OPTIMIZATION OF POWER INPUTS OF PNEUMO-TRANSPORT AND STORING OF FINE-GRAINED BUILDING MATERIALS ON THE BASE OF ADAPTIVE MICRO-PROCESSED SYSTEM

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Abstract: Transport systems are the essential parts of technological processes of building and provide the spatial and temporal conformation of work of all devices and units of production. Transport systems are not passive elements of structure of production circuit; they affect important indices of work of main transformed units, determining the extent of their load, continuity and smoothness of change of material streams. The most important problem of pneumo-transport of fine-grained building materials is the problem of achievement of the highest possible transport efficiency in the presence of stable tendency to increase the cost of power inputs and raw materials.

Key words: optimization, adaptive system, pneumo-transport, building materials.

Modern building production is under the hard press of fast changed state of market and customers demands to assortment and quality of output. It necessitates the increase of flexibility, adaptability and controllability extent of building production.
The decision of optimum functioning of highly efficient ramified systems of pneumo-transport and storing of fine-grained building materials is suggested on the base of integrated micro-processed systems with the use of reliable control devices of state of transport dispersed mediums.

From the point of control view the main features of ramified systems of pneumo-transport and storing of fine-grained building materials are:

- considerable quantity of input and output disturbing variables different by the extent of influence on the process and by the extent of availability to measuring;
- connection between the variables because of the distribution of the process is given by the system of nonlinear differential equations in partial derivatives with parameters depending on input and output;
- high level of interferences, little delay (decimal parts of a second) and latent character of passing of processes hamper the estimation of state of process and its characteristics;
- heightened sensibility of output variables to uncontrolled variations of disturbing actions which results in the control leading the closed system in the whole to low sensibility to
] disturbing factors;
- no stability of process characteristics leads to low efficiency of stationary control principles.

One of the most important stages in the development of algorithms of control of technological modes of ramified systems of pneumo-transport and storing of fine-grained building materials is the substantiation and choice of target functions of control, expediency of which realization should be evaluated from a position of economic efficiency of production.
Thus the value of power input N is chosen as a target function in the considerable system:

$$N=p \cdot Q \qquad \min \qquad (1)$$

Providing conditions of stable transport process as

$$V_{ci} < v_i < v_{u;} \quad d_{il} < d_i < d_{iu;} \qquad i=1,m \qquad (2)$$

where p – pressure in the input nipple of blower;
Q – total air volume flow in set;
v_i – velocity of carrier agent (air) in the i-th pneumo-pipe;
d - density of flow (air with particles);
m- number of pipes in the system.

Lower boundary of inequalities (2) is caused by physical realization of process and upper boundary by the blower power.

During the transport process of material the velocity of carrier agent v_i should be less then certain critical meaning v_{ci}, otherwise particle separation from the flow is proceeding to the bottom of horizontal pipe leading to the stopping up of pipe. The pipe stopping up is a result of unstable mode of transportation developing in main because of changes of material flow on account of working

mode deviations of charges. In uncontrolled ramified pneumo-transport set air distribution in separate pipes proceeds depending on their hydrodynamic resistances. Change of load in one of pipes effects the working mode of the rest and transition from one steady-state behavior to another realizes in a fractions of a second. So in practice so-called reserves of air volume flow and pressure in separate pipes are made at the planned stage to provide steady-state behavior in uncontrolled ramified pneumo-transport set; these lead to premeditated over expenditure of electric power to pneumo-transport.

As a result of quiescent optimization of functional of power inputs defined in the function of carrier agent velocity v and flow density d

$$N = N(v,d).$$

Is established that the minimum of functional is at the boundary of the region of physical realization of the process. It means that supporting meaning of working velocity of transport near v_c is the most contributory from the power point of view. But uncontrolled ramified pneumo-transport set is a connected system from the standpoint of technology and change of load can cause a reduction of flow velocity in the loaded pipe lower then critical meaning so that providing of stable transport requires displacement meaning of working velocity to the side of increasing $v > v_c$ on the value of probabilistic outlet to the low boundary of stability. In the uncontrolled system the largest displacement from the optimization point takes place and these corresponds to the largest deviation of the power inputs functional from the optimal meaning. So the target of creation of automatic control system is to dislocate the working point closer to stability boundary at the same meaning of load saving the meaning of probability of nonappearance from this boundary. Usually for realization of such control air velocity in loaded pipe is increased proportionally load increasing. Such algorithm of control provides the best compensation of load in the loaded pipe. But because of common power supply and technological connection of system velocity reduction can take place in the rest pipes in dynamic mode. Air velocity in these pipes can reduce lower then v_{ci} and emergency conditions can develop. So such conception of control critical system state is not rational because the probability of development of emergency conditions in the rest pipes is great

Authors suggest another control conception – conception of foregone power escapes which uses the idea of partial load compensation in the loaded pipe. It expects some foregone power escapes in the loaded pipe due to the fact that changing of air velocity comes not to the increasing side but to the reduction side not repeating the change velocity low in uncontrolled mode of stabilization of flows in technological connected ramified pneumo-transport system.

Algorithm of functioning of control system consists of minimization of power inputs to recreation technologically safe mode of material transport in loaded pipe during the cycle of control. Adaptive control system is synthesized to realize this algorithm of control.

Technological connection of continuous parallel random processes in pipers determines a creation of complex hierarchic control system.

Common structure of hardware and software of automated control system of pneumo-transport and storing of fine-grained building materials is designed as two-level system. Different functions are realized at the each level. Such architecture permits to optimize the expenditures on development by using standard hardware and software and develop only substandard blocks of system.

Suggested access to designing permits to produce the further modernization of the separate blocks of hardware and software as applied to concrete types by configuration and geometry, output and equipment of systems of pneumo-transport and storing of fine-grained building materials.

At the first, lower level of control the next functions are realized:

- gathering and processing of primary data coming from measuring devices of system;
- calculation of optimal parameters of regulator adjustment;
- forming of control input to measuring devices and actuating mechanisms of pneumo-transport control contours and control contours of charging and discharging of industrial capacities;
- forming of control input for finishing of processes of pneumo-transport, charging and discharging.

Interface modulus links computer of upper level with actuating mechanisms and measuring devices.

At the upper control level on the basis of static optimization settings for effective control are produced and then corrected during the control process. Besides computer of the upper level does the next function:

- control and analysis of information about physical and mechanical properties of transporting material from the lower level;
- assumption the decision to storage charging and discharging and the set switching on and switching off;
- commutation of pneumo-transport process to other storages or to stop it;
- interaction with automatic control system of the more upper level;
- accumulation and analysis of statistic information about parameters of control processes.

Such micro processed automatic control systems permits already at the planning stage to develop pneumo-transport system for the working at optimal and not critical loads reducing thus expenditures on material consumption of pipes, on servicing of sets. Thus can be created a new class of system of pneumo-transport and storing of fine-grained building materials and provided the realization of power saving technologies.