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Information model describing the polypropylene aviation filtering elements forming process

In aviation industry the polypropylene filtration elements production is essential. In order to increase the efficiency of such production, the informational processes modeling use is necessary. A functional model, a complex of production automation means and an information model in the system of equations form are developed.

In order to increase the efficiency of production of filtering elements, polypropylene fibers play a special role in the automation of technological processes, the main tasks of which are to improve the quality of filters, the use of resource-saving technological regimes, increase production efficiency. The solution of such problems is possible only on the basis of modern intellectual technologies.

The design and analysis of the polypropylene filter elements production is accompanied by the process of uncertain transmission, processing and storage of information. Information models are often used for description and analysis of such processes.

Information model – is a model that considers the object main properties and information links between them and allows you to evaluate the design process characteristics.

An analysis of the current polypropylene fibrous filter elements automated design and production process state and the existing problem solution methods and approaches application, showed a number of flaws.

First of all, this is due to the fact that more than 15 parameters affect the production technological process[1]. Mathematical modeling of processes associated with production and filtration is examined in the following works [2-3].

The filtering elements formation process will be reviewed as a system in which the operator-expert, in the beginning, receives the technical specification (TOR) from the customer, develops the decision and brings it to the required form in the accordance with legal documentation and DSTU, using the necessary equipment, and at the output the result is the finished project in the form of the final product (Fig. 1).
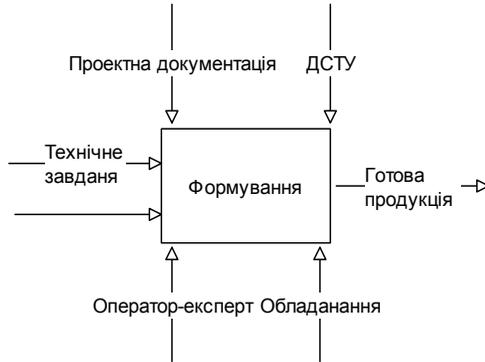
Fig.1 System function

The functional model for this polypropylene fibrous elements production automation set of means is shown in Figure 1.

The central position in it is directly occupied by the formation process. Thus, the process of filtering element forming as an object, or a separate part of it, is implemented.

The operator-expert influence the selected working area with the computer software through the network, or directly, through the equipment.

The work of the expert operator is influenced by his supervisor. Management influence occurs both outside the production system, and inside the system itself, where the manager can change the subordinate work results.
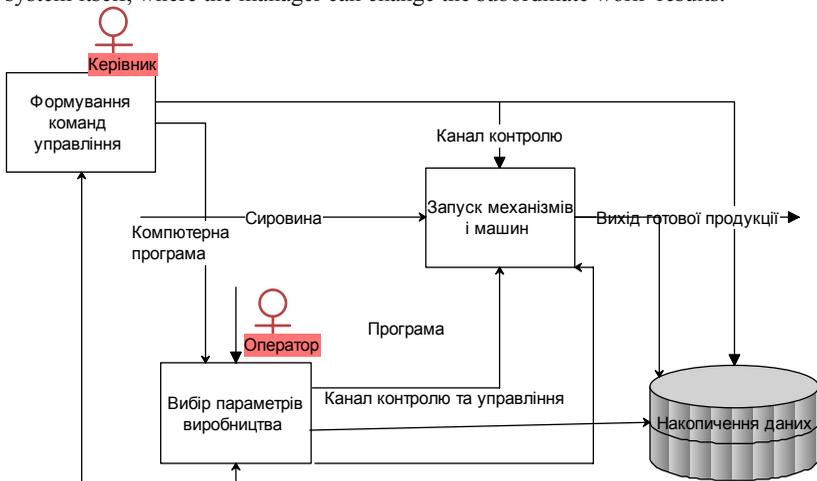
The digital security subsystem traces commands made by management and operator-experts, and also programs that is being executed in the system. In

accordance with the adopted information security strategy and tactics, it makes the necessary decisions and carries out the planned actions.

All subsystems use data from a single depository and store data in it.

The developed information model can be described by a system of equations Eq. 1:

$$\begin{cases} T_4 = f_1(T_1, T_2) \\ T_5 = f_3(T_1, T_2, T_4) \\ T_6 = f_0(T_1, T_2, T_3) \\ T_7 = f_3(T_2, T_4) \\ T_8 = f_4(T_1, T_2) \end{cases} \tag{1}$$

The three arrays of parameters: T_1, T_2 and T_3 are the input information for the prodution process start. The data array T_1 is a technical specification, which contains a set of requirements for the formation object, as well as a description of its further exploitation conditions.

The T_2 array is a reference information for the polypropylene fibrous filtering elements production, which contains the set of internal parameters of the product $Q_i(z)$, which depend on the set of external influences Z. In the case if the product or its parts have counterparts for which the failure statistics are collected, an array T_3 is formed which saves operational statistics. T_3 is a matrix of M_{NV}, where N is the number of elements, and V is the number of parameters application for these elements (failures frequency , failures causes, etc.).

Data arrays T_1 and T_2 fall into the forming of a mathematical model input procedure f_1, based on finite difference and finite elements methods. Performing the procedure f_1 using the input data (T_1, T_2) allows us to form a technical process set of models (T_4): *Wi {Xi (ζ), Yi (ζ), Qi (z)}*.

Current plural represents a set of a various physical processes models. With the use of physical processes mathematical models occurring in an object, physical simulation with application of modern software environments is performed (f_2). The simulation results that form the T_5 array must satisfy all the requirements of the T_1 specification. f_1 and f_2 are complex operations in which there may be many iterative processes, from the filter element parameters selection. T_5 is a matrix of M_{NP}, where N is the number of elements, and P is the number of calculated parameters.

An important element in the automated polypropylene fibrous filtering elements formation is the operator-expert (f_0). Operations performed by an expert using data T_1, T_2, T_3, and T_4 allow to get the T_6 array and use it for further simulation.

The T_6 array is an expert-based thought, which is considered when forming a set of elements (parameters) that are diagnosed and formed as a vector-string:

$$x = \left\{ (x_1, ..., x_j, ... x_n) : \sum_{j=1}^{n} x_j = 1 \right\} \qquad (2)$$

where x_j is the weight coefficient of j-th element, according to the expert.

This information model describes, first of all, all the processes involved in ensuring the quality of produced goods.

IV. CONCLUSION

The information model of the polypropylene filtering element structure, which depends on the object contents and structure and being formed dynamically during the design process, is developed.

The complex processes description is proposed; different in form but compatible in content, process descriptions complement each other, provide the implementation of solved tasks from the initial stage of processes conceptual modeling to their execution support, management and improvement. The unified model provides work automation for performers with different levels of authority, provides unambiguous understanding of the tasks performed by them and the convenience of harmonizing various description components when adjusting the model.

References

1. A. S. Vecherkovskaya, S.V. Pereshnyak *Automation of the production of elements from porous polypropylene by the method of pneumoectrusion* Bulletin of the National Academy of Sciences of Ukraine. tech Un-th "KHPI": Sb. sciences pr sir : Mechanic-technological systems and complexes. - Kharkiv: NTU "KhPI", 2017. - № 44 (1266). - P. 117-122.
2. A . Vecherkovskaya, S . Popereshnyak, *"Mathematical modeling of the process of fluid filtration through a multi-layer filtering elemen*t" in Technology audit and production reserves — № 4/3(36), 2017. P. 9-13
3. A. Vecherkovskaiya, S. Popereshnyak *Mathematical modeling of multi-layer filter parameters calculation depending on application field*. 2018 XIV-th International Conference on Perspective Technologies and Methods in MEMS Design (MEMSTECH): IEEE Press, 28 May 2018.