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Software Tool Monitoring Process of Processing Raw Cotton

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ABSTRACT: The article deals with the creation of a software package for solving the problem of technological monitoring of the parameters of aggregates during the processing of raw cotton. The linguistic variables that characterize the cotton processing process for the formalization of the mathematical model of the object, allowing to automate the solution of the problem, are controlled by the technological units. The structure of the software package is presented.

KEYWORDS: raw cotton, process, ginning, cleaning, drying, aggregate, technological processes.

I.INTRODUCTION

The ginning industry as a whole is fairly traditional, and the technology is used up. The main technological processes of processing raw cotton are: drying, cleaning, ginning raw cotton, etc. Details questions about the technology of processing of cotton, are highlighted in [1,2]. With the development of processing technology of raw cotton, improved methods for optimizing the control of technological processes based on the methods of mathematical modeling have been improved. However, their practical use refers only to the early 1980s and is associated with advances in computing.

MODEL DESCRIPTION

The study of process control issues in the cotton ginning industry showed that the degree of use of information technology is insignificant here, almost no methods are used for planning the production of fiber, taking into account the multivariance of technological regimes, methods for choosing the best option, taking into account both raw processing data (primary data of raw cotton, equipment condition) and the influence of various perturbations [3,4].

In a cotton-cleaning enterprise, decision-making support tools are practically not used. This applies to all aspects of the production cycle: the preparation of raw cotton for processing, technological regimes, tooling, etc.

The situation changed with the advent of higher technical and economic requirements for the primary processing of raw cotton, which necessitated a revision of approaches to the creation of a control system based on modern information technologies. The latter circumstance is connected with the use of the latest achievements of science and technology, as well as advanced production experience, which make it possible to obtain high-quality cotton fibers in a short period of time without substantial costs, ensuring optimum technical and economic indicators.

For each case of processing of raw cotton (grade, weediness, humidity of the original raw cotton), it is necessary to select the appropriate mode of operation of technological units on the basis of production schedules.

The choice of operating modes of technological units is carried out empirically and on the basis of a controlled parameter carried out under laboratory conditions. In this case, the decision-making procedure is subjective and time consuming, since not only technological regimes, but also equipment parameters can vary[5,6].

The approach to the problem can be greatly improved by applying mathematical models adequate to the actual process. Indeed, significant progress has been made in the field of mathematical modeling. There are models and software products that allow to “describe” on their basis the individual components of the process of processing raw cotton.

Modern software products (Matlab, etc.) are a powerful tool in the hands of an engineer, but even are quite limited, since they are focused on solving small components of real problems. It is also important to keep in mind the problem of the adequacy of the mathematical models themselves that underlie the software. As follows from the above, the process of processing raw cotton is multi-parameter and quite complex.

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The technological route must take into account the results of previous operations, and even correct the deviation. When trying to describe a process, inevitably a collision with a multidimensional and complex mathematical model with low accuracy and incompleteness of the initial information and ambiguity of the control criterion. This was the initial premise for the classification of the processing of raw cotton as an organizational and situational object. Making management decisions for organizational and situational objects is feasible based on the theory of artificial intelligence and situational management, as well as principles for developing expert systems that ensure the processing of non-formalized knowledge of the problem area [7].

The basis of situational management is the use of a logic-linguistic model of an object that is formally represented by a tuple:

$$L = \langle A, C, T, P \rangle,$$

Where A - alphabet; C -the rules for constructing expressions, the syntax of the language; T - set of initial formulas (axioms); P - rules of withdrawal. The A -elements are linguistic variables, which are represented by words or phrases of a natural language, reflecting the concepts and properties of the problem area; linguistic variables $a_i \in \mathrm{A}$ are represented as:

$$a_i = \langle F(I) \rangle,$$

where is F - some property of the object (attribute); I - the value of the linguistic variable.

Examples of linguistic variables for raw cotton processing technology are “state saw gin”, taking the values: “on”, “off”, “unknown”. Then the expression “saw gin is on” corresponds to the value of the linguistic variable <state saw gin (on)>. The linguistic variable “fiber removal condition” takes on the values “bad”
“Satisfactory”, “good”. The logical-linguistic model allows to formalize declarative knowledge about the structure and functioning of the organizational-situational object and to develop management decisions based on the procedures of logical inference, processing of knowledge, training and generalization. For this purpose, knowledge representation models in the form of frames, semantic graphs and predicates are used [8-10].

Intellectual automated system of situational control of the processing of raw cotton (IASSUPPH) is called the system of management of organizational and situational objects in which the output of management decisions is carried out in an intellectual dialogue with the decision maker (DM) on the basis of the processing of declarative knowledge of the essence of the processes of the object and using data and procedural knowledge.The functional structure of IASSUPPH can be represented by the following tuple:

$$U = \langle \mathrm{B}, \mathrm{M}, D, Y, S, J, H \rangle,$$

where B is the knowledge base; M - block output control solutions; D-block analysis of situations; Y-block output control decision; S-unit analysis of the situation; J-linguistic processor; H-component explanations.

The functional structure of the intelligent automated system of situational control of the processing of raw cotton is shown in the figure.

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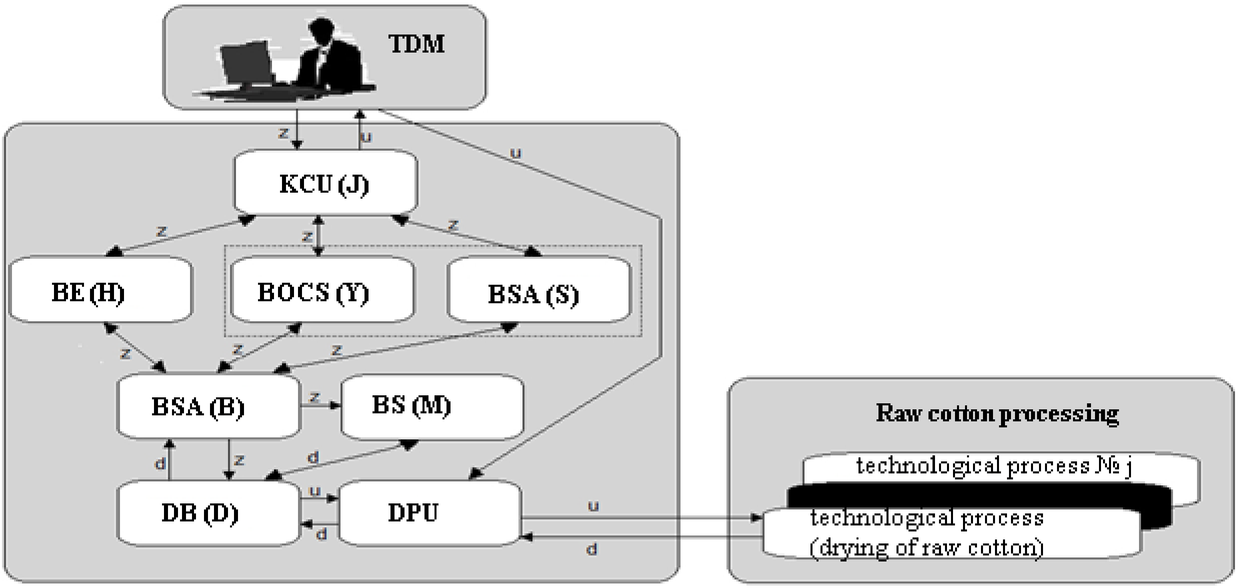

The functional structure of the intellectual automated system of situational management of the processing of raw cotton: TDM - the decision maker; KCU-knowledge conversion unit; BE-block explanations; BOCS-block output control solution; BSA-block situation analysis; Knowledge base; knowledge base;BS block simulation; DB-database; DPU data processing unit; PRCP process raw cotton processing; DS-data streams; FMD-flow management decisions.

Explicitly, in the processing of raw cotton, none of the components of the proposed scheme of the structure of an intelligent automated system has been implemented. However, the available regulatory, technical and reference documentation covers almost the entire range of fiber produced, equipment used, and raw cotton. On the basis of high-quality information, with significant efforts to analyze and systematize it, the first part of the “D” database can be created (at present all the above-mentioned documentation is presented and used exclusively on paper). Another part of the base "D" should contain:

• initial, for technological process, information:
the results of previous technological operations, some of which can be extracted from the database of production information support;

• the results of solving problems of choosing the parameters and modes of the process, for example, for the process of ginning should be given: a reference to the processed raw cotton (comprehensive information about which should be contained in the first part of the base), the uniformity of raw cotton supply, the density of the raw roll , the speed of the raw roller, the angle of rotation of the seed comb, the air flow rate in the fiber removal device, etc .;

• factual and numerical information coming from technological equipment (gin saw, gin feeder, etc.), including various auxiliary information: remarks about the peculiarities of the process or the external environment, etc. (slaughter of raw cotton in the feeders and the working chamber, the cotton fiber emission factor, the residual fiber content of raw cotton seeds, malfunction or equipment problems, etc., that is, all those factors that as a result may affect the quality of cotton fiber) ;

• retrospective data, allowing IASSUPPH to solve the problem of forecasting the situation and the state of the process of processing raw cotton, the quality parameters of the finished product.

The knowledge base “B” should include all software-implemented frames displaying declarative knowledge about the technological routes of the raw cotton primary processing process, technological equipment, as well as about the essence of the physical properties of the primary cotton raw processing process, and management objectives.

The essential difference of IASPSUPS from traditional ACS is the principle of operation of the block of mathematical models - “M”. Tasks from “M” are solved on request from the knowledge base, if necessary, the generation of relevant new knowledge and data. This can be ensured by the presence in the database of frames describing knowledge of mathematical models, the conditions of their use and the output data obtained in the solution.

The search for solutions in IASSUPPH is provided by the situation analysis block “S” and the output block of the control solution “Y”, which constitute a two-step process of semantic, or logical, output implemented in the output block “R”. Allocation of procedures for the withdrawal of control decisions and analysis of situations into independent

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blocks makes it possible to programmatically implement various decision derivation strategies in IASSMES. As a result, knowledge is separated in IASSUPPH from the way they are processed, which makes it possible to qualitatively change and tune the heuristic algorithm of IASSUPH functioning when the production situation changes. As a result of the work of the IASSUPPH for the engineer and the operator, recommendations are generated on the selection of parameters and modes of the process, the control of technological equipment, which can be presented in the form of phrases and texts in a limited natural language.

It is advisable to eliminate the doubts in the decision maker about the correctness of the generated IASSUCT, based on the processing of knowledge and data of the governing decision, to implement the "H" explanation block, which would form a description of the reasoning in the output. Communication specialist and IFSSUPS can be carried out using a linguistic processor. providing limited natural language.

In the future, the implementation of the system discussed above in full will allow the transfer of a significant part of the functions of the selection of parameters and modes, management and optimization of technological processes to the automated system.

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