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DRILLING WORKS FOR DEGASATION PURPOSES IN THE CONDITIONS OF GREEN GAS DPB, a.s.

1. INTRODUCTION

'Degasation' is one of the terms which was a part of the name of a specialized organization introduced in 1960 in the Ostrava-Karviná mining district for the purpose of ensuring the security of the coal mining works' realization in the Czech part of the Upper Silesian hard coal basin. The Degasation and Drainage Plant (the original name of today's Green Gas DPB, a.s.) has thus already been dealing with borehole degasation related activities for 48 years.

2. DEGASATION IN THE CONDITIONS OF GREEN GAS, a.s.

Activities, commonly called 'Additional Degasation', were started within the DPB in the 1990s in order to reach these goals:

1. increasing the effectivity of the realized boreholes of the classical coalfaces' degasation,
2. ensuring new, long-term methane resources with high concentration,
3. minimizing the costs per one cubic metre of gas gained from the acquired resources.

These preconditions are met in the organisation Green Gas DPB, a.s. for reaching the above-mentioned goals:

1. long-standing experience with the degasation borehole´s realization,
2. high quality of the operating personnel and the support of special subdivisions (geology, hydrogeology, ventilation, degasation, logging), supplemented by a close cooperation with specialists from the VŠB – Technical University of Ostrava and from individual mines,
3. own manufacturing of drilling rigs.

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We realized 48 km of boreholes within the additional degasation programme between 1993 and 2007. The footages of realized boreholes and their numbers are stated in Table 1. After the deduction of realizations of boreholes shorter than 50 m* (in most cases because of an early termination of drilling, owing to the impossibility of ensuring the tightness of the surface casing, eventually because of a higher deviation from the projected direction and gradient measured by logging), the average borehole depth amounts to 180 m.

Table 1

The footages of realized boreholes

Year	1993–2000	2001	2002	2003	2004	2005	2006	2007	Total
Footage in total	36 562	2 041	1 735	2 011	1 488	1 506	1 364	1 244	47 950
Number of boreholes	218	10	10	9	9	10	10	11	287
Boreholes over 50 m*	36 177	1 997	1 397	2 011	1 488	1 413	1 325	1 044	46 851
Number of boreholes*	202	8	8	9	9	7	9	7	259

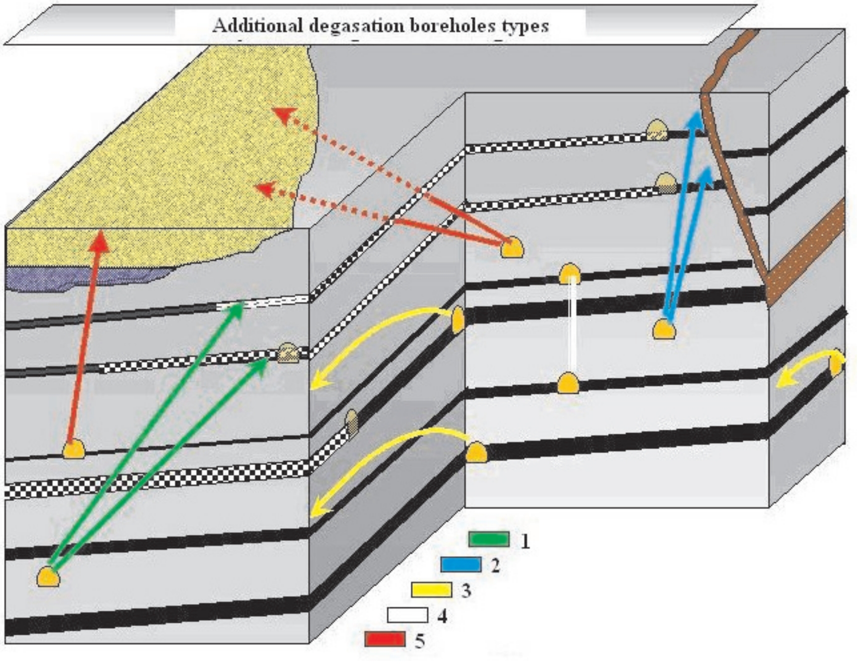

Fig. 1. Types of realized additional degasation boreholes. 1 – Boreholes into worked out areas of coalfaces and openings (entries), 2 – Boreholes into disruption zones, 3 – Long horizontal boreholes – coalfaces, 4 – Technical, transportation boreholes, 5 – Detritus (dehydrated, non-dehydrated) boreholes

According to the gas's accumulations' sources, the boreholes can be divided into boreholes into the zones of:

a) worked out areas of coalfaces and openings (entries),
b) disruption zones and tectonics,
c) long horizontal boreholes into the proximate hanging of active coalfaces,
d) technical and transportation boreholes (substitution for the degasation pipeline),
e) dehydrated detritus, eventually boreholes directed over the detritus water level.

In case of all enumerated degasation boreholes' types, we distinguish three main realization phases, i.e. projection preparation, the drilling itself, and evaluation (Fig. 1).

3. PROJECTION AND REALIZATION PHASE

Projection phase

The collection of all available pieces of geological, mining, and technical information, their evaluation, the research of already realized boreholes in the touched area, the research of the mining-technical plan, and of the changes in the allotment resulting from it, etc. The determination of the borehole's direction and gradient, the drilling diameter and outfit determination, and the verification of the feasibility in the mine.

Realization phase

When realizing the drilling itself, special attention is paid to these two aspects:

1) keeping the project parameters (the drilling rig's set-up, boring for the surface casing, and direction and gradient verification by means of a logging measurement, even before the initiation of the casing of the surface casing, direction and gradient correction through the use of a set of guides, interval control through azimuth and direction measurement, monitoring gas outflows and water inflows in the course of the drilling, interval extractions of boring gravel samples);
2) keeping drilling work safety parameters (a correct surface casing´s length, pressure tightness tests, external casing cementations, regular functionality tests of the safety fittings at the top of borehole, special safety rules for upward boreholes over 45^{o}).

4. THE BOREHOLE´S EVALUATION

Each borehole group has its specifics and demands special approach.

1) **In case of upward boreholes above the detritus water level**, we make the best of the experience gained during the realization of safety boreholes for anticipated water pressures 4.0–10 MPa. The safety of directing such a borehole is adapted to anticipated pressures (conductor, surface casing 30–50 m, pressure tests, safety armatures, backward valves, filter section's by-pass for the transportation of the wash-out to the borehole's bottom, etc.).

2) **Boreholes to worked out areas of coalfaces** and especially to closed openings have to be realized pursuant to making use of all available pieces of knowledge concerning natural causes of boreholes' deviation and their interaction. The goal is to impact the required place and area by the borehole.

3) **Boreholes directed in the proximate hanging of the prospective coalface** from the base of the block against the advanced coalface demand 'laying' the borehole's trajectory into a subhorizontal position in relation to the coalface after the initial, more sheer drilling phase with the installed surface casing. According to the simulation of the coalface's hanging desintegration by the help of the software by Lunagas Ltd. Roofgas, Floorgas, the optimum height of the borehole's directing above the coalface is determined. It is suitable to begin drilling the borehole from a working which will not be closed and its mouth will be further accessible after finishing the mining of the particular coalface. After the realization of long horizontal boreholes above the coalface, we employed the downhole engine technology in two cases, namely because of direction and gradient changes after the initial, sheer drilling phase. In other cases we employ, more or less successfully, sets and combinations of the guides in connection with the drilling mode, in order to regulate the borehole's gradient. A thin engine DO-01 was employed in both cases of the downhole engine's application. Through a unique solution combining the downhole engine technology with the wire-line technology, we achieved the possibility of sinking and mining the multipleshot device for the purpose of the measurement of azimuth and gradient towards the engine through the hydraulic way, even in upward boreholes. The multipleshot on a rope is usually used only for measuring inclined boreholes with the vertical gradient over 45^{o}. Both experiments with this technology confirmed the intention's correctness. Even though the required borehole depths were not achieved, the boreholes were connected to the degasation.
The water wash-out appeared to be a serious problem when implementing the technology of controlled directional drilling using the downhole engine in case of upward boreholes in the mines' underground (Fig. 2). These are the causes of the problem:
   - when drilling by means of a direct clean water wash-out it is necessary to:
     - supply 300–420 $lmin^{1}$, 5.5–8 MPa to the place of drilling in the underground;
     - ensure draining this quantum off to the surface through waste piping;
   - when drilling by means of an indirect wash-out with recirculation:
     - increased demandingness on space in the working for placing the set of sedimentation carriages with overhangs;
     - ensuring a sufficient clean-up of the water wash-out;
   - erosion of seams and of their proximate hanging and foot-wall:
     - turbulent streaming of the wash-out;
     - passage through the seam under a very closed angle under 15^{o};
     - repeated drainage of water from the borehole when adding and taking away each drill pipe ($l = 1$ m);
     - falling of big rock particles into the borehole, which were being transported through the annulus to the top of borehole, and subsequently kept on plugging the preventer.

Boreholes realized by means of the downhole engine St 1 (PDMU 1) in the mine Paskov and PDMU 2 in the mine Dukla were cased totally lengthwise, using a pipe string with a diameter 70 mm with a cutted perforation. The borehole PMDU 1 performs its task even today. Educted CH_4 quanta (conversion for a 100% mixture) are given year after year in the Table 2.
For the degasation of active coalfaces, we concentrated on perfecting the boreholes' series, eventually their groups from the gates, and on the possibilities of their substitution through the medium of long horizontal boreholes directed over the coalface. An experi-

ment was carried out in the mine Dukla in R 36 513 with the realization of 17 classical degasation boreholes from the return airway, and at the same time with the realization of a long borehole from the base against the coalface's advancement. The experiment proved that when sucking by means of the long borehole, this overtook the task of the coalface's degasation, and that it was possible to take the set of parallel boreholes out of service, without any influence on safety and on the CH_4 concentration in the coalface.

4) **Technical boreholes** for an additional degasation are not used for a direct CH_4 removal from the rock massif, however they belong to the degasation system. These boreholes are characterized by high safety requirements, because they join 2 different workings or mine's levels. These boreholes with diameters ranging from 190 to 450 mm, realized through the Box boring technology through the use of drilling rigs Turmag 1200, are cased through gas-tight casing pipes DN 100-300, and have the degasation pipeline's function.

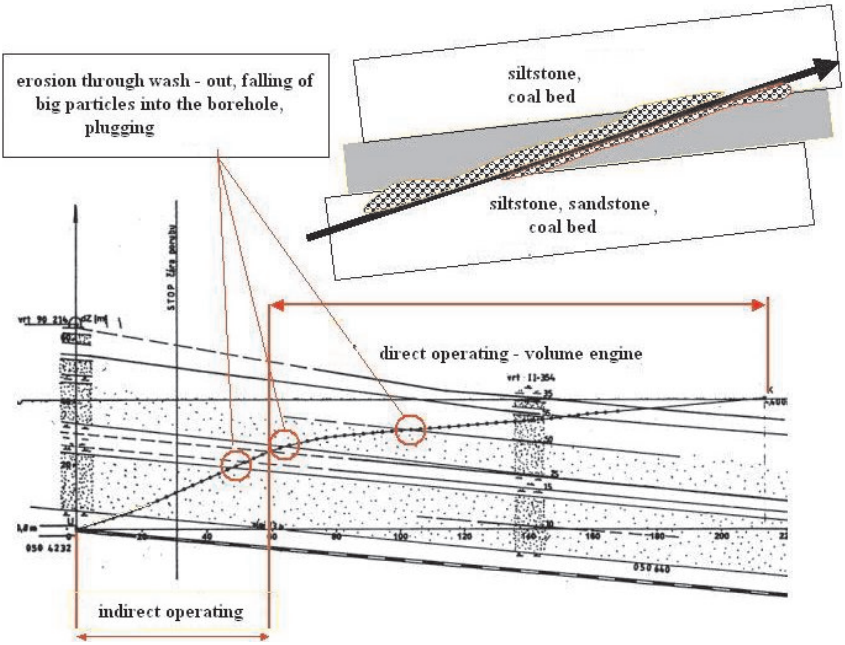

Fig. 2. Erosion through wash-out when passing through coal beds

Table 2

CH_4 eduction (conversion for a 100% mixture)

Borehole's number / year	Mine	2001	2002	2003	2004	2005	2006	2007
PMDU 1	Stařič	54	637	221	533	590	371	468
PMDU 2	Dukla			355	677	401	278	–

(thousands of m^3 – 100% CH_4)

5. CONCLUSION

We consider solving the issue of the boreholes' stem's stability in the conditions of carboniferous rocks when drilling upward boreholes through the downhole engine technology to be highly desirable in the upcoming period. The goal of the realization of long subhorizontal boreholes over the active coalface is the substitution of boreholes´ groups from the entries through one long subhorizontal borehole.

Czech – English translation: Bc. et Bc. Jiří Mazáč.

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