Findings. Set of objects for performing technological processes (operations) in the mine, which operational planning should be performed is systematized. A reasonable choice of technological regularities for the main objects of mining technology, which should be used in the operational planning methods of surface mining, is made. Requirements for the operational planning of surface mining operations, which follow from the recommended technological regularities, are formulated.

The originality. For the first time, the technological, which determine the approaches to the creation of system methodology and operational planning systems for the mining and geological conditions of specific mines for subsequent stages, principles of operational planning for surface mining are substantiated and formulated.

Practical implications of the obtained results is based on a justified choice of technological regularities in the mining technology main objects, which should be used in the methods of operational planning of surface mining operations, in justified requirements for the operational planning of surface mining and in the recommended approaches to the creation of operational planning systems for mining and geological conditions of specific mines.

Keywords: *surface mine, mining, operational planning, technological principles, system methodology, operational planning systems for surface mining*

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ДОСЛІДЖЕННЯ ТА ОБҐРУНТУВАННЯ ЕФЕКТИВНОСТІ ВІДПРАЦЮВАННЯ УСТУПУ ДРАГЛАЙНОМ З ОДНОГО ПОЛОЖЕННЯ З ПЕРЕМІЩЕННЯМ ҐРУНТУ НА КУТ ДО 220 ГРАДУСІВ ПРИ ВІДПРАЦЮВАННІ ПОЛОГИХ РОДОВИЩ

© O. Strilets, G. Pchelkin, D. Shmura, M. Mekshun

INVESTIGATION AND SUBSTANTIATION OF EFFICIENCY OF WORKING OUT OF A DRAFT WITH DRAGLINE FROM ONE POSITION WITH MOVING OF A GROUND TO AN ANGLE TO 220 DEGREES AT WORKING OUT OF SMOOTH DEPOSITS

Мета дослідження - Встановити залежність змінної продуктивності драглайна на швидкість просування та підготовки корисної копалини до виймання та обґрунтувати раціональні параметри схеми роботи драглайна під задані вимоги відпрацювання ділянки Західна-1.

Методика. Аналіз і узагальнення науково-технічної літератури і практичних даних, експериментальні дослідження роботи драглайнів на різних технологічних схемах, методи обробки результатів.

Результати. Визначено оптимальні параметри елементів системи розробки пологих родовищ вогнетривких глин із застосуванням драглайна ЕШ 10/70 (ЕШ 11/70) з одного робочого положення при підготовці пласта корисної копалини до виймання. Наведено результати експериментальних спостережень роботи ЕШ 10/70 на кар'єрі Західний-1 Андріївського родовища вогнетривких глин. Встановлено залежність площі підготовлених до виймання запасів від параметрів виробки.

Наукова новизна. Перевагою схеми є те, що робота екскаватора на розкриві і оконтурюванні проводиться з одного положення, економія часу на крокування з кінця заходки на початок по відвалам для виконання оконтурювання, зменшення коефіцієнту переекскавації, зниження питомих енерговитрат.

Практичне значення. Запропонована схема відпрацювання може бути застосована на пологих родовищах, з комбінованою системою розробки з застосуванням одного драглайна ЕШ 10 (11)/70 з описаними в статті параметрами забою, незважаючи на граничний і малоефективний кут переміщення породи екскаватором, що дозволяє виключити зайве переміщення екскаватора по заходці і знизити коефіцієнт переекскавації при збереженні темпів підготовки запасів до виїмки. Зменшення часу експлуатації виробки знижує ймовірності зсуву розкривних порід на пласт корисної копалини. Зниження змінної продуктивності драглайна по розкриву в зв'язку з додатковими операціями, пов'язаними з плануванням, переміщенням ґрунту на граничні кути не впливає на швидкість посування фронту гірничих робіт за рахунок зменшення коефіцієнта переекскавації і роботи екскаватора з одного положення. Більш рання підготовка запасів до виїмки.

Ключові слова: *переекскавація, призабійна смуга, безтранспортна система розробки, комбінована система розробки, відвал, коефіцієнт переекскавації*

Introduction. The deposits of refractory and refractory clay in Ukraine are usually represented by rocks of coal. The productive layer is represented by the clay of the Poltava suite (N1pl). The overlying rocks are composed mainly of soil-vegetation, loam, sandy loam and sand. Extremely rarely found pebbles, fractures of siliceous rocks and solid sandstones.

The article deals with the Andreevsky field of refractory and refractory clays in the Donetsk region. The capacity of the open field fluctuates in the range from 8 to 50 m, so the work is carried out in an open mining with internal dump formation. The most inexpensive and productive way to open up is the use of dragline as the main overlapping equipment.

Advanced lanes on the Andreevskoye deposit are worked out in a transport scheme with the transfer of loams, as potentially fertile soils for reclamation. The horizon of the work of draglines is represented mainly by sands. Due to the low power of overburden, the level of ground water, which during the operation of the field changed several times, affects their stability. Therefore, during the opening up and preparation of the reservoir of long-range mineral resources, there is a risk of excessive losses due to collapse and landslides both from the side of the internal dumps, and from the side to the prepared reservoirs. The collapse leads to the need for additional work to clean up landslides, which reduces the speed of the front and leads to increased costs. Therefore, it is necessary to conduct mining work in a timely manner after opening and outline.

For many years, the use of draglines in shallow fields, has proven a scheme of working out, with the location of the main excavator on the slope and auxiliary in the fore-drop for re-excavation of rocks and contouring the reservoir of minerals. Application of such a scheme allows to increase the width of the approach and the distance of soil movement in one pass, increase the speed of preparation of minerals to the slot and the speed of advance of the work front, and also excludes a long, simple solved excavation due to timely excavation.

However, the application of two draglines on one site, in turn, entails an increase in cost through increased maintenance and repair costs of equipment, payroll. Therefore, it is expedient to consider application in sections of one dragline with work in two positions, the first - on a sloping ledge with the formation of the lower tier of the dump, the second - on the pre-ditch with the formation of the upper tier of the dump.

Consequently it is necessary to choose the most optimal slaughter parameters to achieve the maximum distance of transshipment and the required speed of promotion of overlap in one dragline passage with the formation of the formation to the slot.

Organization the purpose of the article. In order to justify the rational parameters of the dragline's scheme of work for the given requirements for the development of the Western-1 site, it is necessary to determine the main performance indicators for the applied scheme and to determine the parameters of the new scheme of work from one position, as well as to establish the dependence of the equipment productivity variable on the speed of promotion and preparation of the minerals to the excavation.

Presenting main material. According to the project of development of the fields, working out of third overlapping ledges of the West-1 site is dragline EK 10/70 for the complicated transportless system with the installation of dragline on the opening ledge in the first position and in the pre-dive - in the second position (fig. 1). Width of the walk - 40 m, the height of the ledge varies from 16 to 20 m and an average of 17 m. The coefficient of overexpression with these parameters varies within 0.9 -1.

The principle of such a technological scheme is as follows:

- The end face slicing from the side of the whole and opened the formation for the entire length, with the placement of rocks in the first tier of the dump. Part of the reservoir remains below the bottom of the dump through the formation of a shallow natural slope of the loose rock.

- Return of the excavator from the end of the take-off to the top of the boat section with the route planning.

- The re-excavation of soil from the first to the second tier of the dump, the contouring of the formation (the frill of the edge of the formation) for the entire length of the tread.

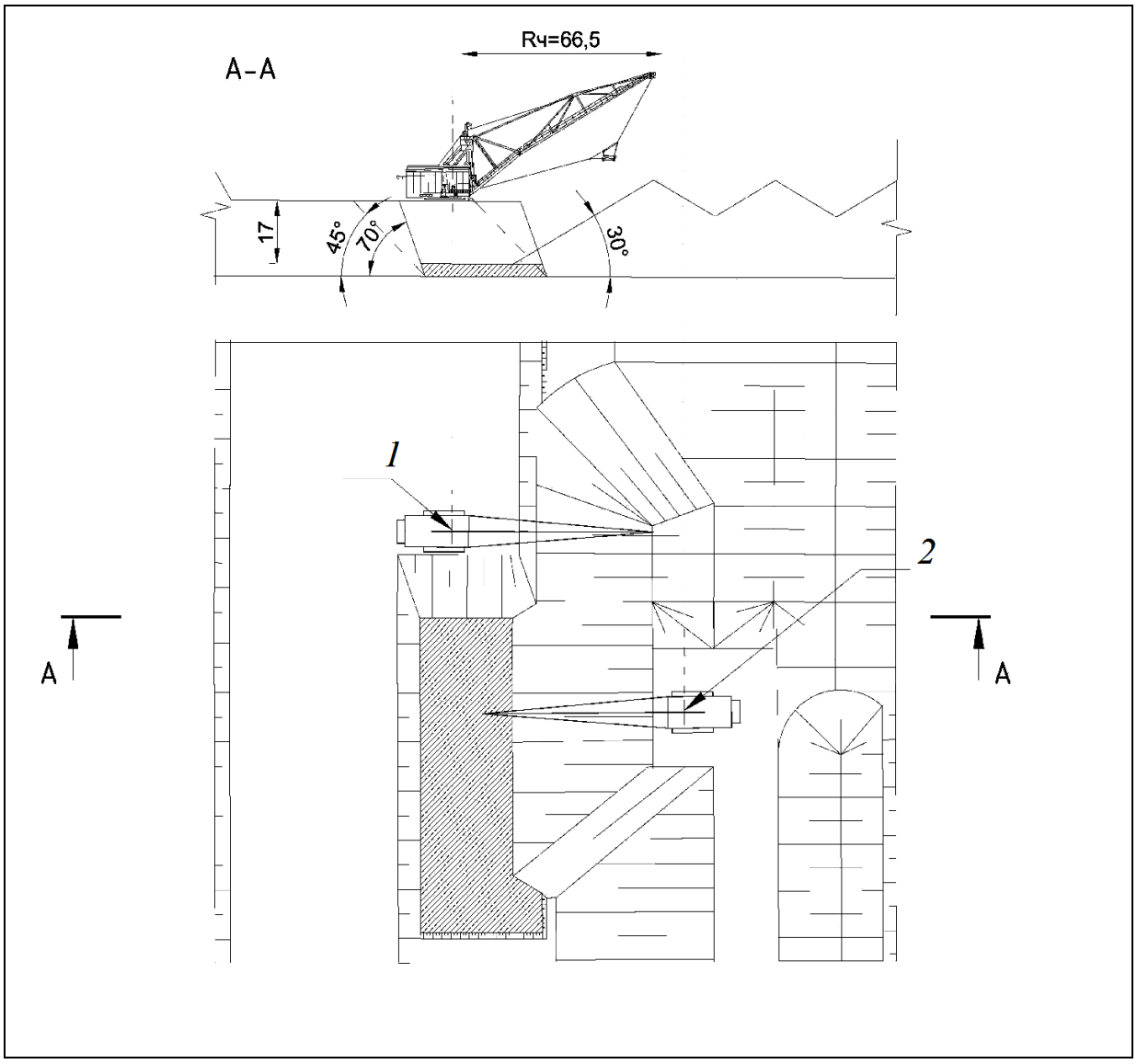

Fig. 1. Classical scheme of the complicated without transport scheme in two provisions of the dragline

- Return to the beginning of the cuddles and cuts from the side of the whole.

Thus, it follows from the foregoing that the opening consists of 4 cycles, 2 of which can be eliminated, using a second excavator on a parallel axis to the first on re-excavation and contouring.

Given the need to use one dragline, it is necessary to solve the problem of working from one position without moving the excavator to perform the contouring. Therefore, the scheme of working out of the openings, which is to increase the width of the working platform, by pushing the slope of the loose rock, in the premise to the whole at the level of the existing working platform is proposed (fig. 2). The operating axle of the excavator, however, is located on this stroke and does not change during the entire drive.

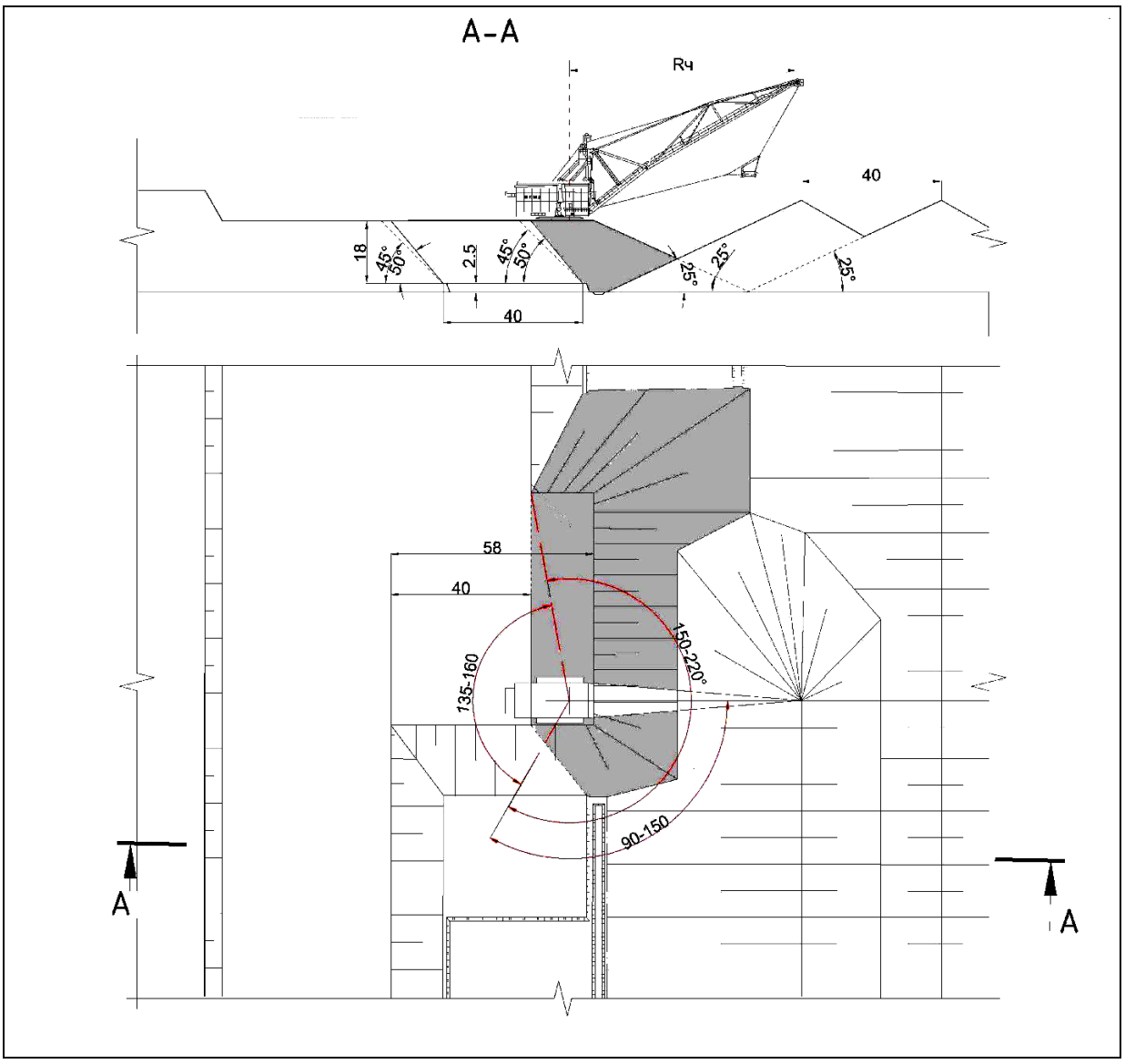

Fig. 2. Complicated transportless scheme with placement of the pipeline at the level of the work platform

Under this scheme work is carried out in the following order:

Arrangement of the route and the work platform by moving the rock mass from the end slaughter of the whole to the produced space, into the harbor to the whole, at an angle of rotation of the arrow 150-220 degrees;

Planning of the route at the level of the work platform (here in after referred to as the "pond band");

Clamping on the ditch strip and installing the excavator in the working position;

Execution of overlapping works from one position with the placement of the rock mass into the inner bulkhead and the dipping band in accordance with the subsequent planning of the stepping path.

When cutting into the beginning of the next step and the initial formation of the belt with the specified parameters, the excavator is installed on the whole and the work is repeated until the formation of the substrate with the given parameters.

Taking into account the linear characteristics of EC 10/70 and the given parameters of development, we will calculate the parameters of the slaughter of this scheme.

$$X = B\_v + H * ctg\ \gamma + h * ctg\alpha + a + Ho * ctg\beta\text{-}R, m$$

where:

X - the width of the strip of pill, m;

Bв - safe distance of installation of the base of the excavator from the eyebrow of the subsurface, m;

H - thickness of overburden, m;

α - slope angle of the slope;

β - angle of the slope of the dump;

But - the height of the dump, m;

h - the thickness of the reservoir of minerals;

R - excavation radius, m.

At the maximum design height of the draft drainage 20 m, the width of the drainage will be 18 m. Thus, the width of the slaughter is 58 m. When openings are 40 m wide with the data of the parameters of the work platform, the layer of minerals is disclosed in full, in one passage and with the provision of the zapping band width 5 m, which allows you to outline the clay by sinking the trench at the edge of the lower edge of the dump and formation.

Given that the scheme involves the transfer of soil redevelopment at an angle ≥180 ° in the volume of 30-60%, the variable productivity will be significantly reduced.

Under the existing scheme, the variable dragline productivity is 4400 m3 per shift.

As a result of the timekeeping observations, measurements of the cycle times of the excavator were performed, depending on the angle of rotation of the arrow (fig. 3)

Thus, measurements have shown that the cycle time increases by 27% when turning the arrow at an angle> 150 °.

Also an additional cycle of operation to seal the road stepping loosened soil, which occupies about 10% of the time full cycle of sinking slaughter.

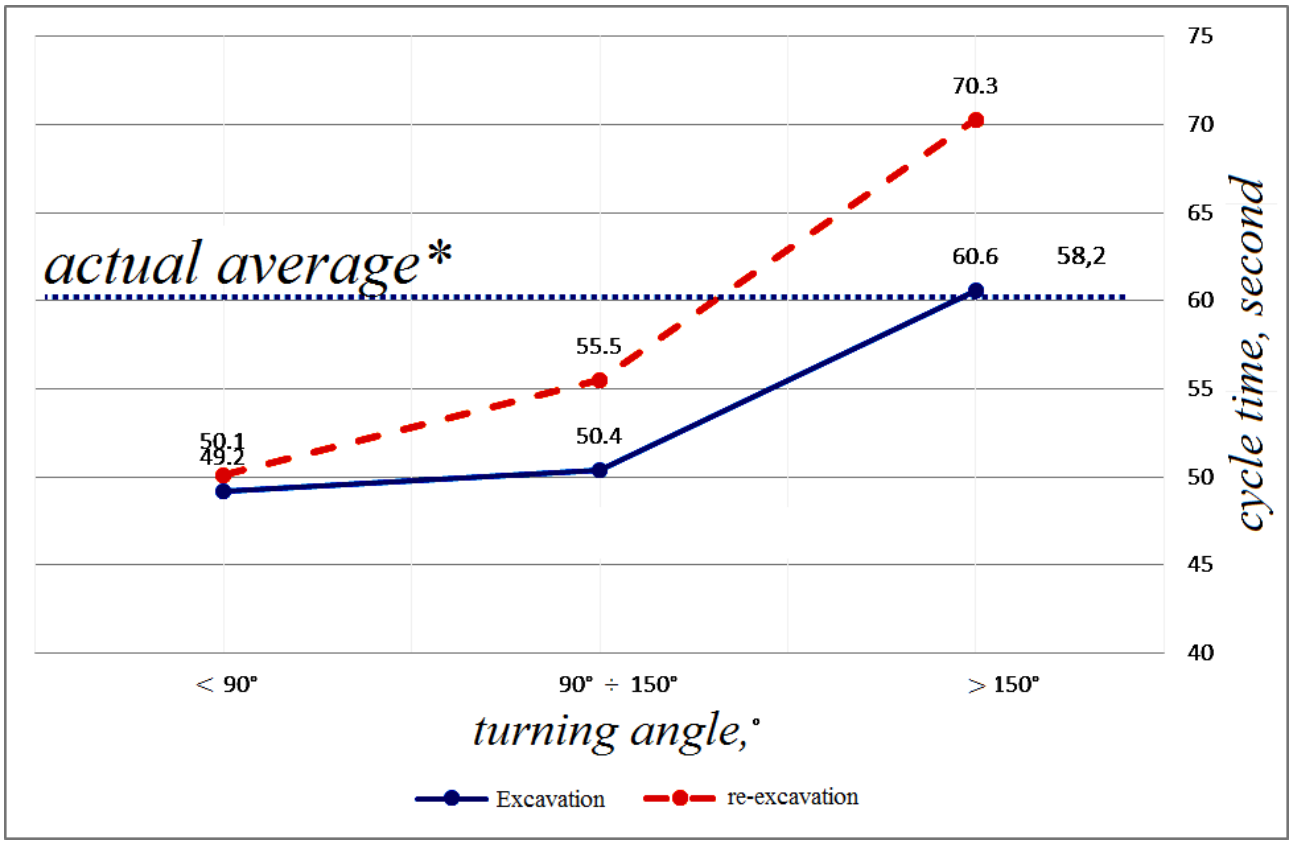

Fig. 3. Dependence of the cycle time of the excavator on the angle of rotation of the arrow

* The actual average takes into account the specific weight of work in 3 months on each group of angles of rotation of the arrow 26.9%; 45.1%; 28.0%, respectively.

Specific weight of the angles of rotation of the dragline arrow during unloading of the soil, during the time of the passage of one block:

- 90 ° -150 ° - 65-70%
- 150 ° -220 ° - 30-35%

Movement of soil to the marginal angles up to 220 ° is carried out only when performing overexposing, namely, when forming the route in the strip of spillage. The estimated conversion factor for this scheme will be:

$$Кп = \frac{Sп}{Н \times A \times Kp}$$

where:

PP-cross section of the prism of the re-encapsulation, m2;

A - width of the walk, m;

Kr - coefficient of loosening 1,2.

$$Sп = X * (H - h) + 0.5 * (H - h)^2 * (ctg\beta - ctg\,\gamma) - 0.25 * [X + (H - h) * (ctg\beta - ctg\,\gamma) - a]^2 * tg\beta$$

where:

X - the width of the strip of pill, m;

γ - the angle of the slope of the board on the minerals.

Estimated performance at the same time will be 3150 m^3 per shift.

Having received a coefficient of re-encapsulation in the range of 0.3-0.5, depending on the angles of the slope, we can conclude that as a result of the transition to this scheme, the conversion factor decreases by 30-50%. Also, given the absence of the need for the excavator to run at the beginning of the drive to perform the outline, these two factors compensate for the decrease of the productivity variable.

The rate of slaughter on the minerals will amount to:

$$P = \frac{Q_{vskr}}{(A+X)*(H+h)}, \text{ m/shift}$$

where:

Q_{vskr} - variable dragline performance.

Thus we get - the displacement will be 2.78 m / s or 160 m per month.

Given the actual movement of the front of the classical scheme with the placement of dragline on the downhill slopes, which is 140 m per month, one can conclude that the decrease in the productivity variable does not reduce the speed of laying and preparation of the formation to the slot.

The alternating cycle during the formation of the route with the movement of soil at an angle of 150° - 220° can be reduced by changing the direction of turn of the arrow, with the angle of 135° - 160°. However, moving the soil to form the trail will take place over an electric cable.

According to clause 5.13 of the NPABO 0.00-1.54-93 it is prohibited to load the mining mass with the excavator "through the cable". In production necessity, the management of a career may be allowed to load "through the cable" for a period of no more than 24 days provided reliable protection of the cable in the area of operation of the excavator. Therefore, when organizing work through a cable to reduce the angle of movement of soil on the track, and due to a decrease in cycle time, it is necessary to provide additional measures aimed at protecting the cable and preventing damage to it. Works should be done during the day.

When performing work under this scheme, you must fulfill the basic requirements:

- Adhere to the development parameters;

- What changes to maintain the parameters of the stripline - the estimated width, length, to carry out the planning of the route to move the excavator by piping.

The given calculations and schemes allow to reduce expenses on the river. work in connection with the reduction of the volume of remediation works.

The main stages of technical remediation usually include: rough and final surface planning; surface coating with potentially fertile and (or) fertile soil layers; or-

ganization of erosion and prophylactic territory; the final planning of the land must be carried out using machines with low specific pressure on the soil to reduce the additional sealing of the layer that is being recuperated; drying of a compact soil level to create favorable conditions for plant roots; defining the area where technical remediation was carried out.

The biological stage takes place after the completion of the technical stage. At the biological stage, the requirements for land reclamation depending on their use (arable land, other agricultural land, forests, etc.) should be taken into account,

Land reclamation can be achieved in several different ways. The easiest way is to fill the area with a large amount of fertile soil. Streams of flooded wetlands are often used to restore land for agricultural use.

Conclusions. Scheme of workout confirms the following hypotheses:

- The calculated coefficient of re-export is 0,3-0,5 and depends on the angle of the slope of the working board and the angle of slope on loose soils.

- The advantage of the scheme is: the work of the excavator on opening and outline from one position, saving time on the step from the end of the step to the top of the cavity to perform the contouring, reducing the conversion factor, reducing the specific energy consumption (kWh / t).

- Reduced working life of the excavation, reducing the likelihood of displacement on the layer of minerals. Earlier preparation of stocks for dumping.

- Reduction of the productivity variable by opening the EC due to additional operations related to planning, moving the soil to the margins.

- Reducing the productivity variable is compensated and does not affect the speed of moving the mining front by reducing the conversion factor and work from one position.

In the case of non-compliance with the parameters, increasing the width of the feeder strip - the overlap factor increases, the speed of movement decreases, there is a need to move the excavator to the slaughter to achieve linear digging parameters.

It is recommended that the soil be moved from the hull, to a greater extent, in the ditch to an angle of 150 degrees, and the lane of the piling move as you move to the future track.

Thus it can be argued that the proposed treatment scheme can be applied on shallow fields with a combined development system using one dragline EC 10 (11)/70 with the parameters of the slaughter described in the article, despite the marginal and ineffective angle of rock displacement, which allows to exclude excessive movement of the excavator on arrival and to reduce the coefficient of re-export while maintaining the rate of stock preparation to the dumping.

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АННОТАЦИЯ

Цель исследования - установить зависимость изменения производительности драглайна на скорость продвижения и подготовке полезного ископаемого к выемке а также обосновать рациональные параметры схемы работы драглайна под заданные требования отработки участка Западный - 1.

Методика. Анализ и обобщение научно-технической литературы и практических данных, экспериментальные исследования работы драглайнов на различных технологических схемах, методы обработки результатов.

Результаты. Определены оптимальные параметры элементов системы разработки пологих месторождений огнеупорных глин с применением драглайна ЭШ 10/70 (ЭШ 11/70) с одного рабочего положения при подготовке пласта полезного ископаемого к выемке. Приведены результаты экспериментальных наблюдений работы ЭШ 10/70 на карьере Западный-1 Андреевского месторождения огнеупорных глин. Установлена зависимость площади подготовленных к выемке запасов от параметров выработки.

Научная новизна. Преимуществом схемы является то, что работа экскаватора на вскрытии и оконтуривании проводится из одного положения, экономия времени на возвращение с конца заходки на начало по отвалам для выполнения оконтуривания, уменьшение коэффициента переекскавации, снижение удельных энергозатрат.

Практическое значение. Предложенная схема отработки может быть применена на пологих месторождениях, с комбинированной системой разработки с применением одного драглайна ЭШ 10 (11)/70 с описанными в статье параметрами забоя, несмотря на предельный и малоэффективый угол перемещения породы экскаватором позволяет исключить лишнее перемещение экскаватора по заходке и снизить коэффициент переекскавации при сохранении темпов подготовки запасов к выемке. Уменьшение времени эксплуатации выработки снижает вероятности смещения вскрышных пород на пласт полезного ископаемого. Снижение сменной производительности драглайна по вскрыши в связи с дополнительными операциями, связанными с планированием, перемещением грунта на предельные углы не влияет на скорость подвижки фронта горных работ за счет уменьшения коэффициента переекскавации и работы экскаватора с одного положения. Более ранняя подготовка запасов к выемке.

Ключевые слова: *переекскавация, призабойная полоса, бестранспортная система разработки, комбинированная система разработки, отвал, коэффициент переекскавации*

ABSTRACT

Purpose. To establish the dependence of the dragline's productivity variable on the speed of the advance and preparation of the minerals to be extracted and to justify the rational parameters of the dragline's scheme of work in accordance with the requirements for the development of the Western-1 site.

The methodology. Analysis and synthesis of scientific and technical literature and practical data, experimental research of the work of draglines on various technological schemes, methods of processing results.

Findings. The optimum parameters of elements of the system of development of flat deposits of refractory clay with the use of dragline ESH 10/70 (ESH 11/70) from one working position in the preparation of a reservoir of minerals for extraction have been determined. The results of experimental observations of the work of ES 10/70 on the career of West-1 Andreevsky deposit of fire extinguishers and the production of natural clay are given. The dependence of the area prepared for the removal of stocks from the parameter is established.

The originality. The advantage of the scheme is that the work of the excavator on the opening and outline is carried out from one position, saving time to step from the end of the drive to the top of the cavity to perform the contouring, reducing the coefficient of re-exclusion, reducing specific energy consumption.

Practical implications. The proposed scheme of working out can be applied on shallow fields, with a combined system of development using one dragline ESH 10 (11)/70 with the parameters described in the article of slaughter, despite the marginal and ineffective angle of rock placement by the excavator, which eliminates the excessive movement of the excavator on the start and reduce the coefficient of re-extraction while maintaining the pace of stock preparation to the slot. At the reducing operating time of the work reduces the probability of the displacement of overburden on the layer of minerals. Reducing the dragline's performance through the opening due to additional operations associated with the planning, moving the soil to the margins does not affect the speed of moving the mining front due to reducing the coefficient of re-excavation and the work of the dragline from one position. Earlier preparation of stocks for dumping.

Keywords: *redevelopment, the lane, transport system for development, combined system of development, dump, coefficient of re-extraction*