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DEVELOPMENT OF INTEGRATED TECHNOLOGICAL SYSTEMS FOR ORE AND COAL MINING

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ABSTRACT

Development of mining of firm minerals technological systems is the constantly and multifactorial process having for an object to intensify mining in various mining and geological conditions of the person and the nature safety growing requirements. It is directed on improvement of the interconnected things of the technical and technological support including the organization of mining works.

Herewith (in this article, in this report) some results of cooperation of Moscow state mining university and Scientific and Production Association "Hydrotechnology" dealing with designing and improvement of non-blasting, integrated technological systems of mining of ore and coal deposits by the opencast, underground and hybrid method with use of also hydraulically mechanized equipment. Technology options with partial processing and complete mineral enrichment at the mining enterprises are also presented. There are separate and complex technical solutions realized in the mining industry.

Keywords: *Coal mining, hydro-transport, dewatering, graphite, ore deposit, belt and scraper conveyor*

INTRODUCTION

Underground hydro mechanized coal mining technology had higher technical and economic indicators in comparison with "dry" traditional coal mining especially in complicated mining-and-geological conditions. However for wide introduction of hydraulic mining in the coal industry was interfered by high capital intensity and power consumption of this technology, considerable operational losses, need of constructing of special factories for coal dewatering, aggravating an ecological situation, high labor input and cost of dewatering of coal and purification of technological water.

DESIGNING AND REALIZATION OF THE INTEGRATED TECHNOLOGICAL SYSTEMS OF COAL HYDRAULIC MINING

To eliminate the abovementioned shortcomings we could use the created SPA "Hydrotechnology" highly effective, non-polluting coal mining hydro-mechanical technology, which simplify coal mining process. Use of the expensive longwall mechanized complexes inherent in traditional technological systems is excluded. Basis of new hydraulic mining technology /1/ is the underground closed hydro-transport system including a complex of the equipment for underground dewatering and enrichment of

coal, purification of technological water and supplying it in cleared working and development faces, Figure 1, [1,2,3].

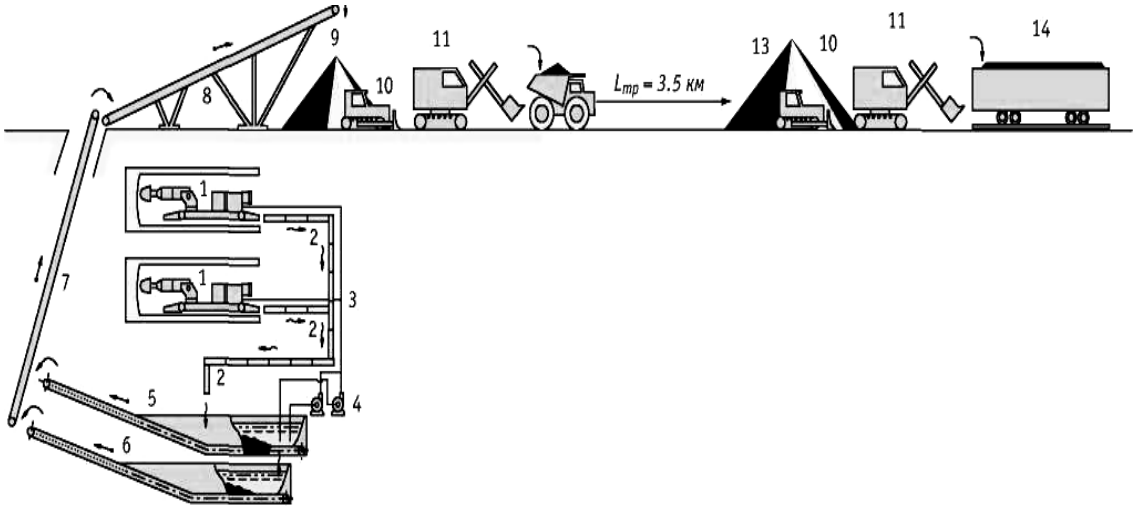

Figure 1. Mine technological scheme with of coal mechanic-hydraulic technology mining

Development of new level hydraulic technology confirmed its high efficiency on experimental hydraulic mines "Nagornaya – 1" and "Nagornaya – 2" in Kuzbuss – Russia in production process, table 1.

Table 1. Main progress data of work of "Nagornaya-1" and "Nagornaya-2" hydraulic mines

№	Indicator name	Dimension	Value of an indicator
1	Labor productivity of the worker: • on ordinary coal, • on a concentrate	 t/month t/month	 350 250
2	Ash-content of extracted coal	%	10
3	Coal ash-content on the next mines with traditional technology of production	%	22-26
4	Hydraulic mines construction term with volume of production of 300-500 thousand tone/year	month	6-8

The technological structure and engineering new technology of hydraulic mining, which provides for high progress data, characterized by existence of technological processes limited number that defines its: simplicity, low capital expenditure and ecological purity [4, 5]. New technology includes the following processes:

- mechanical-hydraulic roadways drivage
- mechanical-hydraulic coal extraction in room and pillar system, support-walking roadheader
- gravity free-flow non-pressure hydro-transport of coal to the dewatering room;
- underground closed complex of coal dewatering and enrichment, purification of technological water and supplying in coal and development faces
- dewatered coal delivery and warehousing on the surface of the mine
- coal additional enrichment (if required) on surface and concentrate loading in vehicles

Mining in coal and development faces is carried out by support-walking roadheader KPA – 3M, Figure 2, equipped for work with hydraulic transportation.

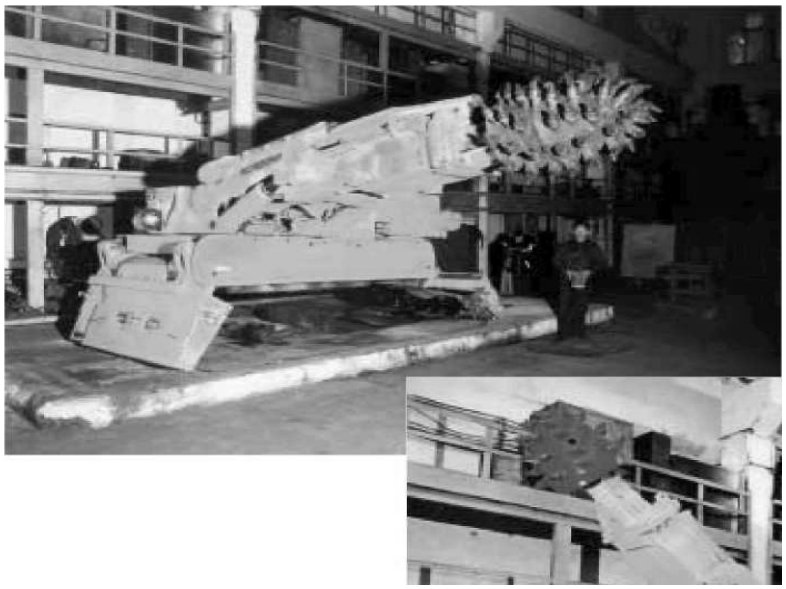

Figure 2. Remotely controlled support-walking roadheader (model KPA-3M)

Technological water in volume of 150-250 m^3/h is supplied to development face on a flexible pressure head sleeve in diameter of 80-120 mm. for pulp transportation on the floors of room and drift when the angle of floors greater than 5%, and on metal chutes (trenches) when it is 3-4%. Coal extraction is carried out selectively, that due hydrotransport excludes presence of large pieces of rock layers and roof in a stream of pulp. It is necessary to note that the mechanical-hydraulic method of roadways drivage can be used in coal mines with traditional technology of production with separate local system of coal dewatering, Figure 3.

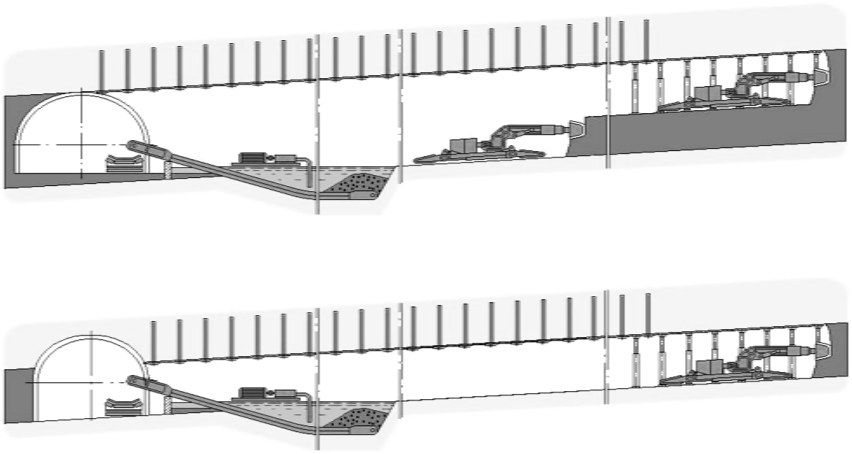

Figure 3. Continuous driving (drifts) technology by mechanical-hydraulic support-walking

Roadheader with local application of hydraulic transportation and coal dewatering in "dry" mines conditions:

A – roadway drivage technology in thick seams;
B – roadway drivage technology in thin seams.

Coal extraction in coal working faces is also provided by the remotely controlled support-walking roadheader, Figure 2 & 3. It especially worked actively due: to compact size, high stability, and the possibility of parallel movement. Reduction of ash content of the coal produced is achieved by

selective extraction and enrichment in gravity free-flow non-pressure hydro-transport. Dewatered coal moves along an inclined shaft by scraper or belt conveyor to the surface warehouse.

On Figure 4. technological scheme of coal mining by mechanical-hydraulic method on "Anzherskaya-Yuzhnaya-3" mine is shown [6].

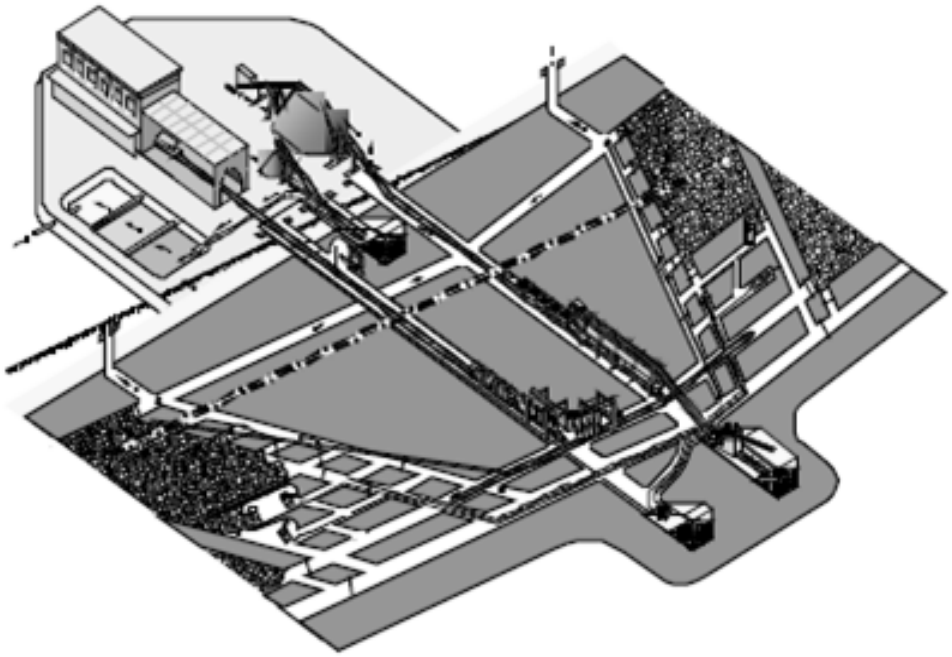

Figure 4. Technological scheme of mining by mechanical-hydraulic method on "Anzherskaya-Yuzhnaya-3" mine with underground enrichment of coal.

Practice of construction and operation of five coal-mining enterprises with use of offered technology allow to note, except economic advantages, its following additional advantages: lack of dust in mine atmosphere since it is localized directly in formation places; decrease mining enterprises harmful emission to minimum; more complete useful mineral dredging at the expense of possibility of local mining coal. Reserves and wrong configuration mine fields, mineral product high quality not demanding its enrichment; decrease mine waters pollution as a result of water closed cycle use. In our view, the main advantage of this technology is the high work safety, since high humidity of mine air minimizes the possibility of methane and coal dust explosion. In this understanding, it really is Non-Blasting technology.

Absence analogs of hydraulic integrated technology of coal mining and underground enrichment open good prospects for its widespread use, including mining of other mineral.

REALIZATION OF INTEGRATED TECHNOLOGICAL SYSTEMS OF GRAPHITE ORE DEPOSIT DEVELOPMENT

Development and realization of new technologies are especially actually for design, construction and maintenance of medium-sized and small mining enterprises. Though, in existing variety of mining-and-geological, economic and social conditions of development of concrete deposits or their sites to "small" it is possible to refer the enterprises not only with limited stocks, but also with "limited" investments.

Mining of graphites ore deposit development project in place Hyng Nyong located in 20 km in northwest from city Kuang Nyong in Vietnam can be an example Figure 5.

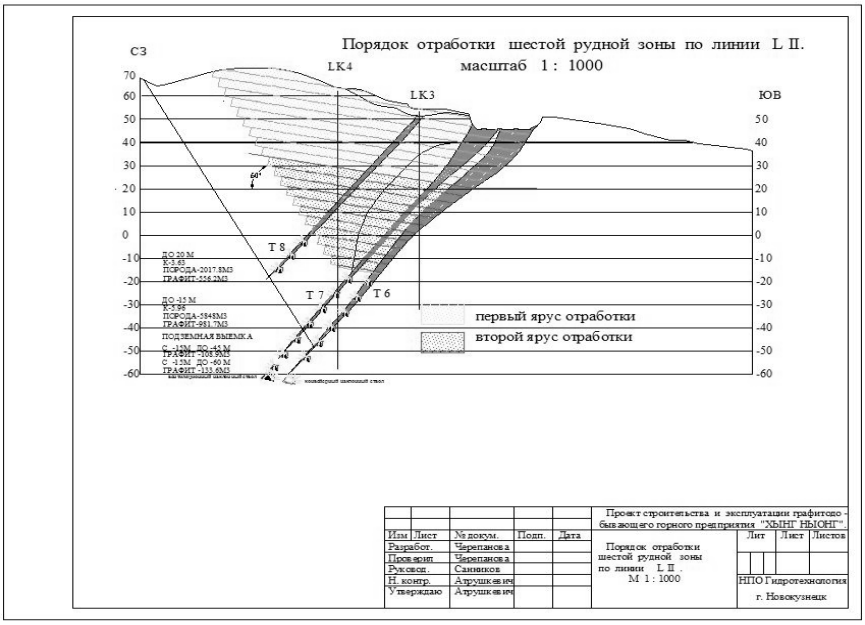

Figure 5. An order of graphite reserves mining of ore deposit (Kuang Nyong) in Vietnam

There are six bunches of ore bodies with total volume of 2 million tones. Graphite seams have thickness from 2 to 14 m with thinning on depth of 110 m and inclined at an angle from 30 to 90 degrees. In top part of field there are strongly cracked, unstable bearing strata, down – hard, strong.

Mining-and-geological conditions of field and it is insufficient demand to use flexible, modular, low-expensive technologies, allowing to carry out field supplementary exploration in its operation and to realize transition (conversion) from one bunch of ore bodies to another one. Thus for working off of overlying stocks of bark of aeration, because of weak stability of containing breeds, application of an underground way wasn't represented possible. Taking into account climatic conditions (lack of negative temperatures), land relief (allowing to place breed capping between tops of heights with formation of horizontal sites for cultivation of rice and other crops), the combined (hybrid) technology, of hydraulic-mechanical way working off of stocks, widely and comprehensively tested by our specialists was offered at construction and operation of the coal-mining enterprises in the Russian Federation [6, 7].

Opencast and underground way the technology of dredging with hydraulic transport, dewatering complexes and the closed cycle of water use is applied by mechanical-hydraulic roadheaders, Figure 6 and 7.

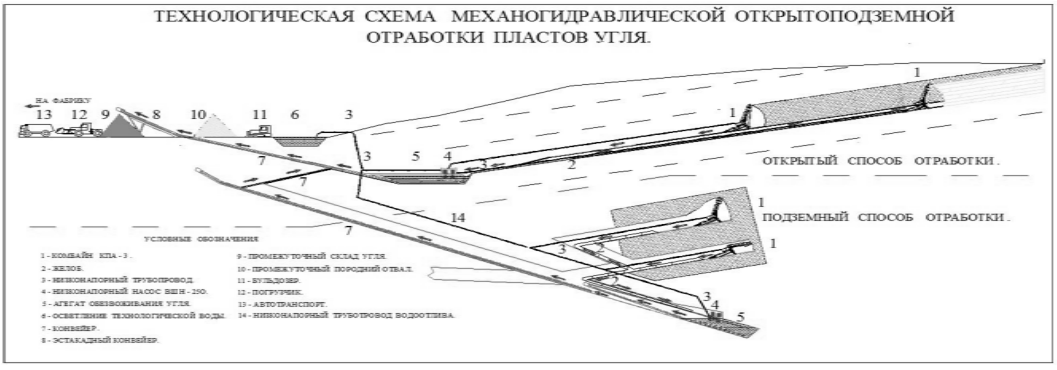

Figure 6. Hybrid technology of opencast and underground mining reserves of the ore body containing graphite in Vietnam

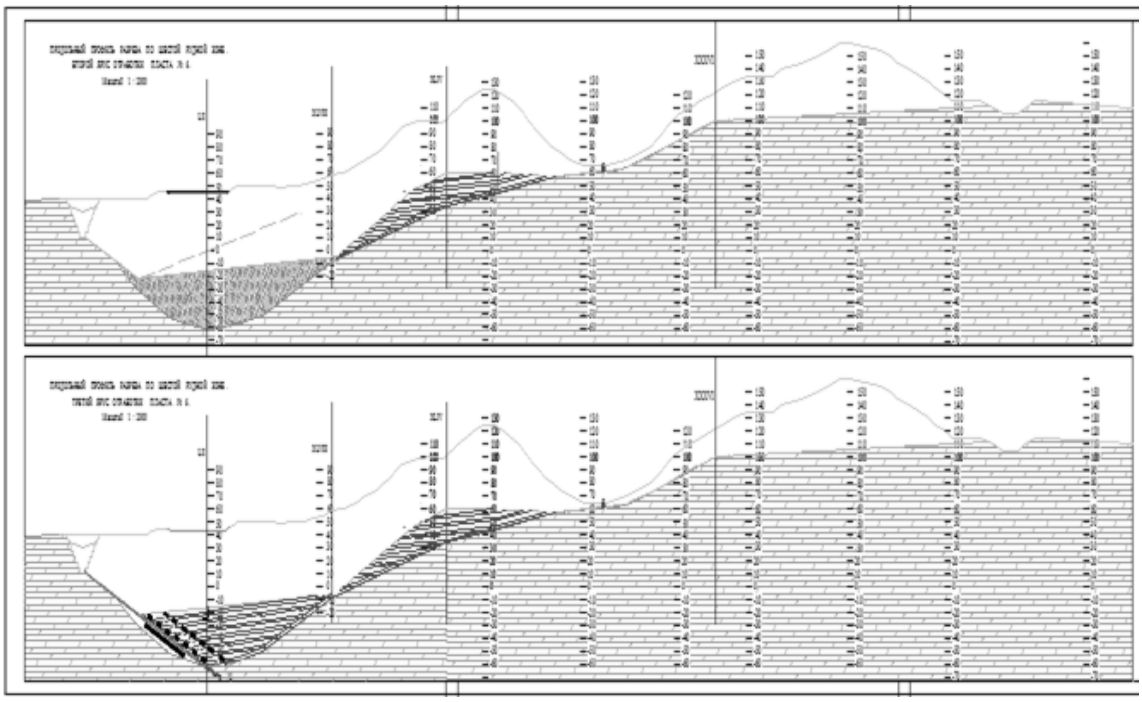

Figure 7. The longitudinal profile of the section of the ore zone shows the fraction of open pit and underground mining operations on the influencing factors (topography, the strength and stability of rocks)

Considering technical possibilities of KPA-3M combines (free moving at angle of 30 degrees) and local, mutually isolated arrangement of bunches of ore bodies, option of sheeted opening (at the beginning of bunch pro-deleting on the bottom layer in suite) and sheeted preparation of stocks on sites intended to underground development was accepted.

For working off of stocks of the pulled together layers of suite sheeted preparation by diagonal slopes and mechanical-hydraulic mining combines dredging from sub level drifts were carried out cross-drifts.

Cross-drifts drivage on strong rocks is offered to carry out using thin high-pressure water jets, Figure 8.

Figure 8. Demonstration of strong rock destruction with using thin high-pressure water jets (30-80 and more MPa)

The project is approved by the customer (the Russian company "Nobel Oil") and accepted by the Vietnamese party to realization. The low capital intensity, high efficiency and ecological safety of the decisions offered in the project are especially noted [8, 9].

CONCLUSION

The high-adaptive hydromechanized technology of the hybrid mining of coal, grafits ore is developed. Options of realization of new technologies of production and processing in Russia and abroad are considered.

Research results are applicable to the conditions in the mining of Bosnia and Herzegovina in terms of effective indicators improving. Innovative technologies can be effectively aplied in a different working environments with complex geological conditions.

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