AN ANALYSIS OF SURVEYOR CONTROL OF LOSSES OF BALANCE-INDUSTRIAL SUPPLIES IS AT MASTERING OF BOWELS OF THE EARTH

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Abstract

Executed calculations of supplies taking into account the balanced manner on maintenance quality indexes minerals of supplies, show that the losses of balance-industrial supplies and impoverishments of content of quality indexes of minerals far more than they are certain on the accepted methodologies and that is why careful attitude toward the well balanced on maintenance quality indexes minerals of supplies in iron-ore mass, their timely maintenance and bringing in exploitation are major measures in relation to the guard of bowels of the earth and environment.

Offered methodology of control of the use of found-balance and maintenance of balanced on maintenance quality indexes minerals of supplies, that is attracted in exploitation, calculations conduct that after formulas, that take into account the volume of useful components attract that with breeds and balance on maintenance the quality indexes of minerals of supplies, so losses of balance-industrial supplies of that or other part of found-balance supplies of deposit. If not to conduct the separate account of all sources of entering iron-ore mass of useful components, then throw away opportunity objective comparison of job performances for the improvement of the use of bowels of the earth of areas of arrays of hard minerals that are in different mining-and-geological terms.

The considered methods of the surveyor providing of works are on determination of volumes of crop and setting of norms of quality indexes of balance industrial supplies of bowels of the earth, in that examine the losses of balance-industrial supplies and impoverishments of content of quality indexes of minerals as the determined (non-random) sizes. The conducted review of methods and technical upshots will allow to bring down losses of

balance industrial supplies and impoverishments) of content of quality indexes of minerals at a booty, ware housing and necessity of variegation of content of quality indexes of minerals in the stream of iron-ore mass. It is well-proven that for the correct choice of optimal (normative) the level of losses of balance-industrial supplies and impoverishment of content of quality indexes of minerals in iron-ore mass in every concrete case of the use of criterion of estimation of economic efficiency, that full enough takes into account the difference of variants of development for operating and capital charges. The criteria of economic evaluation at setting of norms of losses of balance-industrial supplies are differential mountain rent and income, that is counted on 1 т balance supplies.

Introduction. Estimate rationality of process of mastering of mineral resources the indexes of plenitude of exception of them from the bowels of the earth and to the further processing. The complete losses of minerals consist on the average of losses: in the process of booty - 10-30 primary processing (enriching) to 20-40 metallurgical redistribution - 10-15. Especially severe losses at the primary processing of multicomponent mineral resources. Therefore, the number of «passing» components withdraws that from complex mineral raw material increases continuously. If in 1970 from the supplies of the colored and black metals withdrew 35 useful components, in 1990 their number attained 70, then in the beginning of the XXI of century - over 80. That is why a task of the complex mastering of bowels of the earth is *actual*.

Researches are based on materials of work of ore mining enterprises of Krivbass, that are in the central part of the Ukrainian shield that is the basic geostructural element of south-west of the east Europe platform. In the structure of the district, two structural floors participate: the crystalline foundation, made by metamorphism volcano upsetting and by granitioid formations of Pre-Cambrian and upsetting cover the cut of that is presented by the sedimentations of cainozoic. The structure of Kryvyi Rih belongs to one of the most interesting geological objects of Ukrainian of shield, that explains not only localization of bowels of the earth of unique supplies of iron-ore components but also original geological structure, history of geological development of region, that represents all basic stages of the formation.

The aim of the work is the development and introduction of methodology of determination of losses of balance-industrial

supplies and impoverishment of content of quality indexes of minerals taking into account the complex mastering of bowels of the earth.

For the achievement of the aim, such tasks are untied: The analysis of present methods of determination of losses of balance-industrial supplies and impoverishment of content of quality indexes of minerals; The improvement of existent methodologies of determination of losses of balance-industrial supplies and impoverishment of content of quality indexes of minerals taking into account the complex mastering of bowels of the earth; The establishment of norms of losses of balance-industrial supplies and impoverishment of content of quality indexes useful minerals.

The idea of work is analysis and determination of methods of calculation of optimal losses for development of economy of ore-mining enterprises and indexes of plenitude of the use of resources of bowels of the earth at present labor and material resources.

The research object is balance-industrial supplies of bowels of the earth.

The subject of research is losses of balance-industrial supplies and impoverishments of content of quality indexes of useful minerals.

Analysis of present methods of determination of losses of balance-industrial supplies and impoverishment of content of quality indexes useful minerals. Basic indexes of the use of supplies of bowels of the earth are losses of balance-industrial supplies and impoverishments of content of quality indexes of minerals in an array and in the stream of iron-ore mass [1]. In quality of indexes to them reciprocals – coefficient of exception of minerals from the bowels of the earth and coefficient of changeability of content of quality indexes of minerals are accepted at the booty of balance-industrial supplies. Methodology recommends also [2] the coefficient of obstruction of content of quality indexes of minerals. The first four indexes of the use of balance supplies are accepted officially by all ore-mining enterprises in accordance with [2] on determination, setting of norms and account, to the economic evaluation of losses of balance-industrial supplies of hard minerals at a booty, that is ratified [2]. Based on these, pointing corresponding branches and pool instructions were made: for the mines (quarries) of

ferrous metallurgy – one, for the mines (quarries) of standard – other, for enterprises of coal industry – third, to industry of building materials – fourth etc. These instructions are obligatory leading materials at planning, building and exploitation of all ore–mining enterprises. In this connection will bring only generals over on an account, estimation and setting of norms of losses of balance-industrial supplies and impoverishment of content of quality indexes of minerals in iron-ore mass with some working out in detail of the surveyor providing of works at working mine of hard minerals, in particular taking into account the complexity of the use of the bowels of the earth.

For correct determination of losses of balance-industrial supplies and impoverishment of content of quality indexes of minerals in iron-ore mass, the same as indexes of exception from the bowels of the earth and changeability of content of quality indexes of minerals of iron-ore mass, value has a choice of method of the surveyor providing of works, that most full answers that is why or to other type of minerals. The indexes of losses of balance-industrial supplies and impoverishment of content of quality indexes of minerals are needed for the decision of economic tasks in iron-ore mass must take into account not only content of quality indexes of minerals, lose that impoverishing breeds, but also where and on what stage of the survey or providing of project mountain works lose these minerals and impoverish.

Only classification of losses of balance-industrial supplies of hard minerals [3–5], built because of division on the technological processes of booty and places, where losses of balance-industrial supplies are. This classification is given for all methods of development and all hard minerals. Taking her for basis, will consider the types of the surveyor providing of works on determination of losses of balance-industrial supplies and impoverishment of content of quality indexes of minerals in relation to the terms of development of iron-ore deposits.

Under the losses of balance-industrial supplies mean that part of balance supplies that do not withdraw, and under impoverishment of content of quality indexes of minerals is a decline of content of quality indexes useful to the component in digging in comparing to his content in the array of balance supplies. Subdivide the losses of

balance-industrial supplies into the losses of balance-industrial supplies in guard that does not withdraw even after liquidation of ore-mining enterprise and if barrier temporal in some period of time envisage their partial or complete exception, then minerals in that does not attribute to the losses of balance-industrial supplies, but set off to the balance supplies) the operating losses of balance-industrial supplies(quantitative and quality), that is related directly to the booty of balance-industrial supplies, as they largely differ in technological reasons and places of their formation.

Taking classification for basis [5–8,11–13], the basic operating losses of balance-industrial supplies in relation to the terms of development of iron-ore deposits will present as a table 1. In relation to that or another way of development or to the certain mining and geological conditions, a number of varieties of losses of balance-industrial supplies will be it is or diminished, or megascopic. Depending on the type of losses of balance-industrial supplies and impoverishment to content of quality indexes of minerals in an array and in the stream of iron-ore mass choose the corresponding methods of the surveyor providing of works on their determination, and the detailed selection of types of losses of balance-industrial supplies and impoverishment of content of quality indexes of minerals in an array and in the stream of iron-ore mass allows in every separate case to choose more exact methods of the surveyor providing of their determination.

Determination of volume of losses of balance-industrial supplies and impoverishment of content of quality indexes of minerals in iron-ore mass matters for the decision ore-mining and economical and surveyor tasks. Foremost at a choice and comparison of methods and systems of development, determination of production capacity of mine (career), height of floor (to the ledge), estimation of balance-industrial supplies and establishment of standard on minerals, comparison of opening methods, determination of rational parameters of the systems of development and surveyor providing of technology of mountain works. Characterize the losses of balance-industrial supplies an amount and quality of part of minerals that abandon in the bowels of the earth, in comparing to liquidate balance-industrial supplies.

Table 1

Basic operating losses of balance-industrial supplies and impoverishments of content of quality indexes of minerals are in relation to the terms of development of iron-ore deposits of Kryvyi Rih

Group, sub-group, kind
Losses of balance-industrial supplies in an array: between areas (under blocks, interpanel, barrier, interchamber), in the sides of quarry; into the area, block, chamber, panel, post, quarry field of array of hard minerals; close the fire, flooded or heaped up areas, geological violations and mine-out space; in an array from incompleteness of exception: in a laying, hanging side, roof, sole, in parties of chambers; between the layers, in the attached areas; making that was brought down, fire, flooded areas heaped up; close inwardly contour breeds that remain, including; close array of establishment; as a result of complication of deposit, bed, ore body or area; on the bottom of quarry.
Losses of balance-industrial supplies of dissociated from an array: in mine-out space: on the sole of open chambers, from incompleteness of producing and loading, on the ledges of quarry; on on the bottom of block and on a laying side at the systems with bringing down of minerals; on the bottom of chambers(to the sole), laying side from mixing at producing with the heaped up breeds; in a book-mark; in the places of bringing down, in obstructions, in the fire, flooded and attached areas: in obstructions from bringing down of roof of chambers and sides of quarries; in mine-out space from destruction of bottom of block; in the heaped up block and shop, in days a quarry; in the attached areas; in cleansing and entry-driving coalfaces: from mixing with breeds at general and at the separate exception of minerals and breeds; in the places of unloading and overload: in the underground making; on superficial folds, in bunkers; in the places of sorting and previous concentration; in the dumps of breeds and balanced minerals, in the assorted breeds; on transport ways of mountain enterprise : in the underground making, in the middle of quarry; on a surface.
Impoverishment of content of quality indexes of minerals is on the stage of loosening the array: as a result of bringing in of breeds at the breakage: from the breeds of hanging and laying parties(to the roof, sole), on the contours of deposit, bed, ore body, layer; from the inwardly contour including there are the more set standards; from material(dry hydraulic book-mark that hardens and т. п.) of establishment, stale and heaped up breeds from the side of earlier exhaust blocks, chambers; from bringing in of breeds at separate breakage of minerals and in entry-driving coalfaces; as a result of abandonment of part of rich on maintenance quality indexes minerals : from the losses of balance-industrial supplies of more rich minerals(in ore layers in the bottom of blocks, sole, roof of chambers, at a laying side); from bringing down of breeds of hanging and laying parties and destruction of bottoms of blocks.
Impoverishment of content of quality indexes of minerals after loosening of array: in cleansing coalfaces from adulteration of removed or breeds that was brought down: from bringing down of breeds of hanging and laying parties, on the contours of deposit, bed, ore body, at producing from chambers; from penetration in useful fossil, that apply lateral breeds at producing from blocks; from bringing down of breeds of roof in open chambers at loading; from the losses of balance-industrial supplies: more rich part of removed useful minerals(in particular, to the ore change) on the sole of chambers, ledges, on a laying side, on the bottom of block, inwardly-contour including, not articles of exception; from bringing down of material (book-mark that hardens) of establishment or heaped up breeds from the side of earlier exhaust blocks; from mixing with breeds at a separate exception; in the places of overload, warehousing, previous concentration and sorting.

The coefficient of exception of balance-industrial supplies from the bowels of the earth characterizes an amount and quality of the obtained part of balance supplies. If balance-industrial supplies are lost on content of quality indexes of minerals does not differ from the balance-industrial supplies of block determine their volume directly in the process of the surveyor providing of realization of mountain works in a coalface, for example at the semilongwall of development of loss of balance-industrial supplies determine in parts units by a direct method after formulas

$$\Pi = \frac{\overline{\Pi}}{Б} \quad \text{or} \quad \Pi = \frac{\sum\limits_{1}^{к} \overline{\Pi}}{Б}, \qquad (1,2)$$

where is a $\overline{\Pi}$ volume (mass) of the lost balance-industrial supplies; $Б$ is a volume(mass) of the liquidated balance-industrial supplies; k is a number of types of losses of balance-industrial supplies of minerals.

If content of quality indexes of minerals, lose that, differs from quality of balance-industrial supplies in middle on a block, then the losses of balance-industrial supplies it follows to determine after a formula

$$\Pi = \frac{\overline{\Pi}c_{\Pi}}{Бc} \quad \text{or} \quad \Pi = \frac{\sum\limits_{1}^{к} \overline{\Pi}c_{\Pi}}{Бc}, \qquad (3,4)$$

where c_n and c is content of quality indexes of useful component accordingly in the lost balance-industrial supplies and balance-industrial supplies of array of hard minerals.

At the surveyor providing of mountain works at the systems of development with bringing down of array of hard minerals of loss of balance-industrial supplies determine an indirect method after next formulas

$$\Pi = 1 - \frac{Дa}{Бc} \quad \text{or} \quad \Pi = 1 - \frac{Дa(a-b)}{Б(c-b)}, \qquad (5,6)$$

where $Д$ is a booty of balance-industrial supplies of loosening iron-ore mass; a and b is content of quality indexes of metal accordingly

in the obtained iron-ore mass and impoverishing content quality indexes of useful component breeds.

Impoverishment of content of quality indexes useful minerals in iron-ore mass (changeability of content of quality indexes of minerals) characterize a decline in the process of booty of balance-industrial supplies of content in them quality indexes of useful components and increase of part of the finished mixing breeds in comparing to the same indexes in the balance supplies of array of hard minerals. In separate case at the surveyor providing of mountain works of development of iron-ore deposits of hard minerals, impoverishment of content of quality indexes of minerals in iron-ore mass determine attitude of mass of the finished mixing breeds toward the obtained iron-ore mass. Characterize the coefficient of changeability of content of quality indexes of the obtained balance-industrial supplies content of quality indexes in him (in comparing to the balance supplies of array of hard minerals) useful components or harmful admixtures, parts of the finished mixing breeds, by humidity, grade and other factors on that the degree of fitness of minerals depends for the further processing or use in a national economy. Impoverishment of content of quality indexes of minerals in iron-ore mass determine in parts of units a direct method after one of the over brought formulas.

$$P = \frac{B}{\text{Д}}; \quad P = \frac{\sum B}{\text{Д}}; \quad P = \frac{B}{A+B}, \qquad (7,8,9)$$

where B is a volume (mass) of the minerals of breeds finished mixing on maintenance quality indexes; and A is a volume (mass) of the obtained balance-industrial supplies (part of the liquidated balance supplies).

$$P = 1 - \frac{a}{c}; \quad P = 1 - \frac{a-b}{c-b}; \quad P = \frac{c-a}{c-b}. \qquad (10,11,12)$$

Both types the brought formulas over allow to estimate the use of balance-industrial supplies in two cases, when lose balance-industrial supplies with balance content of quality indexes of useful components, and at impoverishing on maintenance the quality indexes of obtained minerals breeds there are not useful components or there are useful components.

In two another cases, when lose balance-industrial supplies that on content of quality indexes differ from middle balance on maintenance the quality indexes of minerals and at impoverishing on maintenance the quality indexes of obtained minerals breeds there are not useful components or there are useful components. These formulas for the estimation of impoverishment of content of quality indexes of minerals in iron-ore mass not enough. For more clear surveyor providing of works on control of the use of found-balance and maintenance of balanced on maintenance quality indexes minerals of supplies, that will be in the near time attract in exploitation, calculations conduct after formulas, that take into account both mass of useful components attract that with breeds and balanced on maintenance the quality indexes of minerals of supplies (what attract sometimes in a booty technologically) and losses of balance-industrial supplies of that or other part of the found out supplies.

In third case, when lose the balance-industrial supplies of minerals, content of quality indexes of that differs from balance supplies on maintenance the quality indexes of minerals, but at impoverishing on maintenance quality indexes minerals breeds there are not useful components, determine the indexes of the use of balanced on maintenance quality indexes minerals of supplies after next formulas.

$$\Pi = \frac{Бc - Дa}{Бc_\Pi}; \quad P = \frac{Б(c - c_\Pi) - Д(a - c_\Pi)}{Дc}. \quad (13,14)$$

In most general, fourth case, when content of quality indexes of minerals in balance-industrial supplies, lose that, differs from middle content of quality indexes of minerals in the balance-industrial supplies of array of hard minerals and impoverishing on maintenance the quality indexes of minerals of breed contain useful components, formulas for determination of indexes of the use of balance-industrial supplies of bowels of the earth have such kind:

$$\Pi = \frac{Б(c - b) - Д(a - b)}{Б(c_\Pi - b)}; \quad P = \frac{Б(c - c_\Pi) - Д(a - c_\Pi)}{Д(c_\Pi - b)}. \quad (15,16)$$

Formulas are however above-mentioned suitable only for one component minerals without the account of possibilities of the

complex use of passing components of minerals. Today all less than one component minerals become and less than. In ferrous quartzite's except a basic component there is much copper, vanadium, zinc, lead and other useful components, part from them in composition wastes use as building material. Thus the cost of such macadam approximately equals prime prices of booty of iron-ore minerals. On some deposits, beds, ore bodies or areas of array of ferrous quartzite's content of quality indexes of titan, vanadium, cobalt, copper, zinc, sulphur, nickel, phosphorus, germanium and non-metallic minerals sometimes higher, what in the basic deposits of minerals of the coloured metals. The applied formulas are for determination of indexes «visible» losses of balance-industrial supplies and impoverishment of content of quality indexes of minerals in iron-ore mass concordantly [5,7,8] both adulterations in iron-ore mass of useful components of containing breeds and their additions or reductions take into account in her due to abandonment in the losses of balance-industrial supplies of impoverished or enriched on maintenance the quality indexes of minerals of part. However the end-point allows exactly to take into account and divide the sources of bringing in iron-ore mass on maintenance the quality indexes of useful components and source of losses of balance-industrial supplies and on maintenance quality indexes minerals of supplies, as a result visibility of prosperity is created sometimes even in case of impermissible severe losses of balance-industrial supplies. At content of valuable component in breeds that apply, (often it arrives at 0,3–0,5 middle content of quality indexes of minerals) such visibility of prosperity is possible even at 30 % losses of balance-industrial supplies.

For example. In the balance-industrial supplies of ferrous quartzite's is to 32 % cities of quality indexes of iron, and at applying and containing on maintenance quality indexes minerals breeds is a 16 %. Volume of losses of balance-industrial supplies even 30 balanced supplies, but due to producing on maintenance the quality indexes of minerals of breeds in the volume of to 30 of 100 e exception on mountain mass (that quite possible), then on a formula (5) at content quality indexes of iron in the obtained iron-ore mass 27,2 %.

$$P = \Pi = 1 - \frac{\textit{Да}}{\textit{Бс}} = 1 - \frac{100 \cdot 27,2}{100 \cdot 32} = 0,15$$

what testifies to safe position, but 30 balanced supplies it is lost beyond retrieve, similarly as thrown away opportunity the use in the future presently balanced on

maintenance quality indexes minerals of supplies and breeds with content of quality indexes of iron 16 And the supplies of these breeds in a pool are enormous.

If not to conduct the separate account of all sources of entering iron-ore mass from the balance-industrial supplies of useful components, then lose another possibility of objective comparison of work for the improvement of the use of bowels of the earth of areas of arrays of hard minerals that are in the different mining(at presence of in the breeds of useful components and without them, at possibility of abandonment in the losses of balance-industrial supplies of poor on maintenance quality indexes minerals and without them) and geological conditions. In an order to take into account this important circumstance, some other factors (even partly), for example multicomponent of minerals and possibility of determination of losses of balance-industrial supplies at the surveyor providing of booty and complexity of the use of mineral raw material, it is expedient to replace an index – content of quality indexes of useful components (metals) by next indexes:

- minerals, that withdraw the value of content of quality indexes in the balance supplies of $ц_б$;

- in supplies, that lose $ц_n$;

- at impoverishing on maintenance quality indexes minerals breeds of $ц_p$;

- by a value on maintenance quality indexes in digging, that withdraw $ц_д$.

Then for four losses of balance-industrial supplies and impoverishment considered earlier cases on maintenance the quality indexes of minerals of breed determine after next formulas:

а) when $ц_б{=}ц_n$ і $ц_p{=}0$

$$\Pi = 1 - \frac{Дц_Д}{Бц_б}; \quad P = 1 - \frac{ц_Д}{ц_б}; \qquad (17,18)$$

б) when $ц_б{=}ц_n$ і $ц_p{\neq}0$

$$\Pi = 1 - \frac{Д(ц_Д - ц_p)}{Б(ц_Б - ц_p)}; \quad P = 1 - \frac{ц_Б - ц_Д}{ц_Б - ц_p}; \qquad (19,20)$$

в) when $ц_б{\neq}ц_n$ і $ц_p{=}0$

$$\Pi = 1 - \frac{Дц_Д}{Бц_Д}; \quad P = \frac{Б(ц_Б - ц_n) - Д(ц_Д - ц_n)}{Б(ц_П - ц_Р)}; \qquad (21,22)$$

г) when $ц_б{\neq}ц_n$ і $ц_p{\neq}0$

$$П = \frac{Б(ц_Б - ц_n) - Д(ц_Д - ц_p)}{Д(ц_П - ц_p)} \; ; \; P = \frac{Б(ц_Б - ц_n) - Д(ц_Д - ц_p)}{Д(ц_n - ц_p)} \text{ (23,24)}$$

With these formulas study not only entering sources balance-industrial supplies of useful components (exception of rich part of balance-industrial supplies, addition useful components with impoverishing on maintenance the quality indexes of minerals breeds) but also entering sources iron-ore mass of harmful components.

Indexes of the use of bowels of the earth are with taking into account of sibilance on maintenance quality indexes minerals of supplies. Experience of development of iron-ore deposits testifies that in many cases she is carried out in a few stages. On the measure of working off the richest deposits, beds, ore bodies or areas of array of hard minerals in exploitation attract more poor on maintenance quality indexes minerals. In a number of cases with high efficiency already work off deposits, beds, ore bodies or areas of arrays of balance-industrial supplies that yet recently distinguished as sibilance. Maintenance and account presently of sibilance on maintenance quality indexes minerals of supplies matter Therefore, especially for creation of raw mineral-material base of country on the nearest years. If to take into account that content of quality indexes of the coloured and liquid metals in the obtained balance-industrial supplies annually goes down on 2,0-3,0 % of units, and content of quality indexes of iron is on 0,5-1,2 % then it is possible to assume, that breeds with content of quality indexes of the colored metals and iron according to a 0,25-0,32 % 0,52-0,65% city them quality indexes in balance-industrial supplies already in 5-10 % can be attracted in exploitation, because content of brack of quality indexes of useful components usually presents for the minerals of the coloured and liquid metals 0,42-0,53 % and for iron-ore - to a 0,63-0,84 % city them quality indexes in balance-industrial supplies. On many deposits the supplies of zabalance and poor on maintenance quality indexes minerals considerably exceed balance-industrial supplies both on a volume and on content of quality indexes useful minerals considerably exceed balance-industrial supplies both on a volume and on content of quality indexes of useful components.

On many deposits of hard minerals exploitation of poor and sibilance on maintenance quality indexes minerals of supplies is already conducted. In the Kryvyi Rih pool develop ferrous quartzite's in that on maintenance quality indexes iron presents 32-37 % id est 0,76-0,82 % and 0,61-0,73 % medium on maintenance the quality indexes of minerals in the balance-industrial supplies of rich on maintenance quality indexes minerals. Mark at the same time, that a guard and rational use of balanced on maintenance quality indexes minerals of supplies on enterprises carry out levels not on a due. Yes, from data [8,11–13], at development of rich on maintenance quality indexes minerals of supplies of Kryvyi Rih counterfeited and, thus, up to a point 2,6 milliards of т of ferrous quartzite's are lost for future development. On some ore mining enterprises the surveyor providing of mountain works is at development of balance-industrial supplies on mine enterprises carry out levels not on a due. To such attitude toward the balanced on maintenance quality indexes minerals of supplies the methods of their determination and account applied at this time promote in a great deal. In accordance with them the volumes of losses of balance-industrial supplies, impoverishment on maintenance the quality indexes of minerals and indexes of exception of balance-industrial supplies provide for to determine without an account on maintenance the quality indexes of minerals, lose that and volumes presently balanced on maintenance quality indexes minerals of supplies, that bring over to the booty. On the deposits of hard minerals where clear differentiations are between ore bodies and containing breeds that apply and does not contain the quality indexes of useful components, and also on deposits work off that the systems with a book-mark et al, fully sufficiently methods of the surveyor providing of works on an account, that provide for [5,14], however in most cases they do not allow to provide the complex and rational use balance-industrial and balanced on maintenance quality indexes minerals of supplies.

Zabalance on maintenance the quality indexes of minerals supplies enormous money is expended in secret service of that, unfortunately, while economically not estimated and, thus does not have a value. In the total in mining districts a giant loss the consequences of that it is while difficult to estimate is inflicted a future raw mineral-material base. Quite obviously, that the problem

of the complex mastering of bowels of the earth can not be decided on the basis of estimation and account of the use only of balance-industrial on maintenance quality indexes minerals of supplies, id est supplies of today, without a corresponding estimation and account presently of zabalance on maintenance quality indexes minerals of supplies, or supplies of future periods the especially nearest. Not to take into account them – so to conduct disorderly predatory exploitation of bowels of the earth, but especially their part - balanced on maintenance quality indexes minerals of supplies, that can as it is visible on the example of Kryvyi Rih considerably exceed balance supplies.

The decision of problem of the complex mastering of balance-industrial and balanced on maintenance quality indexes minerals of supplies requires substantial changeability of scientific bases of choice of basic parameters of mine (career), methods of opening of deposit, bed, ore body or areas of array of hard minerals and redemption of emptiness's, systems of development and first of all account, estimation, determination and setting of norms of losses of balance-industrial supplies at the surveyor providing of works at a booty. The same touches the applied methods of account and estimation of exception from the bowels of the earth of balance-industrial supplies and content of quality indexes of minerals, obtain that, including to both balance and balanced on maintenance the quality indexes of minerals supplies. If application of the systems, that answer more complete mastering of balance and balanced on maintenance quality indexes minerals of supplies and methods the redemption of emptiness's, related sometimes to some increase of charges (for the sake of the future considerable winning), then application of more exact methods of the surveyor providing of works on the account of losses of balance-industrial supplies, impoverishment on maintenance the quality indexes of minerals and indexes of exception of balance-industrial supplies provides a considerable economic effect without additional charges.

From position of the complex mastering of bowels of the earth, that apply at this time the methods of the surveyor providing of works on determination and account of indexes of losses of balance-industrial supplies, impoverishment on maintenance the quality indexes of minerals, rational exception from the bowels of the earth

of balance-industrial supplies and content of quality indexes of digging.

Accordingly [3] from the surveyor providing of works on the account of losses of balance-industrial supplies and impoverishment on maintenance the quality indexes of hard minerals, the «actual» losses of balance-industrial supplies and impoverishments determined only on maintenance the quality indexes of minerals, losses of balance-industrial supplies and impoverishments are on maintenance the quality indexes of minerals of balance supplies. The lack of these methods consists in that they do not take into account useful components in finished mixing to iron-ore mass of breeds, losses of balance-industrial supplies balanced after impoverishment on maintenance the quality indexes of minerals and corresponding to them indexes of exception from the bowels of the earth of balance-industrial supplies and changeability of content of quality indexes of minerals in the obtained balance-industrial supplies concordantly [3]. Use of indexes and formulas in [2,8] and branch instructions [5,7] take into account a multicomponent on maintenance the quality indexes of minerals of balance-industrial supplies on the basis of determination of their value, and also total content of useful components in the obtained balance-industrial supplies regardless of or there were they in balance-industrial supplies or introduced with impoverishing on maintenance the quality indexes of minerals breeds or balanced on maintenance the quality indexes of minerals supplies. At the same time, unlike the actual losses of balance-industrial supplies and impoverishment on maintenance the quality indexes of minerals, such indexes, as a coefficient of exception of balance-industrial supplies from the bowels of the earth, the coefficient of changeability on maintenance the quality indexes of minerals and «visible» losses of balance-industrial supplies and impoverishments on maintenance the quality indexes of minerals (concordantly [5]) quite not take into account neither a possible rejection on maintenance the quality indexes of minerals, lose that from middle on maintenance the quality indexes of minerals of balance-industrial supplies, nor part and impoverishing on maintenance quality indexes minerals of breeds (of content in them useful or harmful components.

None of formulas [8] and branch instructions [2,5] for determination of volumes of losses of balance-industrial supplies,

impoverishment on maintenance the quality indexes of minerals, coefficients of exception of balance-industrial supplies from the bowels of the earth and changeability of content of quality indexes of minerals does not take into account the possible bringing in exploitation with the impoverishing breeds of balanced on maintenance quality indexes minerals of supplies or them possible earning additionally, that eliminates normal exploitation of these balanced on maintenance quality indexes minerals of supplies in the future.

On ore-mining enterprises planning content of quality indexes of useful components in iron-ore mass is provided due to earning additionally presently substandard balanced on maintenance quality indexes minerals of supplies, that eliminates their normal exploitation in the future. Earning additionally of supplies of poor on maintenance quality indexes minerals is inflict a loss not only to the bowels of the earth, but potentially and to the environment, because instead of present it will be to master the new deposits of hard minerals and accordingly to distort the ecological balance in new districts. Therefore for more complete and complex use of bowels of the earth and improvement of conservancy it is necessary to take into account all subtleties of the use of balance-industrial and balanced on maintenance quality indexes minerals of supplies in close connection with conservancy.

That more exactly and clearly to control the use self of balance-industrial supplies, but not balance-industrial supplies together with balanced on maintenance the quality indexes of minerals of supplies and by the enriched useful components by breeds and simultaneously to provide an account and maintenance of balanced on maintenance quality indexes minerals of supplies, that can be in the near time also attracted in exploitation, it is necessary to use formulas [9,10], what is taken into account by receivables in iron-ore mass of useful components separately from balance-industrial supplies, containing breeds and balanced on maintenance quality indexes minerals of supplies, and also what quality indexes and how many useful components abandon in the lost iron-ore mass, but not in general in the bowels of the earth.

Taking into account of amount and quality of attracted in the booty of balanced on maintenance quality indexes minerals of

supplies, and also amount and content of quality indexes of attached here and broken, restored to a state, useless for further development in the future, balanced on maintenance quality indexes minerals of supplies. Balance of content of quality indexes of metals at the surveyor providing of works at development of balance-industrial supplies with the partial bringing in exploitation of him balanced on maintenance quality indexes minerals of supplies and adulteration it is hard to iron-ore mass of certain part of impoverishing on maintenance quality indexes minerals of breeds looks like

$$Дa = Бc + q_1 Бc_3 - ПБc + Bb,\qquad(25)$$

where $Д$, $Б$, $В$ is mass accordingly the liquidated balance-industrial supplies obtained, and finished mixing to loosen to iron-ore mass of impoverishing on maintenance quality indexes minerals of breeds, т; and, c, c_3 and b is content of quality indexes of metal or other useful component accordingly in the obtained iron-ore mass from the array of balance-industrial supplies, content of quality indexes of minerals in balance-industrial supplies, at balanced on maintenance quality indexes minerals supplies and impoverishing on maintenance quality indexes minerals breeds, q_1 is a fate of attracted in exploitation of balanced on maintenance quality indexes minerals of supplies (in relation to balance-industrial), part of units.

If mass of the lost balance-industrial supplies equals $П×Б$, then mass of finished mixing to loosen to iron-ore mass of impoverishing on maintenance quality indexes minerals of breeds can be certain after expression:

$$В = Д + ПБ - Б - q_1 Б.\qquad(26)$$

Putting of this expression in a formula (25), determine the losses of balance - industrial supplies (in parts of units) after a formula:

$$П = 1 + \frac{q_1(c_3 - b)}{c - b} - \frac{Д(a-b)}{Д(c-b)}\qquad(27)$$

and impoverishment of content of quality indexes of minerals in iron-ore mass after a formula:

$$P = \frac{Д(c-a)}{Д(c-b)} - \frac{Бq_1(c-c_3)}{Д(c-b)}.\qquad(28)$$

If balanced on maintenance the quality indexes of minerals supplies does not attract in exploitation, and only earn additionally and violate, id est when $q_1=0$, then formulas (27) and (28) look like:

$$\Pi = 1 - \frac{\text{Д}(a-b)}{\text{Б}(c-b)}; \quad P = \frac{c-a}{c-b}. \qquad (29,30)$$

Calculations in obedience to these the formulas show, if to examine the supplies o minerals taking into account the balanced on maintenance quality indexes minerals of supplies, then volumes of losses of balance-industrial supplies and impoverishment of content of quality indexes of minerals in iron-ore mass in reality far more than they are certain on the accepted methodologies.

For example. Will expect the volume of losses of balance-industrial supplies and impoverishment of content of quality indexes of minerals in iron-ore mass for the terms of the Kryvyi Rih pool, if $c=56$ $c_3=35$; $b=16$; $q=0,1$; $a=50$; Д=of 100 т; Б=of 100 т. On the usually applied formulas (5) and (10) the volumes of losses of balance-industrial supplies and impoverishment of content of quality indexes of minerals in iron-ore mass will present

$$\Pi = 1 - \frac{\text{Д}a}{\text{Б}c} = 1 - \frac{100 \cdot 50}{100 \cdot 56} = 0,11$$

$$P = 1 - \frac{a}{c} = 1 - \frac{50}{56} = 0,11$$

In reality according to formulas (27) and (28)

$$\Pi = 1 + \frac{0,1(35-16)}{56-16} - \frac{100(50-16)}{100(56-16)} = 0,2;$$

$$P = \frac{56-50}{56-16} - \frac{0,1 \cdot 100(56-35)}{100(56-16)} = 0,1$$

Therefore careful attitude toward the balanced on maintenance quality indexes minerals of supplies, their timely maintenance and bringing in exploitation are major measures in relation to the guard of bowels of the earth and accordingly all environments. Like a previous conclusion balances of mass and values to the case of the surveyor providing of works on the account of the partial bringing in exploitation and earning additionally of balanced on maintenance quality indexes minerals of supplies in relation to the terms of multicomponent minerals can be presented by the next system.

$$\begin{cases} \text{Д}\text{ц}_\text{д} = \text{Б}\text{ц}_\text{б} + q_1\text{Б}\text{ц}_\text{з} - \Pi\text{Б}\text{ц}_\text{б} + B\text{ц}_\text{р} \\ B = \text{Д} + \Pi\text{Б} - \text{Б}(1+q_1) \end{cases}, \qquad (31)$$

where $u_д$ and $u_б$ is a value of digging from the array of balance-industrial supplies and minerals in the array of balance-industrial supplies; $u_з$ and u_p is a value of mineral sat the balanced on maintenance quality indexes minerals of supplies and impoverishing on maintenance quality indexes minerals of breeds.

Untiing the system of equalizations relatively $П$, obsessed:

$$\Pi = 1 + \frac{q_1(u_з - u_p)}{u_Д - u_p} - \frac{Д(u_Д - u_p)}{Б(u_б - u_p)} ; \qquad (32)$$

$$P = \frac{B}{Д} = \frac{u_б - u_Д}{u_б - u_p} - \frac{Бq_1(u_б - u_p)}{Д(u_б - u_p)} . \qquad (33)$$

Expressions of indexes of losses of balance-industrial supplies and impoverishment of content of quality indexes of minerals in iron-ore mass (27) and (28) characterize only the state of the use of sibilance on maintenance quality indexes minerals of supplies basic to the component. They are the useless for description uses that sometimes attract in exploitation or the counterfeited balanced on maintenance quality indexes minerals of supplies that also beds together with other minerals, breeds of opening and driving of making, feigns etc. For the decision of task of the complex use and mastering of deposit, bed, ore body or areas of array of hard minerals, creation had rejected and unrejected technologies of booty of balance-industrial supplies and processing of content of quality indexes of minerals in iron-ore mass it is necessary to create the corresponding methods of the surveyor providing of works on determination of losses of balance-industrial supplies and processing of content of quality indexes of minerals in iron-ore mass.

Determination of volumes of losses of balance-industrial supplies and impoverishment is on maintenance the quality indexes of minerals taking into account the complex mastering of bowels of the earth. At development of complex deposit, bed, ore body or areas of array of hard minerals withdraw one useful fossil, and other often loses for further development. The value of passing minerals sometimes considerably exceeds the value of basic useful fossils and, naturally, loss from the losses of balance-industrial supplies large enough. However, at determination of volume of

losses of balance-industrial supplies and loss from them this variety of losses of balance-industrial supplies, similarly as volumes of losses of balance-industrial supplies balanced on maintenance the quality indexes of minerals supplies that operate in present tense methods quite not take into account. In quality of losses of balance-industrial supplies will consider privation of possibility of the useful use of mine-out space. So, for example, at the systems with bringing down and with a complete book-mark this possibility is practically eliminated, at the systems with cleansing open-space and with his partial book-mark there is large possibility of the use of greater volumes of mine-out space.

The complex mastering of bowels of the earth requires application of corresponding methods of determination and estimation of losses of balance-industrial supplies of minerals, that take into account the features of complexity and plenitude of the use of all supplies (balance and balanced) and useful all of the tools, and also all other possibilities of receipt of that or other effect from the booty of balance-industrial supplies of concomitant minerals(use of making, mine-out space, different sort of wastes, cultivation of earth surface and fertile earth, productive water sources etc.). From positions of the complex mastering of bowels of the earth and other natural resources a loss consists of losses of balance-industrial supplies: useful components in the contours of balance-industrial supplies; balanced on maintenance quality indexes minerals of supplies, that violate at development of balance-industrial supplies of basic useful fossils; passing minerals; mine-out space suitable for the useful using (for at additional charges on his equipping) with modern amenities; tails, wastes suitable for the use today or in the future; to fertility of earth busy mountain taking and his economy and from the decline of fertility of the surrounding mountain taking of earth; water resources (part of these losses, that will be on lost useful fossils); animal kingdom.

At the surveyor providing of works on the account of potential value of passing minerals that bed together with a basic useful component, mine-out space of breeds and wastes of mountain and ore mining and processing production balance of values on a deposit, bed, ore body or areas of array of hard minerals is presented like previous. At terms, when lose all passing minerals and does not use

other possibilities(mine-out space, opening breeds, wastes of booty of balance-industrial supplies and enriching of content of quality indexes of minerals, is in iron-ore mass), losses of balance-industrial supplies in two simplest cases, when $u_n=u_б$ and $u_p=0$, and also $u_n=u_б$ and $u_p≠0$, determine by formulas:

$$\Pi = 1 - \frac{Д_1 u_{Д1}}{Б u_{б1} + \sum\limits_{i=1}^{n} r_i Б_i u_{бi}} \; ; \; \Pi = 1 - \frac{Д_1 (u_{Д1} - u_{ДР1})}{Б(u_{б1} + \sum\limits_{i=1}^{n} r_i Б_i u_{бi} - u_{бp1})} , \quad (34,35)$$

where $Д_1$, $Б$ is mass of digging from the array of balance-industrial supplies and balance-industrial supplies in the bowels of the earth of basic useful fossil, т; $u_{д1}$ and $u_{б1}$ is a value of content of quality indexes of minerals in iron-ore mass of obtained useful fossils from the array of balance-industrial supplies and balance supplies of basic useful fossil, hrn./of т; r_i is a coefficient that shows, in the how many times greater or less balance-industrial supplies of i-a of useful fossil from the array of balance supplies of basic useful fossil; $Б_i$ is balance-industrial supplies of i-a of useful fossil, т; $u_{бi}$ is a value of content of quality indexes of minerals in iron-ore mass of i-a of useful fossil obtain that from the array of balance-industrial supplies to the hrn./of т; $u_{бp1}$ is a value of impoverishing on maintenance quality indexes minerals of breeds, obtain that, on basic useful fossil, hrn./of т.

Like there can be the decided tasks on determination of losses of balance-industrial supplies and impoverishment to content of quality indexes of minerals in iron-ore mass for another cases, id est when $u_n≠u_б$ and $u_p=0$, and also when $u_n≠u_б$ and $u_p≠0$ [9,10].

Thus, basic indexes of the use of supplies of bowels of the earth are losses of balance-industrial supplies and impoverishments of content of quality indexes of minerals in iron-ore mass and in relation to that or another way of development or to the certain mining and geological conditions, a number of varieties of losses of balance-industrial supplies can be it is or diminished, or megascopic.

1. Depending on the type of losses of balance-industrial supplies and impoverishment of content of quality indexes of minerals in iron-ore mass choose corresponding to them methods of the surveyor providing of works on their determination. The detailed selection of

types of losses of balance-industrial supplies and impoverishment of content of quality indexes of minerals in iron-ore mass allows in every separate case to choose the exact methods of their determination.

2. On the basis of the conducted analysis of present methods of determination of volumes of losses of balance-industrial supplies it is analyzed to content of quality indexes of minerals in relation to the terms of development of iron-ore deposits and it is set that the complex mastering of bowels of the earth, requires application of corresponding methods of determination and estimation of losses of balance-industrial supplies of minerals that take into account to the feature of complexity and plenitude of the use of all supplies balance and all minerals.

3. Methodology of control of the use of found-balance and maintenance of balanced on maintenance quality indexes minerals of supplies, that is attracted in exploitation, calculations it is necessary to conduct after formulas, that take into account both mass of useful components attract that with breeds and balanced on maintenance the quality indexes of minerals of supplies and losses of balance-industrial supplies of that or other part of found-balance supplies and if not to conduct the separate account of all sources of entering iron-ore mass from the balance-industrial supplies of useful components, then throw away opportunity objective comparison of work for the improvement of the use of bowels of the earth of areas of array of hard mineral, that be in different mining-and-geological conditions.

4. On the ore-mining enterprises, working off balance-industrial supplies execute with the groundless bringing in exploitation of part of balanced on maintenance quality indexes minerals of supplies, as a result violate their arrays and throw away opportunity the effective use in the future of basic part, or application of the system of development and the methods of redemption of mine-out space do not allow to return on old areas for the exception of balanced on maintenance quality indexes minerals of supplies.

5. Implementation calculations show, if to examine the supplies of minerals taking into account the balanced on maintenance quality indexes minerals of supplies, then the losses of balance-industrial supplies and impoverishments of content of quality indexes of

minerals far more than they are certain on the accepted methodologies in reality.

6. The complex mastering of bowels of the earth requires application of corresponding methods of the surveyor providing of works on determination and estimation of losses of balance-industrial supplies of minerals that take into account the features of complexity and plenitude of the use of all supplies and all minerals, and also all other possibilities of receipt of that or other effect from the booty of balance-industrial supplies of concomitant minerals.

7. Certainly, that for the correct choice of optimal (normative) level of losses of balance-industrial supplies and impoverishment of content of quality indexes of minerals in every concrete case use the criterion of estimation of economical efficiency, that takes into account the difference of variants of development on running and capital expenses. The criteria of economic evaluation at setting of norms of losses of balance-industrial supplies are differential mountain rent and income calculating on 1 т of balance supplies.

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