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Regulation of the Mode of Mining Operations in Open Cast Mining of Steeply Dipping Fields

D.G.Bukeikhanov, B.M.Madiyev, S.Zh.Galiyev & B.A.Utenbaiyev
D.A. Kunaev Mining Institute, Kazakhstan

ABSTRACT: The methods of mining operation mode control are described. An example of forming a temporarily non-working board in the Kachary quarry is given together with the advanced small quarry of Cokolovsky open cast mine in the planning of mining operations.

1 INTRODUCTION

The performance of the manufacturing and economic activity of mines using an open excavation method is in many respects instituted by the extent of the optimality of accepted solutions İn planning and production management, assets, property, investment and financial activity. These are bound to a conjuncture in the markets of the commodity produced, the materials and machinery obtained, money and capital. The production and ecomonic policy of a firm should allow for stability or the possibility of the changing of the bulk, nomenclature and quality of the commodity, estimation and collation of the most effective directions of mining operations, progress and technology of production, decrease in costs, upgrading of assets and choice of logical sources of collecting information, material and financial resources.

For the maintenance and extension of the productive capacities of mining operations of mineral resources, research into and acceptance of such solutions at the choice of a direction of progressing up for the mode and time planning of mining, which ensure the optimum allocation of bulks of production of an overburden, is indispensable.

Only those bulks of an overburden and in certain directions should be effected which provide continuity of mining and production in given bulks with demanded qualitative characteristics and in particular periods.

2 THE MODE OF MINING OPERATION BY TEMPORARY NON-WORKING BOARD

The regulation of Strippings ıs carried out as follows:

- Variation of open pit boundaries or development cycles, if it causes a decrease in overburden coal ratios without impairment of the qualitative performances of useful mined mineral;
- Installations of a direction of mining operations progressing, supplying sequential drawing in mining leases of deposits, which İn quahtative characteristics and bulks makes it possible to obtain the commodity foreseen for implementation with minimum first mining values of overburden ratios;
- forming of technological zones: in quarry with rational arguments;
- usage of opening schemes with half-stationary and temporary openings;
- application of mining methods in steep layers that allow mining with magnification of the angles of acclivities of working boards;
- of phased mining of the deposits with forming of temporarily non-working boards, small advanced open casts, twinning or threeing of benches that provides conservation and carrying on later periods of considerable bulks of an overburden, with allowance for secure subsequent iterating of mining operations on them and complete improvement of pillars.

Thus, the proposed strategy of regulation of intensity direction, mode and time schedules of mining operations, including in primal time for a decrease of peak loads on overburden, rigid technologies of mining of deposits İn steep layers with forming of temporarily non-working boards and advanced small open casts enables:

- extraction of reserves of an open pit field in periods with service factors of overburden lower or close to a mean overburden ratio in an open pit field at low prices for commodity and rises during high prices;
- systematic mining of ores at complete loading of preparation plant powers;
- possibility of regulation İn time of ore bulks and of corresponding stripping bulks on the basis of the

prognosis of supply and demand on firm's commodity and prices for it, and also on consumable materials in markets;

- continuous mining of ores in required bulk and qualitative performance, forming of optimum ore and rock flows, supplying rise of useful reductants in a concentrate.

A temporarily non-working pit wall represents a tank circuit of open cast, which is reshaped inside an open pit field and İs a temporary boundary, up to which the mining operations in the defined operating periods are carried out. It İs eliminated at the approach of the sustainable tendency of an abatement o*" stripping bulks and cutting of an excavation front. Time and the bulks of an electrode spacing of temporarily non-working boards are determined by concrete accounts in the design or long-term planning of mining operations.

In some cases, as the temporarily non-working board becomes a pit wall or its separate lease, formed by the way of a final board according to the project, acting on mat moment, and which by virtue of new accepted solutions embodied in the new project, envisioning the extension of open pit boundaries has appeared inside the new boundaries of an open pit field and is considered in it as the temporarily non-working board.

In design, the temporarily non-working board represents a stepping surface derived by collection of acclivities of benches and berms (transport, periodic clearing, safety). The arguments for a temporarily non-working board should meet the requirements of stability and mine safety in their formation and improvement. The lean angles of temporarily non-working boards, depending on concrete geological conditions, deformed states of rock in board massifs and periods of existence of boards, are usually in limits from lean angle of a working pit wall up to the lean angle of a pit wall in its end position. The steeper the angle of its slope, the better the performance of its application. The acclivities of benches on non-working boards, as their design element should have for a standing period of one year a stability margin of 1.1-1.2. For 20 years, this should be 1.2-1.5, and for more than 20 years, İt should be 3 or more.

The number and width of berms in a temporarily non-working pit wall depends on the system and opening schemes concrete and from opening up of working levels, arguments of the mining method, and the type of applied open cut transport. The width of safety berms and periodic clearing is regulated by "uniform safety rules at digging of deposits by an opened way". For supply of the uniform mode of mining operations and uninterrupted operation of open cast in ore mining when applying temporarily non-working boards, it is necessary to provide" sufficient penetration feed of mining operations in the moving of this board.

Temporarily non-working boards in open casts have found a use as one of the tools of regulation of the mode of stripping, decrease of peaked bulks of overburden and carrying them on later periods at mining deep seated acclinal, steeply dipping and unformed deposits by sequential queues (Bukeikhanov, 1991).

The technology of improvement of open cast with temporary conservation of boards in the area of the former USSR has continued for more than 50 years. The idea of separation of open cast improvement on stages for the first time was put forward by the designers of the Unipromedy Institute and is applied in practice m the designing of deep open cast mining. In 1945, the scheme developement by stages proposed for Sibay open cast was accepted in the project and is carried out in practice. Then, in different years mining by stages with temporarily non-working boards was applied at the Kovdorski, Nikolaevski, Jitikarinski, Korshunovski, Krivorojski, Kalymakirski and Bajenovski open casts.

Known examples of the use of temporarily non-working boards outside the former USSR are listed below.

The Kessiay open cast (Canada) is divided into nine stages of development. The altitude of the temporarily non-working board is 300-320 meters with an opencast depth of 490 meters.

The planning of mining operations at once in outlines of stages is carried out on the basis of an inadmissibility of termination or decrease of bulks of mining at transferring from stage to stage. The number of simultaneously fulfilled benches and width of safety platforms depend on the output of the excavators. The working area is divided into leases. While the bench of a lease is working, the others are in temporary conservation. The angles of the acclivities of temporarily non-working boards, as well as practically on all foreign opencasts, which are carried out İn stages, are close to the angles of the acclivities of the final boards.

At the Kacharski open cast of the "Sokolovsko-Sarbaiski dressing manufacturing association" use of temporarily non-working boards for regulation of the mode of stripping İs stipulated. The project capacity of open cast on ore in 2000 has increased 8.0 million tonnes and on overburden is 21 million m^3. An exit on total output İn 15 million tonnes is envisaged in 2020. The mining method is one-onboard with transport of empty rock mass on external dump by a combined auto-railway transport.

At present, the open cast has reached a size of 2190 meters in diameter. The depth of the open cast for 1.01.2000 has increased 282 meters. The western board during 2100 meters is set in an end position up to a mark of-427 m. (63 meters in altitude).

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board {from the upper horizon up to a safety berm with the broken-up rockmass arbor inclusively) ceases with the beginning of delivering of the upper horizon. From the limits of a delivered lease of the temporarily non-working board all machinery is removed and access for servicers İs forbidden.

Other methods of regulation of the mode of stripping are small advanced open casts, which allow in short times preparation of the front of mining operations on ore and to start winning operations, and, on the other hand, they can provide forming of padding front of mining operations on overburden. With the use of small open casts in an open pit field, die working area of main opencast and small advanced opencasts is reshaped, i.e., not one working area operates, but a few, which subsequently merge partially or completely. In some cases, the small open casts can be laid out in the limits of a working area of open cast and intensify mining operations on its particular leases. The small advanced open casts, as one of the effective methods of regulation of the mode of mining operations, are applied for development of disconnected deposits in large and deep open casts with the purpose of the creation of a padding front of operations both in mining, and on an overburden and rising of their intensity, and also rising of a complete withdrawal of mineral resources from entrails and decrease of their dilution, if the ore bodies have pitch angles with different directions. Thus, between main and small advanced open cast, the pillars, folded, as a rule, by overburden rock mass are reshaped. They are reshaped in the limits of boundaries of an open pit field and consist of a small number of benches, and also supply the transport link of working levels with a transportation network of open cast, uncovering and preforming developments. The small advanced open casts are usually laid out along the contact of conditioned ores with overburden rock mass on the part of hanging walls of the deposit. The lean angles of working boards and on small advanced open casts can be differenL As a rule, they are from 16° to 30°-45°.

In the planning of mining operations at Sokolovski open cast, for quick input in working off of ores with veins and regulation of the mode of stripping, the creation of advanced small opencast is proposed.

As part of the authorized project (SSGPO, 2000), the output of Sokolovski opencast on ore till 2005 is on level 3 million tons. The ores with veins began development in 1998, as padding to magnetite up to a level 3 million tons. In the project, exploitation of the new reserves of magnetite ores will begin in 2007. The maximum output from these ores accepted by the project is 2 m tons. The complete damping of mining operations İs planned in 2026.

At present, the mining of magnetite ores and extraction of rocky overburden rock mass is conducted from a southern (Main) lease of open cast. Thus, the large part of overburden rock mass is located at an internal automobile dump located in the northern part of the open cast.

Simultaneously with it delivering of East bead with deleting of soils of a friable overburden and mining of ores with veins of ores is prolonged. In a delivering zone, the open cast has achieved the final outlines up to level -125 m., southern and southeast up to level -200m (375m from a daylight area).

The communal depth of opencast to the end of 2000 has reached 420 m (the mark of bottom - 245m). The dimensions of the open cast on the surface are: length - 3400m, width - 2000m.

Expansion of the communal front of mining operations İS 13.2 km, and including on ore - 1.0 km.

Expansion of the fissile front of operations is 6.5 kms, including on ore - 0.7 kms.

The transport of mined rock from the working faces of the east board is carried out by railway transport, and from the working faces of the main open cast by a combined auto-railway transport.

At Sokolovski iron ore open cast at planning of mining operations in the period 2001-2005, the problem on creation of small advanced opencast, which is reshaped İn opencast of a northwest part of opencast, is reviewed. Its creation provides quick access to the ore deposit production of winning operations, without the working off of all strata of overberden rock mass (-35m) / (-80m) on the part of the main opencast and magnification as ore - on 900m, and of overburden - on 1200m fronts. (Fig. 2.)

Thus, the experience of designing, planning and handling of mining operations at Kazakhstan opencasts has shown that the most effective tool of regulation by stripping works and supply of regularity of winning operations when mining large opencasts fulfilling a steeply dipping field are the of creation in them of temporarily non-working boards and advanced small opencasts. It is necessary to allow for these positions İn the creation of systems of design automat projecting and planning of mining-transport systems in deep opencasts (Bukeikhanov et. al., 1989).

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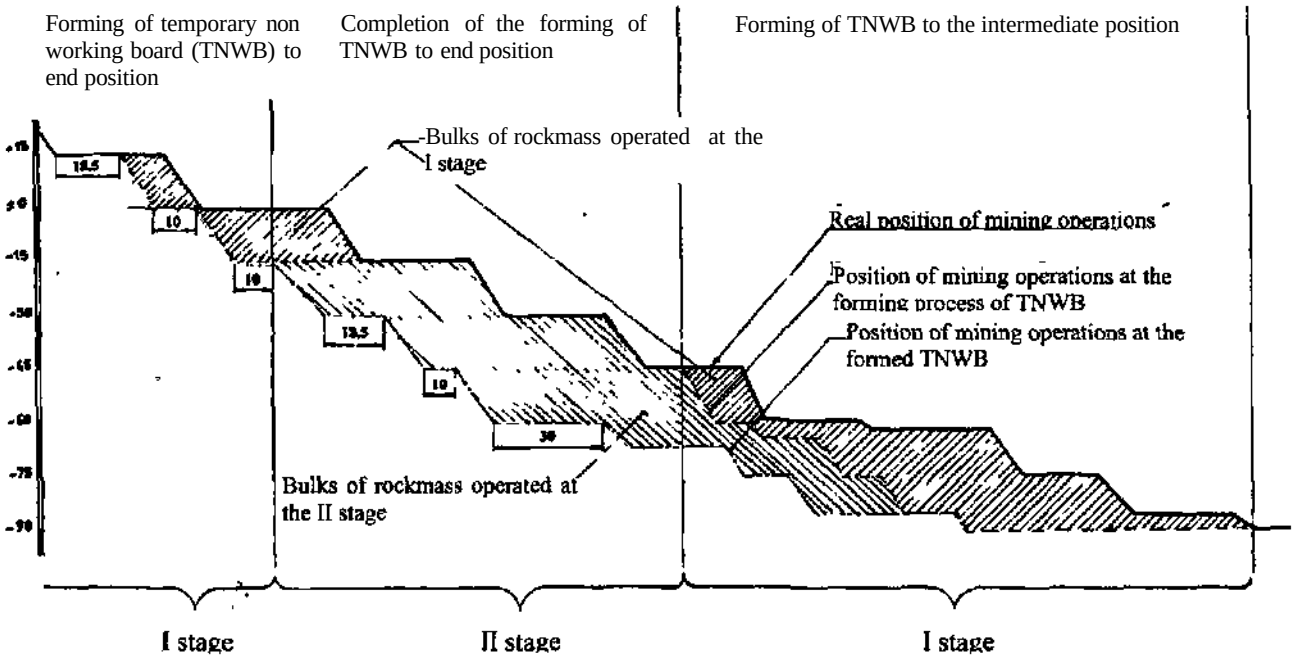

Figure 1 The arguments of TNWB

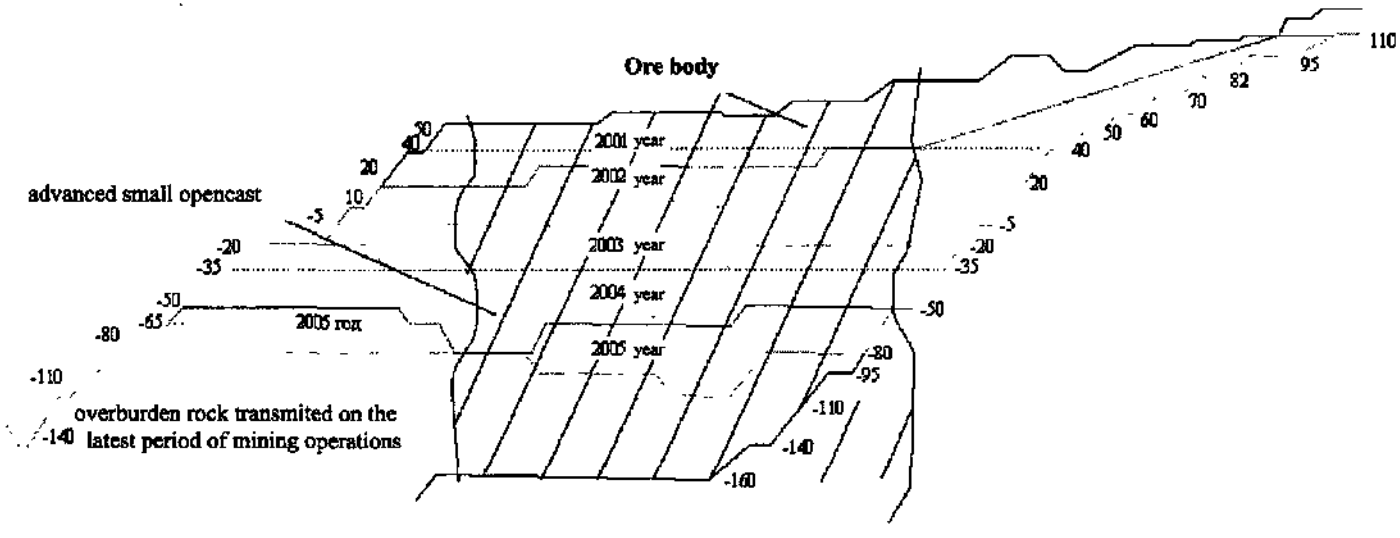

Figure 2. Fonning of advanced small opencast at mining of Sokolovslci opencast.