Dry raw material technogenic deposits formation and development technique

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Abstract
The fundamental requirements to dry raw materials technogenic deposit formation and mining technique can be found in the paper. On these principles basis, the raw materials technogenic deposit formation and mining technique, which provides its development system implementation at the stage formation, was developed. Suggested technique was evaluated and its economic efficiency was proved.
Key words: TECHNOGENIC DEPOSIT, CAVITY, EARTHMOVER, LOADER

Relevance

Ore mining industry, particularly opencut mining, is one of the main branches in Ukraine. However, reaching the significant scale of marketable products production, Ukraine simultaneously is one of the largest mineral wastes producers. Under current conditions of Ukraine competitive positions deterioration, the mining companies operating efficiency improvement by means of production prime cost reduction and yield increase due to full-field development emerges full blown in the mineral world market. This will allow both waste storage problem solving and increasing of marketable products volume.

For mining companies, all of this means reconsideration of not only production activity planning approach but thus also some production strategies.

Publications and investigation analysis

It is worth noting that the problem of full-field development should be considered in respect of three interrelated aspects: complex development of actually geogenic deposits, development of existing technogenic deposits and stable Formation of new technogenic deposits with preset parameters for their further development.

In the papers [1-4], the issues of technogenic deposits development are studied, the basic terms and concepts are determined, some of the existing technogenic deposits formation methods are given.

In the paper [5], the necessity of technogenic deposits stable formation was proved and its main functions are determined. On the basis of these functions as well as modern business activities conditions, the following requirements to

formation technique under development and mining technique have been composed:

1. Selecting storage, which is independent in space and time, and technogenic deposit mining in accordance with mining operations conditions in openpit and market conditions;
2. The minimum alienated area;
3. The minimum reexcavation volume;
4. The maximum route of technogenic deposits mining;
5. The minimum transportation distance.

Problem statement

On the basis of composed main requirements to technogenic deposit, its formation and mining technique meeting these requirements must be developed and also engineering and economical comparison of developed techniques with already existing ones must be conducted.

The material presentation

The technogenic deposits forming and mining method meeting composed requirements is suggested to be carried out by the following technique [6].

The horizontal surface is planned by using earthmover (1). On the obtained surface, the cavity system is put and horizontal workings supports are installed (2). The workings supports are covered by inclined layer (3) up to pilot banket obtaining through the use of earthmover (Fig. 1).

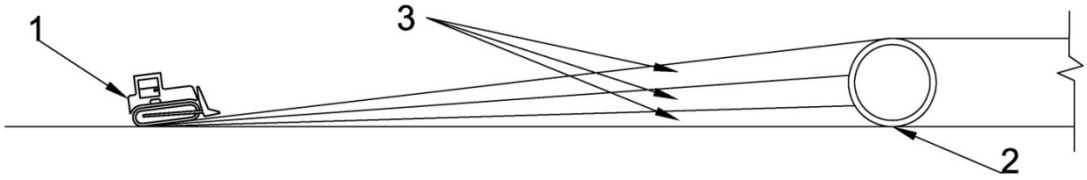

Figure 1. Horizontal workings covering pattern: 1. – earthmover; 2. - horizontal working support; 3. – the layers of stored rocks

At that, the vibration drop-holes (5) are installed in the points of horizontal and vertical workings (4) intersection (Fig. 2). Then the system of working vertical supports is installed upward to H and for the purpose of defects avoidance, the supports are embanked by mined rock lumps upward to h_v^{max}, which is equal to earthmoving blade maximum high. At that, the condition $H=1,2h_v^{max}$ must be observed. For this purpose, the dumptruck (6) is unloaded in proximity to vertical working support and the earthmover performs the concentric embanking around it (Fig. 2, 3).

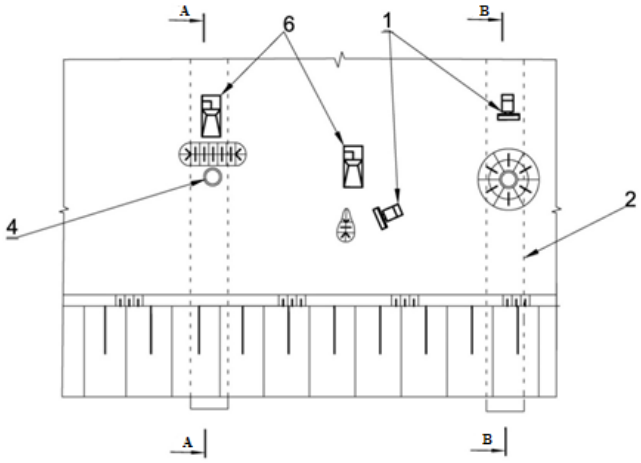

Figure 2. The plan of technogenic deposit formation area: 1. – earthmover; 2. - horizontal working support; 4 – vertical working support; 6. – dumptruck

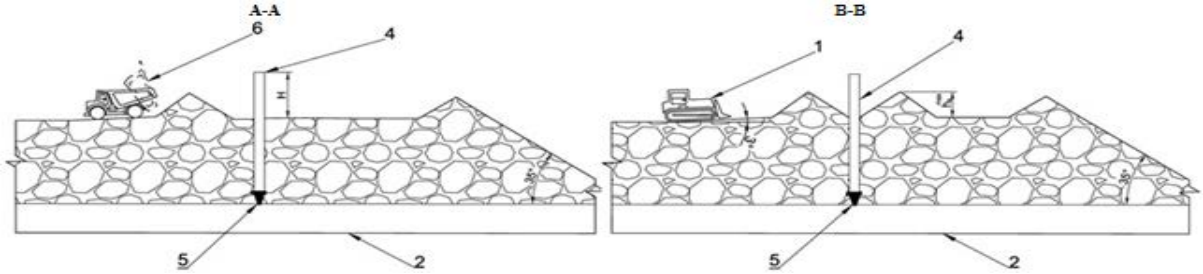

Figure 3. Layer high buildup with laying of vertical supports system pattern: 1. – earthmover; 2. - horizontal working support; 4 – vertical working support; 5. – vibration drop-hole; 6. – dumptruck

After vertical workings support embanking, the layer of technogenic deposit is built-up upward to h_v^{max}. For this purpose, dumptrucks are unloaded in specially designated areas while the earthmover is planning the surface. The distance between vertical workings must be such to provide the maximum operating efficiency of mining-and-hauling equipment and the minimum of capital mining operations. The layer high is determined by standard size of mining-and-hauling equipment, which will be used for when technogenic deposit mining, and also by stored rocks physical and mechanical properties. Horizontal working section is determined by support service vehicles standard size while vertical working one is determined by stored rocks granulometric properties.

After technogenic deposit having been formed, it takes the form according to Figures 4, 5.

It is suggested to perform the technogenic deposit development by using of the wheel loader basing on the following reasons:

- the loader use conduce to selecting rocks removal;
- the loader is characterized by higher maneuverability and requires less area than excavator with the same shovel size;
- the wheel loader is characterized by high draft forces, maneuverability and motion speed;
- considering that loader is mining-and-hauling equipment, its applying allows avoiding of the transportation facilities overload on the technogenic deposit surface.
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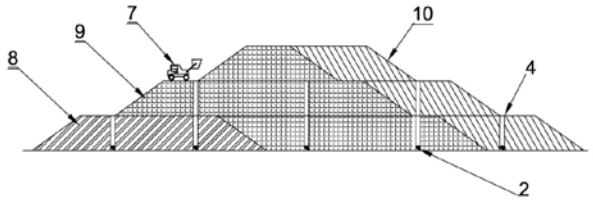

Figure 4. Technogenic deposit cut in the filled form: 4. – vertical workings; 7. - mining-and-hauling equipment; 8, 9, 10 - kinds of minerals

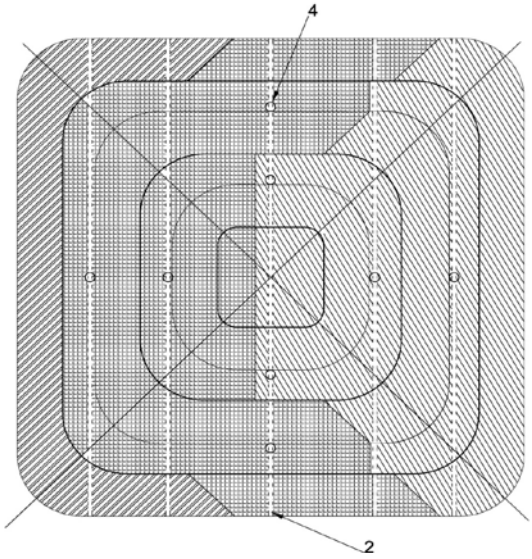

Figure 5. Technogenic deposit plan in the filled form: 2- horizontal workings; 4. – vertical workings.

The suggested technogenic deposit mining technique is carried out as follows.

The loader (7) cleans up mineral deposit of the form as required (8, 9, 10), transfer it to the vertical working mouth (4) and is being unloaded. The mineral moves freely to vibration drop-hole (5) under gravitation and then passes to support service vehicles, which move along the horizontal workings (2) and then deliver the mineral to the consumer.

In order to confirm the developed technique use reasonability, it has been compared with two another technogenic deposit development techniques according to criteria of minimum costs for technogenic deposit formation and mining.

The first technique provides the use of excavator-automobile complex without cavities system laying and consists in successive mineral removal from technogenic deposit by excavator, its load in transport vehicles and mineral delivering to consumer by this vehicle.

The second technique provides the use of excavator-automobile complex with cavities system laying. At that, the dumptrucks transfer the mineral to vertical workings mouth, from which it passes through the vertical workings and vibration drop-holes to the transport vehicles delivering the mineral to consumer.

The third technique is carried out according to suggested variant.

The required mining-and-transport equipment stock has been designed for relative technogenic deposit of 40 million m^3 capacity

according to three variants and summarized in the Table 1.

Table 1. Mining-and-transport equipment for technogenic deposit mining

Equipment	Variant 1	Variant 2	Variant 3
Excavator EKG-4,6	2	2	-
Dumptruck BelAZ -7555	5	4	-
Wheel loader	-		2
CAT-992G			

Then, capital and operating costs on the technogenic deposits formation and mining were calculated using the enlarged regressive statistical model. Since the technogenic deposits formation and mining provide different time cash flow, the variants comparing is performed considering their discounting. At that, formation and mining duration was 10 years, and the discount rate - 10%. The comparative calculations results are summarized in Table 2.

Table 2. The technogenic deposits formation and mining variants technical and economic comparison

Cost items	Variant 1	Variant 2	Variant 3
Capital, $	*27 859 670*	*30 959 944*	*25 390 675*
The cost for technogenic deposits filling	15 966 744	15 966 744	15 966 744
The cost for supports and vibration drop-holes	0	4 280 727	4 280 727
Excavators purchase	5 990 664	5 990 664	
Dumptrucks purchase	5 902 262	4 721 809	
Loaders purchase			5 143 204
Operating, $	*143 241 035*	*132 156 547*	*71 384 630*
Excavators	92 337 670	92 337 670	
Dumptrucks	50 903 365	39 818 877	
Loaders			71 384 630
Common costs, $	*171 100 705*	*163 116 491*	*96 775 305*
Commondiscounting costs, $	*62 494 633*	*61 333 799*	*34 525 698*
Specific cost, $m^3	*1.562*	*1.533*	*0.863*

Conclusions

The results of comparison shows that technogenic deposit formation and mining technique with horizontal and vertical cavities system laying and the wheel loader use is economically sound inasmuch as its use allows discounting costs reduction by 44%.

As can be seen from the above, the technogenic deposits stable formation should be carried out by technique of vertical and horizontal system development in its thickness in order to provide the access to the different minerals for their excavation and transfer.

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