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AN IMPROVING OF THE EXSPLOSIVE TECHNOLOGY OF THE MINE EXCAVATIONS CONSTRUCTION

The new form an excavation is used to maintain the excavating equipment. More than 200 technological parts are being built every year in the Ukrainian coal mines and more than 70 000 men-shifts per year are spent on their construction. Than is why a reduction in the time and complexity of a technological parts of an excavation is an actual scientific and technical problem.

UDOSKONALENIE TECHNIKI WYBUCHOWEJ PRZY DRĄŻENIU WYROBISK KORYTARZOWYCH

W pracy zaproponowaną nowy kształt przodka drążonych wyrobisk korytarzowych, wraz z szczegółowym omówieniem podstaw teoretycznych. Zaproponowano również rozwiązania techniczne dla robót strzałowych umożliwiające uzyskanie dużej dokładności robót strzałowych (uzyskanie bardzo dokładnego obrysu wyrobiska z minimalizacją rozpraszania energii wybuchu w kierunku prostopadłym do obrysu wyrobiska). W pracy przedstawiono również rezultaty zastosowania prezentowanych rozwiązań poprzez przemysłowe wykorzystanie w kopalniach Ukraińskich.

1. Introduction

A technological part of an excavation is used to maintain the excavating equipments. More than 200 technological parts are being built every year in the Ukrainian coal mines and more than 70 000 men-shifts per year are spent on their construction. Than is why a reduction in the time and complexity of a technological parts of an excavation is an actual scientific and technical problem.

2. Theoretical validation of the parameters of the excavation's working face with curve terraced form

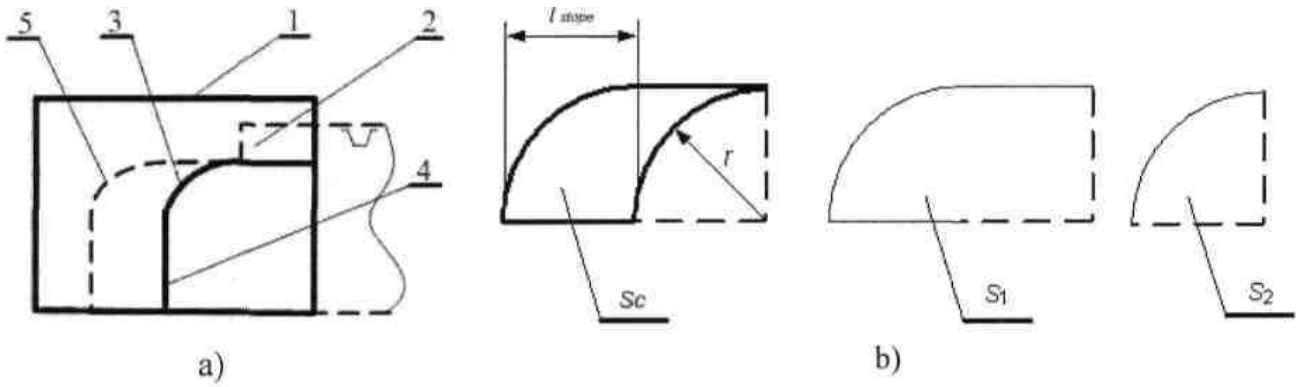

Fig.l. A curve terraced form of the excavation's working face: a) general form; b) schemes for a calculations of the squares of a curve part of an excavation

A construction of the technological part of the mine excavation is the most labor intensive. To reduce a time of the construction in [1] the new curve terrace form (fig. la) of the excavation's face is proposed.

Part of the rock mass (1), adjacent to an excavation, is made as a terrace (2). It interfaces with the cylindrical surface (3) of the certain radius. This surface is perpendicular to the longitudinal axis of an excavation. The lower part of the face (4) is a vertical. (5) - a contour of an excavation after blasting. Use the proposed form involves the next order of blasting: at first charges in the terrace part are blasted, and then - near the ground. After this, the hole rows in series are blasted from the bottom to up.

To satisfy the safety requests a height of vertically-curved part should be at least 1800 mm. Rational length of a stope, l_{stope} = 1 m. The minimum distance from the holes to the contour of excavation is 150 mm, line of the least rock strength - not less then 300 mm, the diameter of the hole - 42 mm, the minimum height of the terrace ledge is taken to be 500 mm. The maximum height of the terrace can be calculated as:

$H_{t\_max} = H_{exc}$ -1800, mm, where H_{exc} - height of the excavation, MM.

A square of an excavation's face is equal: $S = S_t + S_c + S_{vert}$, where S_t - square of a terrace part; S_c - square of a curve part; S_{vert}- square of a vertical part.

$S_t = 2/3 \cdot H_t \cdot B_t$, м^2, where B_t - width of the excavation, m.

Using fig.2b, $S_c = S_1 - S_2$, м^2, where $S_1 = l_{stope} \cdot r + 0{,}25 \cdot \pi \cdot r^2$, $S_2 = 0{,}25 \pi \cdot r^2$

Height of vertical part should be not less then 1800 mm and can be calculated as:

$H_{vert}=H_{exc}-H_t-r$, *mm.*

A square of vertical part: $S_{vert} = H_{verl} \cdot B_{exc}$, m^2.

Thereafter $V_t = S_t - l_{stope}$, $V_c = S_c - l_{stope}$, $V_{vert} = S_{vert} - l_{stope}$.

Thus a rock shaft is formed by blasting of terrace part will be stable,

if $V_t = V_c + V_{vert}$. If $V_t < V_c + V_{vert}$,

the probability that the rock shaft will be demolished be the fragments of blasted rock.

If $V, > V_c + V_{vert}$, shaft hinders to rock to be ejected from the vertically-curved part of the face.

3. A technical solution to keep the rock outside of excavation's contour

To improve the directed explosive destruction of rock the Refractor for blast-holes setting down on a contour (CR) is proposed [3]. Construction of a refractor for blast-holes setting down on a contour is shown on fig.2.

Fig.2. Construction of a refractor for blast-holes setting down on a contour

It is intended for preservation of rocks located outside of a contour. It is executed in the form of the spatial construction formed by crossing of a lateral surface of the basic cylinder to other (secants). One end turned to a bottom of blast-hole, is flat. The other end turned to a mouth, has the form of a segment. The axis of the secant cylinder is perpendicular to axis of the base cylinder. Experiments were carried out with use of various explosives. Therefore the correction factor (ke) to

reduce to a standard (ammonite N°6GV) is entered. Values of deviations of a ballistic pendulum are accordingly were corrected. At tests the cartridge in weight 50 g and by diameter 40 mm and an electric detonator were applied.

Experiments show, that the shock wave and products of a detonation, flowing round a curvilinear surface of the CR, change a direction of the movement from axial (along a charge) on radial. It proves to be true a following results (tabl.l).

Table 1

Results of the experiments

Angle of CR rotation, degree	Deviation of a pendulum, mm	Radial impulse of explosive, N-s	Difference relatively to the construction without CR		
			mm	Ns	%
0 (by curvilinear part)	48	13,056	+2	+0,544	+4,17
90 (by lateral part)	41	11,152	-5	-1,360	-12,20
180 (by rectilinear part)	38	10,336	-8	-2,176	-21,05
Without CR	46	15,512	0	0	0

Application of the CR changed a deviation of a ballistic pendulum as follows. If the CR will turn to a pendulum a curvilinear part deviation - 60 mm; if lateral - 43 mm; if rectilinear - 40 mm. Impulse of explosive is proportional by the deviation of a ballistic pendulum. The analysis shows, that a presence of CR exercises a significant effect on the value of a deviation of a pendulum. Graphic interpretation of dependence of the impulse from the CR rotation angle is the curve represented on fig.3.

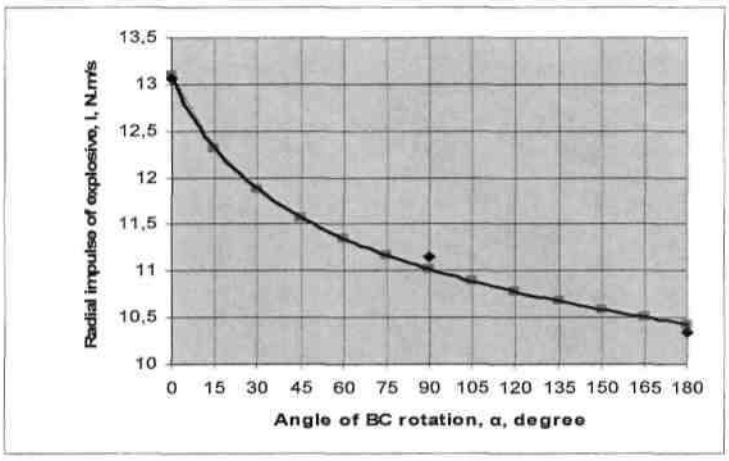

Fig.3. Functional depending of radial impulse of explosive from the angle of CR rotation

4. An industrial implementation on the Ukrainian mines

On the base of the theoretical researches and results of laboratory experiments the "Management on perfection of explosive works at carrying out of mountain developments and cutting of interfaces on mines of IC Donetskmine" is developed. It is approved by the Technical Director of Industrial Corporation. The industrial testing and approbation of inert refractors has been executed on mines "Ilovayska" and "Trudovska" of IC Donetskmine.

A redistribution of the detonation products to a radial direction provides to extend a spacing interval between the neighboring blast-holes. Thus the most part of energy of explosion goes on fulfillment of useful work.

5. Future directions

Direction of future research is to determine the rational parameters of explosive technology with the use of curve-terrace form of the excavation face for the construction of the mining technological parts to improve the technical and economic affectivity of underground building.