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Development of New Mining and Engineering Construction Works for the Development of Remote Northern Regions and the Far East

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Summary
Severe climatic conditions and high-abrasive frozen rocks make the problem of efficiency of development of fields and conducting construction works in the conditions of Northern regions and the Far East. All this leads to growth of economic losses when using traditional equipment at mining works, to delay of rates of development of fields and developments of infrastructure of the region. One of perspective solutions consists in introduction of the modern high-performance technical equipment, and with use of new technological decisions. Possibilities of use the portable explosive reactive complexes capable to form wells in frozen soil and rocky breeds fortress on M. M. Protodyakonov's scale to f =20 and with a diameter from 1 to 0,2 m, in the range of surrounding temperature ±50 ^{0}C, over time preparation and works by one complex no more than 5 minutes are considered.

Key words: *Northern and the Far East regions, development of fields, severe climatic conditions, drilling rigs, frozen rocks, portable explosive reactive complexes.*

1. INTRODUCTION

The large area of the far Eastern Federal district, occupying about 36 % of the territory of the Russian Federation, has enormous natural resources, including deposits of diamonds, gold, non-ferrous metals. A feature of these areas, which seriously hampers the extraction of minerals are harsh climatic conditions, relative underpopulation, the lack of a developed transport network, low production complex, remoteness repair bases, the high cost of living labor.

The problem in the field development consists in the fact that most of them are composed of abrasive permafrost rocks, which affects the efficiency of mining equipment. Low winter temperatures, reaching up to - 60^{o}C, the specifics of mining operations – requiring year round-the-clock operation modes of the machines leads to loss of working time for unscheduled downtime mining and transport equipment. So its running time is approximately 40% from the calendar of the Fund, of which about 25% are unplanned downtime. Will increase 2.5 -3 times the frequency of forced repairs and complexity of recovery, which increases the cost of the processed rock mass [1]. Structural and textural features of the developed array composed of strong and medium strength rocks, usually represented by layers of perennial or seasonal permafrost, high abrasion, impact alternating loads and shock vibration technique in conditions of sharply continental climate (temperature variations from - 60^{o}C to + 30^{o}C) have a significant impact on the reliability of mining and transport equipment.

The major problem lies in the fact that is used in these conditions are usually traditional technique, designed to work in a temperate climate, and the share application component products and machines in a cold climatic design does not exceed 20 % . All this leads to increase in economic losses during mining operations, slowing development of new fields and infrastructure development of the region.

2. IMPLEMENTING OF MODERN HIGH-PERFORMANCE MINING AND ENGINEERING TECHNICAL EQUIPMENT

One of the promising solutions to the problem lies in the introduction of modern high-performance technical equipment that meets the requirements of normative-technical documentation for operation in harsh climatic conditions.

Currently, 40% of the mined gold in Russia falls on alluvial deposits, located in the North and Northeast, where alluvial thickness is in the frozen state. Placer minerals can only be extracted under the condition of complete thawing containing Sands.

The mining method is to remove overburden (thawed or frozen state), the defrosting of the gold-bearing sand them flush on climbing plants. One of the difficulties in the provision of wash facilities melted sand.

So to conduct gidrogeolog thawing in the preparation of drainage polygons on mining operations in the permafrost is already widely used drilling machines model TMB (TM Bohrtechnik, Austria). This technique has been successfully working in JSC " Sysymangold" group Corporation Ltd, is embedded in the deposits of JSC "Artel of prospectors "Amur" [2]. Technical indicators models of drilling rigs are shown in Table 1.

Development efficiency depends on the level of efficiency of the drilling equipment used for immersion hydrogel [3]. Decisive here is the constructional features of the equipment used, its reliability, the choice of the optimal method of drilling with regard to the mechanism of destruction of the frozen rocks (Table 2).

As practice shows, the development of remote Northern regions and the Far East as possible with the introduction of modern mining equipment images, and in some cases with the use of new technological solutions. In this case, the perspective in the site preparation for mining in difficult geological and climatic conditions of the far Eastern region is the use of portable explosive reactive complexes (PERC) [4, 5, and 6].

Table 1. Characteristics of drilling rigs model TMB

The drilling machine (brand)	Type of drilling	The diameters of the wells	Depth of drilling, [m]	Features
Model TMB 102-300 LKW four-wheel two-axle chassis MAN	Exploration wells with removable chernoochene	NQ (76 mm), HQ (93 mm)	300	Can be installed on tracks, you can equip a powerful punchers or rotators
	Immersed hammer		150	
	Water well drilling	To 130 mm	300	The use of core and air percussion instrument
Model TMB 30	Blastholes	Large diameter	300	The use of air-percussion instrument
The TMB model 30 with equipment for drilling with reverse circulation	Blastholes		before 300	The use of a screw tool for drilling in soft rocks (for extraction of precious metals in alluvial deposits)

The features of these complexes are as follows:

1. The ability to form wells in frozen soils and rocks fortress on the scale M M Protodiakonov to f = 20 and a diameter of from 1 to 0.2 m (depending on the strength of rock) with autonomous remove destructible on the bottom of rocks and sludge removal up to 30 - 60 m (possibly the formation of a road embankment).
2. The change in the number of working modules design, equipped with a charge of solid explosives, depending on the strength properties of destructible rocks and depths of excavation.
3. Shipping them to the work site by hand, for which the complex should have a maximum mass of not more than 45 kg, and the mass split modules and devices is not over 10 kg.
4. To work in the temperature range $\pm 50^{o}$C with the preparation and production of work in one complex no more than 5 minutes.

PERC includes explosive reactive unit (ERU), starter, main electrical cable, an independent source of power (ISP) and remote controls (RC). Explosive reactive installation and created on the basis of their complexes (ERI) is a recoilless products, capable of a series of controlled explosions to form wells in rocks, including in flooded conditions thawed soils.

Figure 1 a, b shows the design of portable explosive reactive installations and shows how they work.

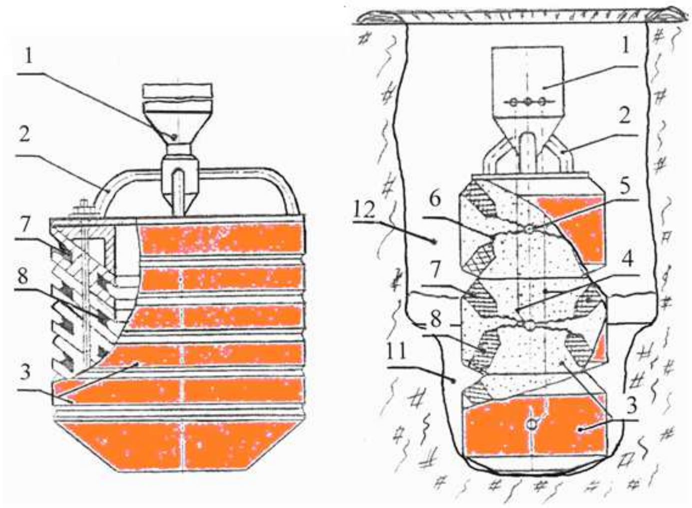
Installing ERU includes the unit's electric initiation and the working body consisting of one to three working modules, each of which is staffed seven recoilless destroy the tapes. Destructible cartridge equipped with downhole and reactive (clamping) lumped or ring shaped charges of explosive, as well as specially designed electric blasting caps of instantaneous action SED.

Each SED is connected to the BEI using electrical wires, stretched from the BEI through the adapter and the housing of the cassette. SED is installed in the cassette so that through the charge placed in the rear or directly to initiate initially reactive (anti-squeak), and then downhole explosive charge, which is equipped with reflectors tapes [7].
To compress ERU to the bottom of the borehole, the expiration of explosion products (EP) from the reactive charge time overlaps the expiration of EP downhole charge. Synchronous-overlap operation reactive explosive charge is achieved by using different length, density and velocity of detonation of reactive and downhole explosive charge.

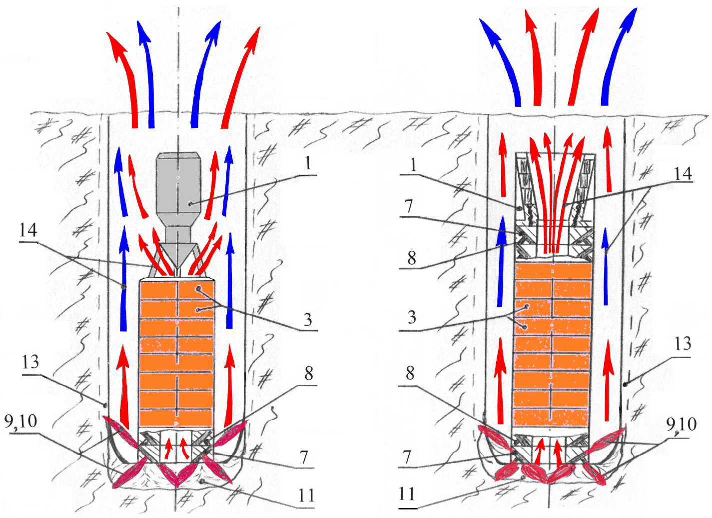
Table 2. Comparison of drilling rigs and drilling methods used for hydroglobe defrost frozen rocks

Type of model	CBB-IV	CDBB-П	HBR 15
The method of drilling	Shock Writely	Fibroblastlike	Keypunch
Base	Tractor T-100	Tractor T-100	Self-propelled drilling rig
Productivity	Low on all types of rock, high energy consumption and minimum efficiency		11.5 m^3/min has a Cummins engine power of 194 kW, the power stroke of the punch 13 kW
Durability	Low, high costs of spare parts, long service and repair downtime.		High on the frozen rocks
Design features	The absence of the moving frame and inclined telescopic mast, there is no automatic screwing/destroy the drilling camp. No computer system health monitoring system. The most time consuming operation is the drilling of wells, which is 42-47% of the total cost hydroactive		The possibility of using and flushing of the borehole bottom air wash it with water. Automatic possibility of screwing up/destroy drilling mill, roomy drum shop (7 rods, drilling at a depth of 29 meters). The possibility of equipping the machine with additional monitoring and control is to carry out the drilling process in a fully automatic mode, to generate reports about the performance of the machine. Ergonomic cab.

While the EP reactive explosive charge acting on the side walls formed by the wells extend them, and EP from downhole explosive charge to destroy the rock at the bottom, forming the initial cavity of smaller diameter.



a)



b)

Legend:
1 - Block electrical initiation (BEI),
2 - adapter with electric wires,
3 - Set recoilless, consistently destroying tapes with reflectors,
4- Electrical wires routed to a special electric detonators (SED),
5 - SED,
6 - The fairing,
7 - jet (pressure) explosive charge,
8 - downhole explosive charge placed in the reflector tapes,
9 - the products of the explosion of jet charges, expiring directional flow of reflectors,
10 - the products of the explosion downhole charge flowing directional flow of reflectors,
11 - the cavity formed in the breed with one cartridge,
12 - formed well,
13 - the zone of high seal or fractured rocks,
14 - the release of destroyed rock (sludge) and gases from the well.

Figure 1. Structure and working principle of ERC: a) one cassette, b) when sinking wells

Reflectors and cassette undergo plastic deformation in the process of accumulation of EP in a directed flow, which affects the breed. After completion of the process of accumulation of EP, the working tape is destroyed by the grooves and the hub of the voltage on its surface, and pieces of glass together with the destroyed rock thrown from a well extending the EP. Initiation of cassettes is carried out sequentially from bottom to top with a frequency of from 100 to 1000 Hz. Appearance ERU installation and well educated one PERC shown in Figures 2 and 3.

Figure 2. The appearance of ERU -7B

Figure 3. The result of the initiation of one complex PERC

3. EFFICIENCY AND ADVANTAGES OF PERC

Efficiency PERC is provided by:

- use the BEI, which does not depend on external power sources and provide the controlled initiation of the SED with a frequency up to 1000 Hz, with a high degree of safety and reliability for multiple use, charging from small energy sources,
- use special electric blasting caps of instantaneous action [7] with high safety during operation and the initiation from the BEI, redundancy can be implemented by special primers-primers [8],
- use disposable cassettes feature destructible reflectors, providing cost-effective energy storage products of the explosion to destroy the rock and allowing to increase the frequency of feeding the next cartridge ERU on the bottom with a frequency up to 50 kHz,
- jet-recoilless work tapes WU, working as "stemming", which provides sufficient retention time of explosion products, affecting destructible rock, and minimizes the time interval of feeding the next cartridge ERU on the bottom,
- spontaneous emission of sludge on the surface products of the explosion,
- autonomy and the possibility of delivery, either manually or cartage way to hard for transport areas,
- high-speed fracture of rocks of different strength in the form of wells, which significantly reduces the time and processing costs in the development of breeds,
- high reliability at a temperature of ±50 ° C, and after long-term storage of products in difficult climatic conditions.

The advantages of using PERC to perform some task in mining and civil engineering works in the Northern regions and the Far East is obvious:

- small delivery to the job site,
- reducing the time of production operations,
- saving supplies and reducing the number of maintenance personnel,
- high operational reliability and environmental safety,
- ability to conduct drilling and blasting in any geological (with complex hypsometric layers) and severe climatic conditions.

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