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unit cost of production, in addition, it can be used with a production breakage face length of more than 300 m, which significantly minimizes the likelihood of a sudden outburst of coal and gas.

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D.L. VASYLIEV, D.Sc., Senior Research Officer
N.V. OSINNIA, Research Assistant
Z.M. RIZO, Postgraduate student, Institute of Geotechnical Mechanics named by N. Poljakov of National Academy of Sciences of Ukraine, Ukraine

MAIN CAUSE OF DYNAMIC PHENOMENA IN COAL MINES

The authors [1] analyzed hypotheses and theories aimed at revealing the nature of the mechanism of manifestation of gas-dynamic phenomena (GDP) in coal mines and came to the conclusion that “in general, the creation of a theory explaining the nature and mechanism, both in general and of individual types of GDP, cannot be considered complete, and research in this direction must be continued. We will present our point of view on the nature and mechanism of the GDP, in contrast to the well-known hypotheses and theories.

It is clear that GDP occurs when the potential energy of rock pressure is converted into kinetic energy. This is possible when the coal seam loses its bearing capacity, i.e. strength. After all, it has long been known [2-5] that the strength of coal increases with the removal of gas from it. The authors indicate that as a result of underworking or overworking, the strength coefficient of coal samples increases by 1,2 times [2]. V.I. Nikolin [5] writes that from the experience of developing highly gas-bearing seams, it is known that in a gassed working, the bottom-hole zone of a coal seam is destroyed by a jackhammer, etc. much easier than in the same working with normal ventilation. In the literature, a mathematical description of the phenomenon of a decrease in the strength of coal during its gas saturation could not be found. Let's try to fill this gap. To do this, it is necessary to develop a method for calculating the bearing capacity of the bottomhole zone of gas-bearing coal seams, taking into account the internal pressure of the gas.

The bearing capacity of a part of the formation is determined by the formula

$$p = \sigma_{y_\xi}\left(1 + 0{,}5 f_c \left(l - x_\xi\right)/h\right), \quad (1)$$

where σ_{y_ξ} - vertical normal stress at crack tip; f_c - coefficient of contact friction between the formation and side rocks; l – distance from the bottomhole to the considered point; x_ξ - crack tip abscissa; h - formation thickness.

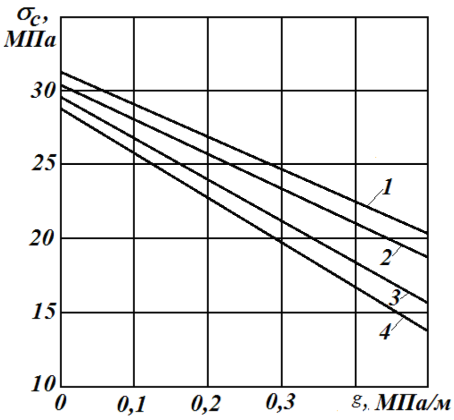
As can be seen, it is necessary to know the value of the vertical normal stress at the tip of a bottom-hole crack in a gas-bearing formation. The book [7] provides a method for determining vertical and horizontal normal stresses at the crack tip. Now the formulas of the book should take into account the pressure of the gas σ_g. We accept the condition that the gas pressure σ_g along the bottom of the formation plane changes according to a linear law and is expressed by the formula

$$\sigma_g = g \cdot l, \quad (3)$$

where g - the gradient of the increase in gas pressure deep into the array per unit distance from the free surface, from the working bottom; After solving the equations of the book [7] for a crack, taking into account the gas pressure, a method was developed for calculating the bearing capacity - the ultimate strength of the bottomhole zone of a gas-bearing coal seam.

Based on the method, dependences of changes in the ultimate strength of the bottomhole formation zone with coal shear resistance k_n=1,5 MPa, internal friction angle ρ=45° и f_c=0 and a length equal to the thickness of the seams were established (Fig. 1).

As can be seen, the internal gas pressure sharply reduces the bearing capacity of the bottomhole zone of gas-bearing coal seams. Thus, at a gas pressure gradient g=0,3 MPa/m, the strength of the bottomhole zone decreases by 20%. g=0,3 MPa/m - by 30%. In the future, based on the foregoing, it is planned to describe the mechanism of coal explosion with a sudden release of its gas.



Formation thickness: *1* - 1,35 m; *2* - 1,5 m; *3* - 1,8 m; *4* - 2,0 m

Fig. 1. Dependences of the ultimate strength of the bottomhole zone of gas-bearing coal seams on the gas pressure gradient

Let us now compare the theoretical conclusions with experimental observations. An analysis of the development of gas-bearing seams gives an unambiguous answer to the question of the influence of the magnitude of gas pressure on the outburst hazard of coal seams. It has been established that the outburst hazard of coal seams of various deposits increases with increasing gas pressure. At one time [3-5], work was carried out to determine the "critical" gas pressure, above which the formation becomes dangerous due to sudden outbursts. The critical pressure in the reservoir turned out to be 1,0-1,5 MPa.

Consequently, the gas pressure is the "starter" of the transfer of the limiting stress state into an outburst hazardous one, which leads to the emergence of the process of converting the potential energy of rock pressure into kinetic energy in the form of gas-dynamic phenomena in mines.

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G.I. EREMENKO, Ph.D. tech. Sciences, Assoc.;
D.A. TITOV, master;
S.A. ZHUKOV, Dr. tech. Sciences prof. Kryvyi Rih National University, Ukraine

ADJUSTMENT OF MINING TECHNOLOGIES IN QUARRIES LOCATED IN CITIES

One of the main problematic features of the Kryvyi Rih iron ore basin is the location of part of the iron ore quarries within the city, among its densely populated areas. Under these conditions, these territories not only suffer from seismic manifestations of technological mass explosions, but also from atmospheric pollution with mineral ore dust, which is unacceptably intense in the area of the studied quarries.

The only real way to solve this problem is to find an effective, simple and inexpensive technology to combat dust generation from mining operations through the introduction of available chemicals and modern mining equipment available in quarries and progressive technologies for their application. Therefore, the purpose of the presented studies is to determine the main factors of dust formation in such problem areas and their susceptibility to the action of various reagents in order to substantiate appropriate options for technological solutions to reduce atmospheric pollution to an environmentally acceptable level using the example of one of the quarries of PJSC ArcelorMittal Kryvyi Rih. The task of the foregoing is to determine effective dust-suppressing agents for the indicated conditions and to substantiate the appropriate options for their use.

The results of the study are presented on the example of dedusting surfaces of the composition of oxidized quartzites (Avtootval № 4) and reducing dust formation during blasting of rocks in the conditions of a quarry of the Mining Department of the Mining Department of PJSC ArcelorMittal