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FORMATION OF PRODUCTION PARAMETERS AND FACTORS IN THE MODEL OF TRANSPORT AND PRODUCTION SYSTEM OF TECHNOLOGICAL WASTE PROCESSING OF METALLURGICAL ENTERPRISE

The mathematical description of the mathematical description of the transport and production system of processing *of technological waste of the metallurgical enterprise is presented. The generalizing model of interaction of transport and production system of processing of technological waste of the metallurgical enterprise with environment is resulted. The main inputs and outputs of the system are selected and described. Recommendations for the practical use of the performed research are given.*
Keywords: *transport and* production *system; technological waste; transport process; rolling stock; traffic volumes; production and technological tasks.*

Представлено математичний опис математичний опис транспортно-виробничої системи переробки технологічних відходів металургійного підприємства. Наведено узагальнюючу модель взаємодії транспортно-виробничої системи переробки технологічних відходів металургійного підприємства з навколишнім середовищем. Виділені та описані основні входи та виходи системи. Надано рекомендації щодо практичного використання виконаних досліджень.
Ключові слова: *транспортно-виробнича система; технологічні відходи; транспортний процес; рухомий склад; обсяги перевезень; виробничо-технологічні завдання.*

Problem's Formulation

To date, the processes of processing technological waste have become widespread in the transport and production systems of domestic metallurgical enterprises. First of all, this is due to the fact that the processing and disposal of technological waste allows to solve one of the most important environmental problems — cleaning areas from heavy waste, which are slags of metallurgical production. Slag dumps serve as sources of dust formation, pollute groundwater and surface sources with heavy metals, occupying large areas of land. The plants are interested in organizing the process of slag processing not only for environmental but also for economic reasons. According to research, the metal content in the slag reaches 15%. Extraction of metal components from slag and their use for the production of steels and alloys can significantly increase the economic performance of metallurgical production. [1—3]

Therefore, in today's conditions, the issues of improving the efficiency of road transport are quite relevant.

Studies of improving the efficiency of production transport and technological systems are reflected in the works of M.I. Luchko [4—7], V.E. Parykiana, M.V. Pomazkova [8—11], O.M. Vueykova [12,13], A.Yu. Zakharova, A.Yu. Voronova [14,15]. The authors often used logical and systematic approaches to the use of methods of system analysis and optimization of transport systems. But their proposed methods do not take into account the peculiarities of the transport and technological process of waste processing of metallurgical enterprises and the need for a deeper level of detail of the studied processes.

Formulation of the study purpose

Formalization of production parameters and factors of the transport and production system of technological waste processing of a metallurgical enterprise

Presenting main material

The system of recycling of technological waste of steel production (SRTVSV) involves five production units of the metallurgical enterprise, namely: open-hearth shop (OhS), slag processing shop (SPS), road transport management (RTM), railway transport management (RTM), dill shop (DS). During the SRTVSV process, each of the above-mentioned structural subdivisions performs the functions assigned to it, the quality and timely implementation of which ensures the processing of technological waste with minimal resource costs.

In SRTVSV, the transport and technological process of technological waste processing is performed directly by the open-hearth slag processing section (OhSPC), which is subordinated to the slag processing shop (SPS). STMS includes transport freight flows, communications, technical means that ensure the process of processing technological waste and are aimed at implementing the plan in accordance with the technology and production needs with minimal costs.

Among the functions of the DPMS should be noted the following:

- organization and provision of reception, unloading and processing of technological waste of current production;
- determination of the required number of orders (requirements) to the PJSC for transportation of technological waste, ensuring the rational use of vehicles in time and capacity;
- organization of shipment, storage of products of processing of technological waste of current production;
- providing the necessary information on the progress of the transport and technological process of all participants of SRTV.
- organization of shipment, storage of products of processing of technological waste of current production;
- ensuring the course of the technological process, technical operation and specified modes of operation of equipment, repair schedules in strict accordance with the technological instructions, maps of labor organization.

The open-hearth slag processing site can be considered as a subsystem as a part of the technological waste recycling system which [1]:

- consists of interdependent parts (sections, services, etc., technical and vehicle), the activities of which affect the final result of production;
- interacts with the external environment, from which the system receives the necessary factors of production for production activities (inputs) and in which the results of production (outputs) are realized and used — products, works, services;
- carries out activities aimed at meeting the needs of production (external environment of the system);

The state of operation of the system can be described as follows. Let the whole set of participants in the process of processing technological waste (M_{pp}) at a given time consists of subsets: loading and recycling complexes (A), fleet of rolling stock (B), fleet of loading mechanisms (C), recipients of products of processing of technological waste (D), that is

$$M_{nn} \subset (A \cup B \cup C \cup D \cup F)$$

The set (A) consists of subsets that include the number of dead ends (a_1), the number of loading platforms (a_2), the number of dumps of technological waste (a_3), number of storage warehouses (a_4), crushing and sorting equipment (a_5).

$$A \subset [\{A_{a1}\} \cup \{A_{a2}\} \cup \{A_{a3}\} \cup \{A_{a4}\} \cup \{A_{a5}\}]$$

Factor (B) includes a subset that determines the type and quantity of rolling stock of automobile (b_1), railway (b_2) involved in the process of transportation of technological waste.

$$B \subset [\{B_{b1}\} \cup \{B_{b2}\}]$$

Factor (C) consists of subsets that correspond to the type and number of fleet of excavators (C_{c1}) and forklifts (C_{c2}), involved in the operation of the research system

$$C \subset [\{C_{c1}\} \cup \{C_{c2}\}]$$

To factor (D) includes subsets corresponding to the number of recipient shops (d_1), types of products of technological waste processing (d_2).

$$D \subset [\{D_{d1}\} \cup \{D_{d2}\}]$$

The degree of complexity of the set that characterizes the fuel assemblies will vary with time, ie each value of t_{mc} will correspond to a certain value of the set (M_{nn})

$$(M_{nn});\ M(t_{mc})$$

Based on this, the state of the transport and production system in any period of time is determined by the dependence

$$Z(t_{mc})\ ;\ M(t_{mc})$$

and in a specific period of time $Z_{mc}[Z \in z(t)]$ transport and production system may be with varying degrees of probability.

The transport and production system of processing technological waste of a metallurgical enterprise in a formalized form can be represented by a generalized model shown in Fig. 1 [16,17]

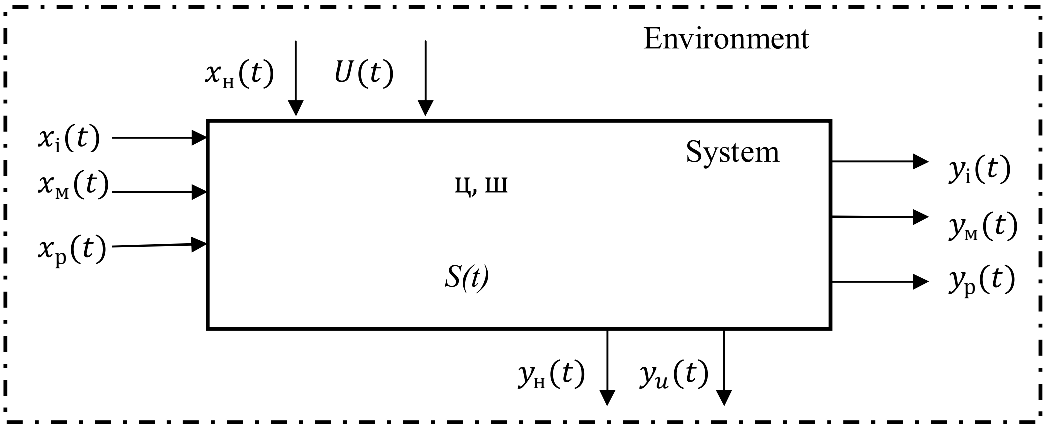

Fig. 1. Generalized scheme of the transport and production system of technological waste processing

The researched system is characterized by informational, material, resource inputs (outputs) and management decisions that ensure the implementation of production and technological processes of the purpose of the system.

According to fig. 1 highlight the following system inputs: $x_і(t)$ — information in which is a set of information that is necessary for effective management and control of the system. (information on the failure of system resources, current data on the progress of the transport process, the results of rolling stock and loading mechanisms, data on the actual volume of traffic, deviations from the planned indicators of the transport process, etc.);

$x_м(t)$ — material is represented by technological waste of the main production, coming from steel production (open-hearth slag) and subject to processing;

$x_р(t)$ — resource is characterized by external and internal resource provision. Internal resource provision is represented by a fleet of loading mechanisms that ensure the performance of loading operations on cargo fronts. External resource provision is represented by rolling stock with suitable drivers and maintenance personnel. The Department of Road Transport allocates the number of rolling stock with drivers ordered by the State Traffic Police for each work shift and ensures its supply to the cargo fronts of the site in good technical condition.

$x_н(t)$ — non-controlling factors of the external environment (failure of rolling stock, loading and unloading mechanisms, production equipment, climatic conditions);

$U(t)$ — management decisions can be characterized as a set of interconnected, purposeful, consistent management actions aimed at ensuring the implementation of production and technological tasks, among which are the following: performance control production and technological operations and making operational management decisions aimed at eliminating disruptions of the production process, determining the required number of rolling stock for transportation and ordering it in the management of road transport, development of technological routes for transportation of technological waste and products of their processing, etc.

The input in general is a vector $\bar{X} = (x_\text{і},\ x_\text{м}.\ x_\text{р},\ x_\text{н},\ x_u)$. Each input can have several components, ie

$$x_\text{і}(t) = (x_{\text{і}j}),\ \text{i} = \overline{1,n};\ j = \overline{1,m};$$
$$x_{ij} = (x_{ijk}),\ k = \overline{1,r},$$

where i — is the type of input; j — nomenclature of the entrance; k — the input source.

The result of the system — vector

$$\bar{Y} = (y_\text{і},\ y_\text{м}.\ y_\text{р},\ y_\text{н},\ y_u).$$

$y_\text{і}(t)$ — information output, which characterizes the information activity of the system;

$y_\text{м}(t)$ — material output, characterizes the material result of the system;

$y_\text{р}(\text{t})$ — resource output characterizes the result of system resources;

$y_\text{н}(t)$ — the output of non-controlling effects of the system on the environment.

As for the inputs, the components of the output vector can be represented as

$$y_\text{і}(t) = (x_{\text{і}j}),\ \text{i} = \overline{1,n};\ j = \overline{1,m};$$
$$y_{ij} = (y_{ijk}),\ k = \overline{1,r},$$

where i — is the type of input; j — nomenclature of the entrance; k — the input source.

The transition function $ц$ transforms the state of the system under the action of X and Y

$$ц/(tЧU) \rightarrow S.$$

The output function ш forms the initial results of the system operation

$$ш/(tSЧU) \rightarrow Y.$$

Thus, the process of functioning of the organizational and technical system can be represented as successive transitions from one state $S(t)$ to another $S(t + \Delta t)$ under the influence of input signals and control actions.

Conclusions

During the study, the structure of the transport and technological system of the metallurgical enterprise was determined by analyzing the processes of its operation. The state of the system was described by a number of participants involved in the production process at a certain point in time, which include: rolling stock (dump trucks), fleet of trucks (excavators, forklifts), freight fronts (railway dead ends for slag unloading), slag storage dumps, crushing and sorting complex, warehouses of slag processing products.

The transport and production system of technological waste processing of a metallurgical enterprise in a formalized form can be represented by a generalized model that reflects the relationship with the environment and is characterized by typical inputs and outputs. Typical inputs (outputs) include information, material, resource flows and management decisions that ensure the implementation of production and technological processes of the purpose of the system. On the basis of the generalized model in the future it is possible to build a mathematical model of the studied system as a set of relations (equations, logical conditions, operators) that determine the characteristics of the system depending on its structure, algorithms, system parameters, state, environmental actions, initial conditions and time.

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ФОРМУВАННЯ ВИРОБНИЧИХ ПАРАМЕТРІВ І ФАКТОРІВ У МОДЕЛІ ТРАНСПОРТНО-ВИРОБНИЧОЇ СИСТЕМИ ПЕРЕРОБКИ ТЕХНОЛОГІЧНИХ ВІДХОДІВ МЕТАЛУРГІЙНОГО ПІДПРИЄМСТВА

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Реферат

Транспортно-виробнича система переробки технологічних відходів є частиною виробничої системи металургійного підприємства й виконує окремі конкретні поставлені цілі та завдання у виробничих процесах переробки технологічних відходів основного виробництва.

У системі рециклінгу технологічних відходів сталеплавильного виробництва задіяно п’ять виробничих підрозділів металургійного підприємства, а саме: мартенівський цех, цех шлакопереробки, управління автомобільного транспорту, управління залізничного транспорту, копровий цех. Під час процесу технологічного процесу кожен з вищезазначених структурних підрозділів виконує покладені на нього функції, якісне та своєчасне виконання яких, забезпечує переробку технологічних відходів з мінімальними витратами ресурсів.

Безпосередньо транспортно-технологічний процес переробки технологічних відходів виконує дільниця переробки мартенівського шлаку, що підпорядкована цеху шлакопереробки. ДПМШ включає в себе транспортні вантажопотоки, комунікації, технічні засоби, які забезпечують процес переробки технологічних відходів та направлені на виконання плану у відповідності з технологією й потребами виробництва з мінімальними витратами.

Стан функціонування системи було описано певною множиною учасників, які задіяні у виробничому процесі на певний момент часу, до яких можна віднести: парк рухомого складу (автомобілів самоскидів), парк вантажних засобів (екскаватори, автонавантажувачі), вантажні фронти (залізничні тупики вивантаження шлаку), відвали зберігання шлаку, дробильно-сортувальний комплекс, склади продуктів переробки шлаку.

Транспортно-виробничу систему переробки технологічних відходів металургійного підприємства у формалізованому вигляді можна представити узагальненою моделлю, яка відображає взаємозв’язки з навколишнім середовищем та характеризується типовими входами та виходами. До типових входів (виходів) відносяться інформаційні, матеріальні, ресурсні потоки й управлінські рішення, які забезпечують виконання виробничо-технологічних процесів мети функціонування системи.

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