Compiling a comprehensive analysis and metodology of packagining equipment based on simulation

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Abstract. *The development is based on the analysis and synthesis of existing designs of machines and lines for packing equipment selection, the advantages and disadvantages of individual functional modules. One of the ways to solve the problem of creating a new generation of packaging equipment is to use the principle of modular design, which presupposes That any part of the system is synthesized from individual units (modules). Modular design of the equipment meets the evolutionary approach and allows equipment manufacturer to design complex systems.*

Key words: *packaging equipment, construction equipment, internal transportation system, structure, functional modules.*

INTRODUCTION

Actual problems of modern packaging engineering: complex automation of technological process, the introduction of flexible technologies, the ability to quickly change the equipment for manufacturing high-quality products with different shape and size, ensure high performance, reduced energy and material costs, configurations of the universal packaging lines – "all inclusive" from the same manufacturer. The development is based on the analysis and synthesis of existing designs of machines and lines for packing equipment selection, the advantages and disadvantages of individual functional modules. One of the ways to solve the problem of creating a new generation of packaging equipment is to use the principle of modular design. That any part of the system is synthesized from individual units (modules). Modular design of the equipment meets the evolutionary approach and provides the equipment manufacturer to design complex systems. It is a system with a consistent and parallel, flat and spatial standardized internal transport systems.

MATERIALS AND METHODS

The main factor of technological systems is to increase the utilization of space at all hierarchical levels in the design:

$$K_p = \frac{V_k}{V_{o_p}}, \quad (1)$$

where V_k- the amount of space, which is the technological equipment (processing element); Where K_p- utilization of space p – level; V_{o_p}- the total volume of space, which limits the functional unit.

The principle of the weighing-and-packing equipment based on the movement of material flows hyperlinked two-stream packing material and flow. If the projected complex technological systems with n-streaming space modules, you need to compose their space in the production area (fig. 1). Areas of spatial component in relation to the total volume of the space production workshop. It should be noted that the areas are placed according to the rate of increase of the density of spatial streams of technological modules in production. A formalized three-dimensional spatial production area is shown on Figure 1.

The modularity of the streaming of spatial technological systems makes it possible to implement the main principles of automated productions: flexibility, continuity, high technical and economic indicators.

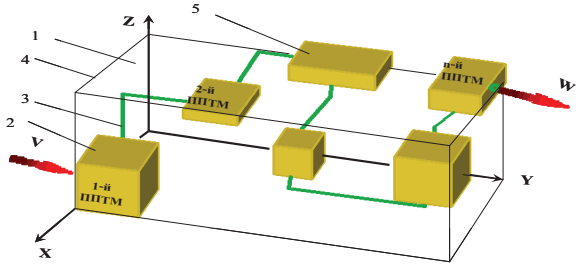

Fig. 1. Formalized 3-d spatial production section: 1-technological system; 2-play-spatial technological module; 3-the relationship between technological modules; 4-line production area; 5-limit streaming spatial

However a process of creation of such technologies is a difficult. process that needs the protracted researches of fundamental and applied character. For the exposure of great number of unconventional variants of new progressive technologies it is possible to use such general theoretical approach of their creation, the field form on crossing of next objects lies in basis of that, : mechatronics, automation and spatial composition.

The like field of unconventional variants of new progressive technologies is determined as:

$$S \equiv A \cap B \cap C, \qquad (2)$$

where S - is a great number of corteges that form new properties of the created technologies qualitatively; A - is a great number that appears on crossing of principles of mechatronics; B - is a great number that appears on crossing of principles of automation; C - is a great number that appears on crossing of principles of spatial composition.

The use of such model gives an opportunity to work out progressive technologies of new level, for that main descriptions can be analysed being based on a chart brought around to a figure 2. This chart has a hierarchical structure and incarnates: basic signs, differences and providing of progressive technologies.

The analysis of processes of development of progressive technologies showed that their creation must come true complex(at least in two directions "depthfirst" and "in a width"). Direction "depthfirst" can be interpreted as providing of high degree of exactness of capital goods. In this case it is necessary to inculcate the special type of the diagnostic system, control, working technologicalenvironment. Direction "in a width" this improvement of the hardware sent to automation and intensification of process of receipt of great number of wares, due to the increase of the productivity, reliability, optimal use of resource base.

Applying complex approach in development of technologies it is possible to create new technologies that in course of time will purchase status of technologies of the future with such features :

- qualitatively new totality of properties of wares,
- qualitatively new degree of utility of wares.

RESULTS AND DISCUSSION

A base at creation of the stream-spatial technological systems is a transition from linear arrangement of technological elements to superficial and then to the volume. It follows to take into account that each of three types of arrangement has a great number of geometrical forms of arrangements. It gives an opportunity to create the enormous amount of variants of the technological systems and find among them most perfect for realization of the set technological process.

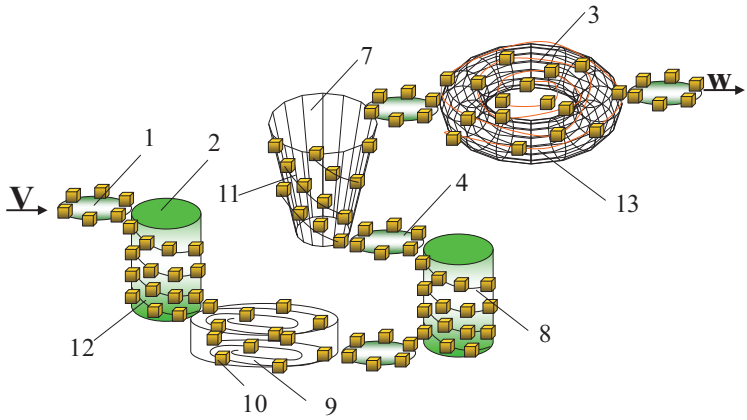

Fig. 2. Fundamentally-structural model of a stream-transport technological system : 1 is a transport rotor, 2,5 - stream technological module, 3 is the stream system of the technological modules. 4,6 is a transport rotor, 7 is the stream-spatial technological module, 8 is a stream limit of the technological module, 9 is a block of technological influence, 10 are wares, 11 is a spatial trajectory of motion of block of technological influence, 12 is a stream of blocks of technological influence, 13 are the reserved recurrent trajectories of motion of blocks of technological influence.

For the decision of questions of arrangement of the stream-spatial technological systems it is possible to apply the method of synthesis of fundamentally-structural models on the base of that arrangements of the technological systems are created.

Basis of such method is an operation of decouplig of spatial structure and difficult kinematics chart of transporting.

As an example will consider the fundamentally-structural model of a stream-transport technological system brought around to a figure. 2.

In the technological system wares get on the input stream of V, and unload W began to flow through a weekend. Directions of pointers specify on motion of blocks of technological influence in every module of technological process.

Thus, resulted theoretical approach gives an opportunity to create unconventional progressive technologies. It allows substantially to promote the technical economic indicators of making of wares of packing engineer on the base of technologies and technological systems of new kind.

On the base of undertaken studies, dependence of the productivity of the technological modules of continuous action is set Π to the theoretical productivity of base variant Π_0, in relation to them geometrical parameters ε; (spatial technological zones).

An analysis the brought dependences over shows that at the

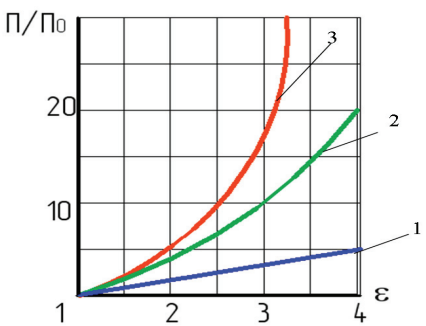

Fig.3. Dependence of the relative productivity of the technological system is on the overall sizes of the spatial system.

increase of overall sizes of the technological module - there is an increase of the productivity after such laws:

- for a linear technological zone(line 1) - on straight proportional dependence;
- for a superficial technological zone(curve 2) - on quadratic dependence;
- for a by volume technological zone(curve 3) - on cube dependence.

And that is why it is possible to assert that to the technological systems with superficial and volume technological zones peculiar qualitatively new, higher technical economic indicators comparatively with technological zones that have linear arrangement(a base is for the modern automated lines).

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This paper has been reviewed