, kind and extent of drainage and sealing measures and consequently on the efficiency of drainage and open-cut technology and the level of safety-in-mines.

Thus, basing on a comprehensive drainage level analysis, the Superior Mining Authority at the Council of Ministers of the GDR stipulated measures giving security for a high degree of well-planned, uniform, and scientific management on the preparation and realisation of drainage measures.

The hydrological calculations will henceforth be carried out by persons certified as **e x p e r t s** on this subject by the Superior Mining Authority on the basis of special qualification criteria.

This decision of certifying experts on the subject hydrology/drainage was taken under the aspect that the certification of experts on the subject of slopes by the Superior Mining Authority has turned out well and has resulted in a sensible reduction of the number of slides since the activities of experts for the dimensioning of slopes and slope systems in 1974.

Prerequisites to the recognition and admission as a certified expert are a special qualification and practical experience of several years on the subject hydrology/drainage. The recognition and admission as a certified expert requires above all a high political conviction of our State and a comprehensive political knowledge enabling to evaluate the consequences brought about for society by the proposed measures. Besides from an education received at a university or technical school, certified experts especially have a good knowledge in the field of geotechnology and a practical experience of several years on the execution of hydrological calculations. Apart from a founded knowledge on the subject hydrology/drainage, the recognition and admission as a

certified expert requires some knowledge on the field of exploration, projecting and open-cut technology.

On the basis of legal regulations and under consideration of requirements with regard to society, the certified experts carry out their activities with objectivity and under the application of recent scientific and technical knowledge. The direction for certified experts /3/ stipulates the tasks and the competences of certified experts in order to guarantee the execution of their activities without any difficulty. Further special rights and duties of certified experts are stipulated in the proper legal regulations of safety-in-mines.

The working results of the certified experts are put down in written and signed with the note "expert certified by the Superior Mining Authority". By this, the state of certified experts and the documentary character of their working results is clearly emphasized.

The hydrological calculations are established according to a fixed skeleton schedule /4/. In this way, a uniformity in kind, extent and point of time of these calculations is guaranteed.

On the basis of the fixed reference values and in analogy with stability investigations for slope dimensioning, more attention will in future be attributed to the reasons and opinions given to the assumptions, conditions, procedures, and results of the hydrological calculations. So, lignite plants get better possibilities of influence and control.

Furthermore, a comprehensive evaluation of the hydrological exploration level is undertaken by the certified expert. This is aimed at reaching the effect of evaluating completely all the foundations which the subsequent calculations are based on.

Measures necessary for the exploration network to be tightened and the geotechnical parameters to be representative are specially shown by the certified expert. The results obtained by accord with the competent certified expert for slopes with regard to the hydrological marginal conditions (residual water level) in stability investigations are documented.

Great importance for hydrogeological calculations is put on specifications concerning the realisation of models. That's why following approaches were made by the hydrogeological calculations:

- Mathematical sub-model

Reasons for the applied analytical and digital calculation methods as well as electroanalogous methods (programmes for data disposal, hydraulic calculations, technological programmes, evaluation programmes).

Specifications concerning the execution of calculation, especially for discrete simulation in locus and time.

- Geometrical model
Specifications for the consideration of geometry and broadening of ground-water aquifers, hydraulic communication and ground-water levels. Reasons for non-consideration ground-water aquifers in the model.
- Parameter model
Specification of the applied permeability coefficients, the used storage coefficients for non-artesian and artesian ground-water flow and the colmatage coefficients.
- Signal model
Choice of locally and / or temporarily distributed new formation of ground-water, reasons for the choice of outer marginal conditions and model boundaries. Discussion about the inner marginal conditions. Hydroisohypsal levels for the zero point of model time.
- Technological sub-model
Evaluation of drainage analysis for the drainage of fields, margins, dumps, and surfaces also with regard to geotechnical safety. Description of the advance in mining technology and reasons for drainage technology design.

On documenting and compiling hydrogeological calculation results, the following specifications are needed according to the skeleton schedule under consideration of each special problem to be solved:

- Drainage of the field in advance of the face and marginal drainage
Number and arrangement of wells, filter occurrence, pump use sequence, rate of utilization in time, volume flows, preliminary drainage, intended values for representative level, slope outflows;
- Dump drainage (analogously the same intended values as for drainage of the field in advance of the face and marginal drainage);
- Surface drainage
Run-offs on working levels, berms and bottom for medium and violent precipitations, extension of available retention surfaces, stores and needed pump capacities;
- Special drainage
Unwatering of worked-out open-cuts or ponds, unwatering of waste-filled roadways and shafts, emptying diagram $V(t)$, $h(t)$, and $V(h)$;
Calculation of pumping capacity;
- Ground-water lowering in the adjacent territory;

- Ground-water re-rising
Re-rising course in worked-out open-cuts, final water levels, ground-water rising in the rock mass.

The specification of information need is proposed to be given under the following aspects:

- Intended values for the control of lowering and re-rising course, respectively (number and arrangement of measuring points for ground-water level),
- Intended values for well control,
- Measuring cycles,
- Specification of the informations to be given to the certified expert by the mine.

The certified expert leads a detailed discussion on the calculation results with regard to effects on the geotechnical and public safety from the hydrogeological point of view. Furthermore, propositions of measures are made for increasing the efficiency of draining technology. Finally, the certified expert indicates the measures which must yet be done for further hydrogeological evaluations.

There is the possibility of doing hydrogeological calculations in two ways, that is as a hydrogeological evaluation or as a hydrogeological expertise.

Whereas the preparation (projecting) of draining measures can be carried out on the basis of hydrogeological estimations, the realisation stage of draining measures is based on the hydrogeological expertise as the qualitatively highest kind of calculation.

Hydrogeological evaluations are made, when the scientific knowledge is insufficient or when an exclusive use of estimated values and analogue conclusions had to be made.

The realisation of draining measures is carried out on the basis of a hydrogeological evaluation only when the scientific level of knowledge does not permit to establish a hydrogeological expertise.

Similar detailed intended specifications were put into operation by the Superior Mining Authority for the establishment of hydrogeological and stability calculations of grouting curtains /4/.

The certified expert examines the potential risks to geotechnical safety on the establishment of hydrogeological calculations, makes a statement on them and is responsible of the statements in the hydrogeological calculations.

Measures to be derived from the hydrogeological calculations for safeguarding and improving geotechnical safety are presented in the technical operational plan of each mine concerned. The technical operational plan is sanctioned by the competent Mining Authority and thus obligatory for the operating management.

Due to the introduction of the state of a certified expert and of special intended specifications for the uniform establishment of hydrogeological calculations by the Superior Mining Authority, preparation and realisation of draining measures in open-cut mines are carried out on a basis of higher quality with regard to science, obligation and control, so that the economy of our open-cut mines could be improved, too.

References

- [1] Strzodka, K. et al. Development and tasks to be solved in future of depp-well drainage in lignite open-cut mines. Paper read at the scientific conference on lignite exploration in Cottbus, 15 - 16 March, 1979, un-published.
- [2] Reisner, H., Fischer, M. Tasks to be solved in research and practice in the field of open-cut drainage under consideration of the development of performance and mining conditions in the open-cut mines of the GDR. Paper read on the occasion of the day in honour of mining and metallurgical industry at the Mining Academy of Freiberg, 1981, un-published.
- [3] Direction of 24th April, 1974 on the rights, the duties, and the recognition of certified experts of the Superior Mining Authority - Direction concerning certified experts - (Official gazette announcing new laws I, No. 23, p. 245).
- [4] Order of the director of the Superior Mining Authority concerning geotechnical safety on the investigation of lignite deposits and the preparation of lignite mines. Draft of 21st August, 1981, un-published.