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PRINCIPLES OF MANAGEMENT OF AGROTECHNOLOGICAL SYSTEMS

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Abstrast: *Modern approaches to the solution of problems of increase in the outputs and quality, reduction of cost of agricultural production, negative impacts of agropro-technologies on the environment provide consideration of transformation of energy in agroprocesses as a part of uniform agrotechnological systems. Creation of a control system of devices of different function and application on the basis of modular model doesn't demand development of difficult algorithms and schemes of management. Application of modular models, use in them standard mathematical dependences for forecasting of changes of characteristics of processes and management significantly simplifies technical realization of elements of a technogenic part of agrotechnological centers, creates possibilities of unification of circuit and software solutions for various control units agroprocesses, reduces expenses of time and material manpower at a stage of their development and deployment.*

Keywords: *objects of agrarian production, a biocenosis, the unit, management, modular model, mathematical model, agrotechnology, control systems, the self-organized processes, the environment, productivity, the working car, agrotechnological processes, cyclograms of work, control algorithms.*

1. INTRODUCTION

The satisfaction of needs of nature of growth and development of the object of agrarian production (OAP), ensuring its potentially possible efficiency during realization of agroprocesses demand physiologically and economically reasonable expenses (input) of material and energy resources, information. In cycles of production of agricultural products these expenses depend on a type of OAP, concrete technologies and climatic conditions of his cultivation.

The main reserve of decrease in technogenic power consumption and increase in productivity of agricultural production is increase in biopower efficiency of transformation of natural energy autotrophic photosynthesizing plants (at production of crop production use 97-98% of energy of sunlight and only to 2-3% of technogenic). It is expedient to consider technogenic energy in agricultural production how energy of management of technological processes for highly effective transformation by organisms: solar energy (OI) – plants, energy of forages – animals [1,2].

2. METHODS

Modern approaches to the solution of problems of increase in the outputs and quality, reduction of cost of agricultural production, negative impacts of agropro-technologies on the environment provide consideration of transformation of energy in agroprocesses as a part of uniform agrotechnological systems. Agrotekhnotsenoza (ATTs) – the difficult open systems limited in space and time functioning in the changing

climatic and soil conditions of the concrete region unite biocenoses (natural objects: environment, vegetable and animal organisms of OAP) and tekhnotsenoza (technogenic objects: the artificial communities of the working cars (WC) created by the person for increase in efficiency of agroprocesses) [1].

Tekhnotsenoza are steady in development, their construction is subordinated to objectively existing regularities of formation of technical systems [3,4]. Elements of tekhnotsenoz, as a rule, independent dynamic systems, are dispersed in space, their functioning happens in the environment of uncontrollable stochastic parameters in the conditions of a lack of information on the course of processes and is distributed in time.

The self-organized processes in biocenoses reflect in tekhnotsenoza of reaction of adaptation of technogenic structures of ATTs to the changing conditions. Artificial technical and technological adaptive functions of the advancing reflection of reality, formation of algorithms of achievement of the required consumer purposes in the set tselelogichesky direction are inherent in Vysokoeffekimvny tekhnotsenoza [1,2].

Adaptive abilities of the technogenic equipment to bioecotechnologies reflect logical ratios of adaptive acts of maintaining heritability of the carried-out operations and evolution of concrete types of agricultural production. The repeatability of procedures in cycles of technological operations enhances quality of adaptation gained in practice of technological knowledge and experience to systemically organized knowledge base, real production base [5]. In these conditions the role of preventively advancing management of elements of a technogenic part of ATTs with use of the forecast of development of the self-organized processes in structures of biocenoses is important.

3. RESULTS

ATTs control systems. The equipment of tekhnotsenoz functions according to regular (standard) lists (complexes, cycles) of technological operations including the sequences of actions regulated by flow charts of the carried-out processes. If realization of a regular cycle of operations irrespective of their performance has begun or not, is impossible, the standard sequence is corrected: between process phases where this event is established, introduce the phases or separate operations which aren't provided by a regular cycle.

The systems providing relevant cyclograms of work have at the top level of management tekhnotsenozy (a direct connection with the self-organized processes of natural origin) or – at the top level of management of groups of processing equipment (communication with cycles of technological operations).

Control systems of agroprocesses unite a large number of the elements described by different mathematical models. These are the complex unique structures demanding considerable expenses of time, resources, high qualification of experts when developing, debugging and operation focused on concrete applications and control algorithms.

In most cases agroprocesses, even united by the general technology, are implemented as independent technological operations between which interrelations are shown implicitly and which carry out the specialized RM through independent managing directors of influence. For example, during cultivation of plants make preparation of the soil, landing of plants, service of various stages of their vegetation, etc. In this regard structures of tekhnotsenoz in practice form in the form of the directed systems – ordered sets of the operated RM having an overall objective of functioning focused on performance of certain functions or concrete technological operations. Respectively the task of management of agroprocesses unites subtasks with the local purpose and criterion of quality of management for RM and operations.

The existing methodological classification refers similar systems to structures of high epistemological level. At different stages of realization of agrotechnologies their functions are determination of structure, readiness for use, compatibility, determination of the sequence and duration of switching, ranges of effective functioning and interaction separate or the RM

groups, distribution between them system-wide resources, etc.

In the analysis and development of multipurpose and multicomponent systems enter the concept "unit". The condition of the unit, his parameters and the processes happening in him characterize sets of sets of various nature, generally casual, for example, phases of processes; the entrance, operating, output signals, a state, etc., operators of the transitions and exits realizing transformations entrance, the output and operating functions, etc. Abstract modular models carry to a class universal, capable to model work of different objects. Application" to technical devices as to converters of information, the concepts "unit" creates the prospects of creation of the unified structures of control units for a flexible algorithm taking into account requirements of real processes [3,4].

When using aggregate approach to ATTs from a tekhnotsenoz allocate the RM family, the technological operations focused on performance of a concrete complex and use cyclograms of work of these RM. The model of such family is characterized by sets: And – the executive technical means (ETM) and the device of switching of operations (DSO) of the carried-out technological processes (control devices of parameters of processes, drives, contactors, gates, executive valves, etc.); T – sites (phases) of the cyclogram of work; Y – conditions of ITS and UPO on sites (phases) of the cyclogram of work; U – conditions of end of sites (phases) and transition to new sites (phases). The set of Y is described by a two-dimensional matrix which number of columns corresponds to quantity of elements of sites (phases) of the cyclogram of work, and number of lines – to quantity of ITS and UPO ($U \in Y$) .

The adaptive robotic cattlefeeders (RC) of farms of cattle with fastened keeping of animals on sites of cyclograms of functioning (fig. P1) carry out various operations, solve specific objectives: calculation and optimization of group and individual diets of feeding of animals within a year and daily, filling of the distributor with a dose of a forage on group of animals and individual distribution of forages in fodder stations; fixing of information on a nepoyedayemost of a forage and about the animals who aren't eating up sterns, veterinary survey of animals, the choice of a way of a round of obstacles, rational speed the movement, assessment of a condition of animals, etc.

The modular model of work of RC is characterized by sets

$$A = \begin{bmatrix} a_1 & a_2 & \dots & a_5 \end{bmatrix};$$

$$T = \begin{bmatrix} t_1 & t_2 & \dots & t_{12} \end{bmatrix}^T;$$

$$Y(a,t) = \begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 \end{bmatrix} \quad (1)$$

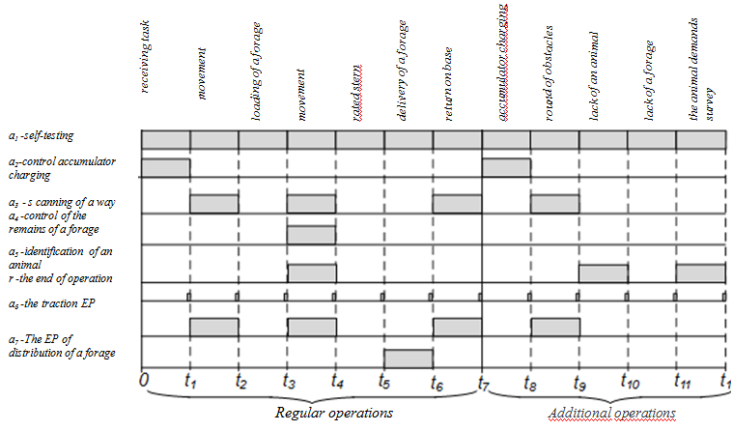

fig. 1. ***Technological operations when functioning RC.***

$$U=\begin{cases}[t_0-t_1]: \bar{a}_1\bar{a}_2 r_1 \to t_1 \vee a_2 \to t_7 \vee a_1 \to t_0;\\ [t_{2(4,10)}-t_{3(5,11)}]: t_{2(4,10)} \& \bar{a}_1 r_{3(5,11)} \to t_{3(5,11)};\\ [t_3-t_4]: t_3 \& \bar{a}_1\bar{a}_3\bar{a}_4\bar{a}_5\bar{a}_6 r_4 \to t_4 \vee a_1 \to t_6 \vee a_3 \to t_8 \vee a_4 \to t_{10} \vee a_5 \to t_9;\\ [t_5-t_6]: \bar{a}_1\bar{a}_7 r_5 \to t_6 \vee a_1 \to t_0;\\ [t_6-t_7]: t_1 \& \bar{a}_1\bar{a}_2\bar{a}_3 r_7 \to t_0;\\ [t_7-t_8]: t_7 \& \bar{a}_1\bar{a}_2 r_1;\\ [t_9-t_{10}]: t_9 \& \bar{a}_1\bar{a}_5 r_{10} \to t_0, \end{cases} \quad (2)$$

where – $a_1, \bar{a}_2, ..., \bar{a}_5$ the list of ITS and UPO; $[t_0, t_1, ...t_{12}]$– sites (phases) of the cyclogram of functioning of RC.

Forecasting of processes in ATTs. Known methods of generation of anticipatory managements for adaptation of technical systems to conditions and characteristics of the carried-out processes are based on the theory of predictions, use retrospective information, settlement or received in real time, etc. Because of complexity of structures of ATTs and bad predictability of processes of realization of these methods in them aren't always possible here. At the same time, according to [1,2,6], creation of tekhnotsenoz, change, transformation and development of processes in them are substantially subordinated to the objective regularities characteristic of natural structures of biocenoses.

The self-organized processes of change of external influences and characteristics of OAP in time, as a rule, inertial, it is possible to describe standard mathematical dependences (long processes – the law of a technical optimum, processes of average duration – exponential, short – linear) or to make of sites on which changes of characteristics of processes describe these dependences. Changes of parameters of the mode of the ATTs technical elements can be formalized similarly.

We will define laws of change of parameters of management proceeding from the following reasons. In the multiple-factor system "OAP — Environment Factors — Factors of the Environment of Managements" uncontrollable influences of an environment (soil climatic conditions, intensity of sunlight, temperature, humidity of air, etc.), technogenic influences, changing which it is possible to influence technological processes and OAP, we will carry to managements and we will divide into three groups: standard management, the external management correcting management.

As standard management we will accept the technogenic impacts on OAP which are almost not changing realized according to production schedules of processes or changing slightly long period of application on structure, parameters and the sequence of technological operations; as external – self-organized uncontrollable (except technological processes of hothouse crop production, the closed keeping of animals, etc.) influences of an environment, as correcting – additional technogenic impacts on OAP for realization of problems of ensuring highly effective production.

At concrete external management and ideal according to requirements of production standard it is enough to realize standard management for obtaining the necessary result. In practice external management can worsen OAP living conditions, and standard – to be insufficient for providing conditions of highly effective production. Then apply the correcting management with attraction of additional resources to improvement of these conditions. The correcting management is operational impacts on technological processes in real time, the best strategy in relation to the purpose and tasks of management. Delays of management on time can limit positive changes of characteristics of OAP, functional and technical parameters of agrosystem in general and to make management inefficient. The paradigm of the correcting management of agrosystems provides

realization of intellectual impact on OAP as reaction to the arising rejections of characteristics of processes from the required values and on emergency situations. It is the management initiated by objective need of elimination of the discrepancy of controlled characteristics of agrosystem and its elements of area of admissible values, the steady tendencies of dynamics able arising during performance of processes to result in such discrepancy.

At realization of agroprocesses of number of variables of process individually depending on a type of OAP (for example, in crop production: grades, a hybrid of plants, stages of their vegetation, etc.), the realized technology, operating conditions, etc. in real time allocate the order variable (which is most quickly changing and most strongly influencing processes in system) and parameters of management (standard, correcting) by means of which it is possible to influence processes of change of OAP. In crop production as a variable of an order it is expedient to choose an exergy of optical radiation concerning photosynthesis of plants, and as parameters of management – one or several parameters of operating conditions (temperature and humidity of air, humidity and mineral structure of the soil, availability of organic fertilizers, etc.) [1,6].

During realization of processes, using information on changes of a variable of an order and parameters of management until implementation of their control, base of retrospective data on realization of similar processes, choose what of the listed above standard mathematical dependences most precisely describes changes of controlled informative variable processes. Extrapolating the chosen dependences to prospect, define expected scenarios of change of characteristics of OAP and agrosystem in general. For check of correctness of the chosen scenarios count value of a variable about. If from the point of view of obtaining potentially possible efficiency of OAP, stability and efficiency of technological processes taking into account the forecast of change of operating conditions, standard management doesn't provide adaptation to the changing conditions and full mobilization of the OAP resources at high technical and economic rates, select laws of change of variables of the correcting management for achievement of these purposes. If expected values of controlled variables and laws of change of the correcting management differ from real in iterative changes of their final values make change of these dependences until the convergence of forecasts of change of controlled variables isn't satisfactory.

Management of RM. In practice achievement of preset values of indicators of agrotechnological processes (productivity, quality of production, energy efficiency, etc.) is carried out due to the correct choice from the existing nomenclature of processing equipment of type and the RM parameters. The RM optimum modes, implementation of local technical requirements to them provide at the expense of control of executive drives of these cars.

Formally statement and the solution of tasks of control of drives are developed rather fully. So in [7,8] at the solution of problems of formalization of control of electromechanical converters of energy and their design the method of dynamic synthesis based on use of standard mathematical dependences for the description of change in time of parameters of processes was used.

For coordination of the RM modes, real conditions and characteristics of the carried-out processes of a control system of the top level have to generate, transport also to RM control units information on the course of change of parameters of agroprocesses for correction of a type of laws of control of drives of concrete RM and also the corresponding entry, final and boundary conditions of the equations formalizing these laws.

Conclusions

Modern approaches to the solution of problems of increase in the outputs and quality, reduction of cost of agricultural production, negative impacts of agropro-technologies on the environment provide consideration of transformation of energy in agroprocesses as a part of uniform agrotechnological systems.

Creation of a control system of devices of different function and application on the basis of modular model doesn't demand development of

difficult algorithms and schemes of management. Application of modular models, use in them standard mathematical dependences for forecasting of changes of characteristics of processes and management significantly simplifies technical realization of elements of a technogenic part of ATTs, creates possibilities of unification of circuit and software solutions for various control units agroprocesses, reduces expenses of time and material manpower at a stage of their development and deployment.

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