ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 3, Issue 4 , April 2016

Algorithm of Estimation of Stability and Noise Immunity of Production in Difficult Installations and Complexes

Yusupbekov N.R, Gulyamov Sh. M., Temerbekova B. M., N.KH.Bobomurodov

Professor, Department of Automation of manufacturing processes, Tashkent State Technical University, Tashkent, Uzbekistan

Professor, Department of Automation of manufacturing processes, Tashkent State Technical University, Tashkent, Uzbekistan

Senior researcher, Department of Automat ion of manufacturing processes, Tashkent State Technical University, Tashkent, Uzbekistan

ABSTRACT*:* The methods of calculating the stability of the production process in a complex chemical-technological complexes and facilities, taking into account the structural diagram of connections storage and processing units. As a result, solutions manager task is issued with a set of tables listing the values of sustainability and cumulative units of technological complexes. The features of construction and use of modelling systems on modern components of computers. A block diagram of the information links of the problem, the solution of which search algorithm is proposed, ensuring the achievement of defined objectives. At the same time, the following procedures: decomposition model; calculation of current sustainable technological and storage nodes and the stability of the production process; Search loads to ensure optimal and allowable values of stability functions; adjustment of the perturbation model for value and noise immunity for a given exposure. The algorithm for calculating the stability of the production process.

KEYWORDS*:* stability of production, accumulative and technological knots, a matrix of structural communications, between shops of chemical production, stability, dispatcher, automated control systems, distinctive feature, supervisory control, system carries.

I. Introduction

At the present stage of development of a social production automation of management is one of the main directions of scientific and technological progress.

Now transition to widespread introduction of the integrated automated control systems in which the complex of problems of organizational and economic and administrative management is integrally combined by production and technological processes is observed.

Development of systems of management of industrial productions is represented not as a problem of creation of system of administrative management which covers, generally questions of economic character and as a complex problem of optimum planning and operational management of production, optimization of operating modes of technological complexes and installations, and also regulation of phase variable technological processes.

Distinctive feature of the integrated management information systems consists available uniform information base with the distributed structure organized by the principle of bank and a database and knowledge. Distribution is carried out or by types of production released by the enterprise, or on types of the available resources, or on functions of management.

In hierarchical structure of management it is necessary to allocate the independent intermediate level urged to solve the following circle of tasks relating to a field of activity of dispatching service of the enterprise:

– ensuring tactics of management, - is submission of any regulation to the purposes formulated within planning;
– elaboration of the operating influences necessary for elimination of unforeseen indignations;
– adjustment the demanded cases of the approved planned schedules of performance of work, distribution of resources etc.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 3, Issue 4 , April 2016

We will consider the solution of these tasks in relation to difficult technological installations and complexes on the example of JSC "Navoiazot" which consists of the shops making ammonia, weak nitric acid and ammonium nitrate. In turn, the last because of territorial dissociation and technological distinctions of the same shops share on turn. For example, the first and second productions of ammonia let out a product of one quality therefore their division is caused only by the territorial and administrative reasons. Shops of weak nitric acid make nitric acid of different concentration. Liquid ammonia is used in shop of nitric acid and goes for shipment.
The automated control system for "Navoiazot" production association includes system of supervisory control of technological processes of the main production and system of the intra factory analysis of the account and planning. It is executed on the basis of modern technical means of automation, a complex of modular monitoring systems and automatic scheduling and electronic computers.
Management of system consists in performance of functions: planning of productions on future (forecasting); supervision over current state of production for the purpose of regulation of deviations from the program and production schedules; analysis of last production activity and development of recommendations for the forthcoming cycles of production.

II. STATEMENT OF A PROBLEM

Control of technological processes is exercised the system of the supervisory control (SC) using information directive and production and technological (consumption, development, shipment, a stock, requirement). Before introduction of this system effective management of dispatching service was low because of the small volume, considerable delay and insufficient reliability of technological and productive and economic information. But even this small volume of the arriving information much more exceeded physical capacities of dispatching service on its processing.
Use of system the SC increased quality of management of technological processes. This system carries out the most important part of functions of automatic manufacturing execution system – the information plan for control, the account and the analysis of work of production on release of the main production, calculation of technical and economic indicators of production, control and the alarm system of work of processing equipment.
Production of liquid and gaseous ammonia is connected by a ratio:

$$q_{j_0} = mq^{ra}, \tag{1}$$

where, m — coefficient, time-dependent years, conditions of condensers, temperatures of reverse water etc. and for planning established by production department of the enterprise.
The collector of gaseous ammonia can be considered as a peculiar warehouse, to the top and which lower level of contents there correspond maximum and minimum admissible pressure of gaseous ammonia, and to the current level - pressure to time at present.
For calculation of amount of ammonia in a collector, (that corresponds to the current level of filling of accumulative knots), and also minimum and maximum admissible amounts of ammonia in a collector formulas are used

$$S_k^{\max} = \gamma_0 \frac{V_k \cdot 273}{T} P_{\max}, \; S_k^{\min} = \\ = \gamma_0 \frac{V_k \cdot 273}{T} P_{\min}, \; S_k^{cur} = \gamma_0 \frac{V_k \cdot 273}{T} P_{cur}. \tag{2}$$

where - γ_0 the specific weight of ammonia under normal conditions; T – ammonia's temperature, °K; V_k - collector volume; $P_{\max}$, $P_{\min}$ - maximum and minimum admissible pressure in a collector; P_{cur} - the current pressure in a collector. Size of $P_{\max}$ depends on ammonia temperature in a collector, $P_{\min}$ - is set by regulations of production. The collector is considered in mathematical model of a warehouse as accumulative knot with $S_k^{\max}, S_k^{\min}, S_k^{cur}$.parameters.
By consideration of inorganic group of shops of the studied object the following regularities of change of loadings are revealed. Shops of ammonium nitrate and weak nitric acid change the load of new value for 10÷15 min., that is in relation to the considered period almost instantly. After change of an entrance stream in shops of nitric acid and ammonia on an entrance to office of conversion of ammonia productivity of office of absorption changes through 50÷60 min., and shops of weak nitric acid — in 70 min. after the beginning of change of loadings. It is enough this time to bring concentration of acid in absorbing columns to procedural values. Change of output streams after establishment of concentration happens within 10 min., that is values of output streams change in relation to entrance streams with temporary shift 55 min. and 70 min. according to.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 3, Issue 4 , April 2016

Change of output streams of shops of ammonium nitrate happens along with change of a consumption of saltpeter on granulyatsionny towers, that is for 5÷7 min.
Thus, dynamic characteristics of objects of management are determined by channels "the entrance-day off streams" by value of time of pure delay.
At creation of model of a technological complex the following assumptions are accepted [3]:
– warehouses of liquid ammonia are united in one accumulative knot;
– ratios of production of gaseous and liquid ammonia on an interval of a usage time of the decision are constant and don't depend on loading size;
– weight functions on loading productivity channels and the current account coefficients α_1, which were intended for the moment t_0 are considered as constants and are set in the form of a set of ordinates on each channel;
– volumes of *Ci* stores are rather great, and possibility of their overflow is absent (these stores in model aren't considered).
Structural communications between shops (*Tsi*) and accumulative knots are presented by the following matrix:

	Ts1	***Ts2***	***Ts3***	***Ts26***	***Ts25***	***Ts23***
Account coefficients	0,830	-0,450	-0,220	0,830	-0,033	-0,220
Volumes of C5 stores	0,000	1,000	-0,790	0,000	0,000	0,000
Task for production	0,170	0,000	0,000	0,170	-0,110	0,000
Volumes of C25 stores	0,000	0,000	0,000	0,000	1,000	-0,790

This matrix contains information on values of coefficient of recalculation α_{ji} of production - i technological knot in a product - j accumulative knot. The sign "+" means receipt in accumulative knot, a sign "-"-consumption of production from it.
For calculation of stability of technological and accumulative knots the following expressions are used [4]:

$$\sigma_{cj}(t) = \frac{S_j^{ext}(t) - S_j(t)}{b_j(t)}, \quad (3)$$

$$S_j^{ext} = \begin{cases} S_j^{ext}(t), if\ b_j(t) \geq 0 \\ S_j^{ext}(t), if\ b_j(t) < 0, \end{cases}$$

$$\sigma_{ni}(t_0) = \frac{Q_i^{\max}(t_0) - Q_i(t_0)}{q_i^{\max}(t_0) - q_i(t_0)} - \frac{q_i^{\max}(t_0) - q_i(t_0)}{2P_i q(t_0)} - Z_i(t_0),$$

$$Q_i^{\max}(t_0) = q_i^{\max}(t_0)(T - t_0)$$

Here: $q^{\max}$ - a vector of the greatest possible productivities (is result of the solution of a problem of calculation of the current capacities of technological knots); $q^{\min}$ - a vector of minimum admissible values of productivity of technological knots (it is set by production schedules); $q \cdot S$ - a vector of the current productivities and levels of filling of accumulative knots (the primary processing of entrance information (PPEI) is result of the solution of a task); $\sigma_{ncj}(t)$ - a measure of stability of knot C_j in a time point t (time during which the level of filling with production of knot C_j will reach one of the borders in the absence of impacts on the related technological knots); $S_j^{\max}$ and $S_j^{\min}$ - maximum and minimum admissible borders of filling of a warehouse with production C_j; Q_i - the size of a plan target to technological knot on an interval of planning of *T*; $Q^{\max}$ - the greatest possible development of knot at the maximum involvement of all of the resources which are available for it during the entire period - $T(Q_i^{\max} = \int_0^T q_i^{\max}(t)dt)$; $q_i^{\max}(t)$ loading at the maximum attraction of all available resources during the T period; $\sigma n_i(t_0)$ - time when it is necessary to

ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 3, Issue 4 , April 2016

begin transition to the maximum loading that process didn't come out stability area (stability of knot at the moment t_0 at loading $r_i(t_0)$ - for an interval $[t_0, t_1]$; $Z_i(t_0)$ - shift of the beginning of change of development in relation to the beginning of change of loading - for an interval - $[t_{1,} t_2)$;$[q_i^{\max}(t_0) - q_i(t_0)]/ p_i q$ transition time from development $q_i(t_0)$ before development $q_i^{\max}(t_0)$ for an interval $[t_2, t_3]$ with the moment; $P_{iq}(t_0)$ - speed of change of development from $q_i(t_0)$ to $q_i^{\max}(t_0)$.

Weight functions on channels "loading of gas compressors-production of ammonia" are set in the form of a set from the corresponding ordinates. Q - a vector of tasks for production in technological knot on time interval t, T (it is set by the dispatcher or production department of the enterprise). Task example: Q = (240; 720; 330; 300; 240; 140) [3-4].

Tasks for production in technological knots as it should be corresponds to a matrix order $A = (a_{ji})$. Similar to the dispatcher it is set P^r - a vector of possible speeds (speed) of change of loadings of technological knots. Record example: $P^r = (4{,}30; 4{,}30; 4{,}40)$. For this model vectors maximum ($S^{\max}$) and minimum ($S^{\min}$) admissible stocks in accumulative knots have the following values: $S^{\min}$ = (50; 1; 100; 100); $S^{\max}$ = (500; 3; 1500; 1000).

If in a time point t the knot C_j has the filling level $S_j(t)$, and a difference between entrance and output streams in accumulative knot is equal $b_j(t)$, depending on a sign of this difference the accumulative knot C_j will or be filled ($b_j(t)$ >0),, or to be devastated ($b_j(t) < 0$).

At achievement in accumulative knot C_j, the upper bound of filling the technological knots developing production - j, won't be able to continue the work as they will have no place to give the production.

III. ANALYSIS OF PREVIOUS STUDIES

At achievement in knot C_j of the lower bound of filling, the technological knots using this production won't be able to continue the work because of absence at them one of types of resources. In both cases the continuity of technological process is broken that at the continuous production technology means an emergency.

First composed in the last expression corresponds to time stock caused by a power reserve, and the second and third members - the amendment on the speed of an increment of development and on shift of development in relation to loading.

As the size estimating a production condition in general pays off

$$\sigma = \min\{\sigma_{n_1}, \sigma_{n_2}, ..., \sigma_{nM}, \sigma_{c_1}, ...\sigma_{c_N}\}. \quad (4)$$

As a result of the solution of a task to the dispatcher listing of the table with a set of sizes of stability of technological and accumulative knots is given.

Results of the decision are used as the output data for an optimizing problem of coordination of loadings. At the same time results of the decision have independent value. The problem can be solved and is autonomous; so, for example, the dispatcher uses results of the decision for an assessment of possibility of performance of plan targets by separate production divisions, definitions on production bottlenecks $\sigma_{\min}$.

Setting various values of $q(t)$ parameter, the dispatcher loses production situations on model. For calculation of optimum trajectories of loadings of technological knots as basic data it is possible to accept the following information: $r_i(t)$ $q_i(t)$; current values of entrance and output streams:; the current values of levels in accumulative $S_j(t)$ knots; the greatest possible productivities of technological knots on an $[t_1 \quad T]$ interval; conditional and constant data – weight functions on channels "entrance - day off streams", plan targets on an $[t_1 \quad T]$ interval; $S^{\max}$ maximum and $S^{\min}$ minimum possible levels of filling; possible speeds of change of loadings of technological knots.

Almost all basic data have character of forecasts. Possible speeds of change of loadings of technological knots are set by the dispatcher before calculation depending on the technological mode of production divisions.

The flowchart of information communications of the considered task for which decision the algorithm of search providing achievement of the formulated purposes is offered is given in fig. 1. Thus the following procedures are used: decomposition of model; calculation of the current stability of technological and accumulative knots and stability of

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 3, Issue 4 , April 2016

production; search of the loadings providing admissible and optimum values of function of stability; correction of model on indignation, on value of noise immunity and on the set influence.

Noise immunity of accumulative knot is meant as its ability without introduction of the operating influences to keep stability during the entire period of action of a deviation.

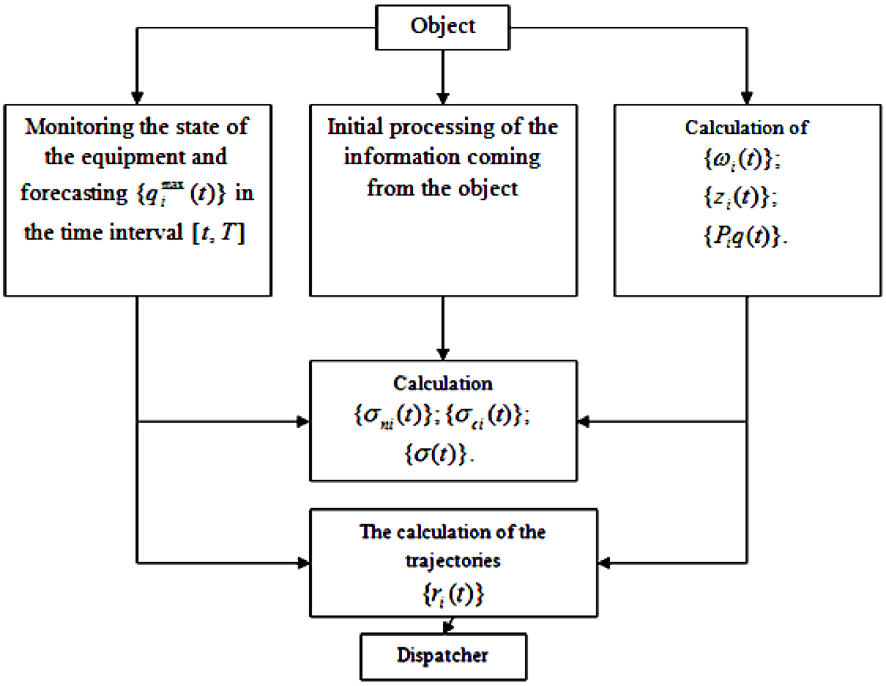

Figure 1. Block scheme of information communications of a problem of calculation of trajectories of loadings.

IV. THE RESULTS OF THE RESEARCH

It is expedient to be reliable characteristics of the related technological knots the basis for determination of size of noise immunity. As a measure of noise immunity $\varphi(S_j(t))$ of the knot C_j having the level of filling of the store $S_j(t)$ at the moment, we will accept probability of such deviation in system that $\sigma_{cj}(t) \geq t_B$, where - t_B time during which former productivity has the size other than initial value.

Value of a difference between entrance and output streams $b_j(t)$ of accumulative knot C_j decides on the help of elements of a matrix A ratio

$$b_j(t) = \sum_{i=1}^{n} a_{ji} d_i, \; i = 1,...., M; \; j = 1,..., N, \tag{5}$$

where,

$$d_i = \begin{cases} r_i(t), if \; a_{ji} < 0 \\ q_i(t), if \; a_{ji} > 0; \end{cases}$$

M – number of technological knots; N — number of accumulative knots. Considering that the size of a debalans $b_j(t)$ is defined only by a deviation, the area of admissible values $S_j^{\max}, S_j^{\min}$ can be broken into zones which provide some size of noise immunity R_k. We will designate such zone $U_j^{R_k}$. For all it is fair $S_j(t) \in U_f^{R_k}$

$$\varphi(S_j(t)) \geq R_k. \tag{6}$$

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 3, Issue 4 , April 2016

Thus, finding for each accumulative knot C_j of a zone $U_j^{R_k}$ and providing in these zones filling levels $S_j(t)$ with probability, not smaller R_k, we achieve uniformity of the current loadings in the technological knots knotted with accumulative, and observance of stability of those knots which the deviation didn't concern.
Apparently, noise immunity in this case characterizes production from the point of view of the probable duration of its existence in the conditions of emergence of deviations and provided that the operating influences won't be put to system.
At research of nature of behavior of function $\sigma(t)$ it is established that it on this interval of time coincides with one of functions $\sigma_{cj}(t)$ or $\sigma_{ni}(t)$. Knot for which function of stability coincides with function of stability of all system, we will call limiting. As $\sigma_{ni}(t)$ depend on one variable $q_i(t)$, and $\sigma_{cj}(t)$ - only on developments $q_i(t)$ of the knots n_i knotted with data accumulative, on the considered interval $\sigma(t)$ of time will depend not on all $q_i(t)$ *(i=1..., M),* but only from function of stability of the limiting knot.
From this it follows that the problem of search of an optimum of function $\sigma(t)$ for all model of system can be broken into sequence of problems of search of an optimum of function of stability for the separate links of system containing the limiting knot. Allocation of a link of the limiting knot is carried out as follows:

– join in a link n_{ik}, for which $a_{j_0} i_k \neq 0$;

for everyone the link n_{ik} joins C_{je} knots — such that $a_{je} i_k \neq 0$

V. CONCLUSION

Stability of production for the set operating influence pays off on the model corrected at the time of the end of transition processes of the technological knots affected by this management influence. Time of transition process τ is defined

$$\tau = \max\{\tau_i\}(i = 1,...., M), \tag{7}$$

where - $\tau_i = \frac{r_i^0 - r_i^1}{P_i^r}$ time of transition process in technological knot $n_i; \{r_i^0\}(i = 1,...., M)$ - production loadings at the moment time; $\{r_i^1\}(i = 1,...., M)$ - new loadings (the operating influences); $\{P_i^r\}(i = 1,...., M)$ - speeds of transition to new loadings.
The trajectories $\{r_i(t)\}(i = 1,...., M)$ used for correction of model on a time point t will have an appearance

$$r_i(t) = \begin{cases} r_i^0 + tP_i^r, \text{ if } 0 \le t \le \tau_i \\ r_i^1, \text{ if } \tau_i < t \le \tau. \end{cases} \tag{8}$$

The algorithm of calculation of stability of production is represented in fig. 2 and is as follows:

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 3, Issue 4 , April 2016

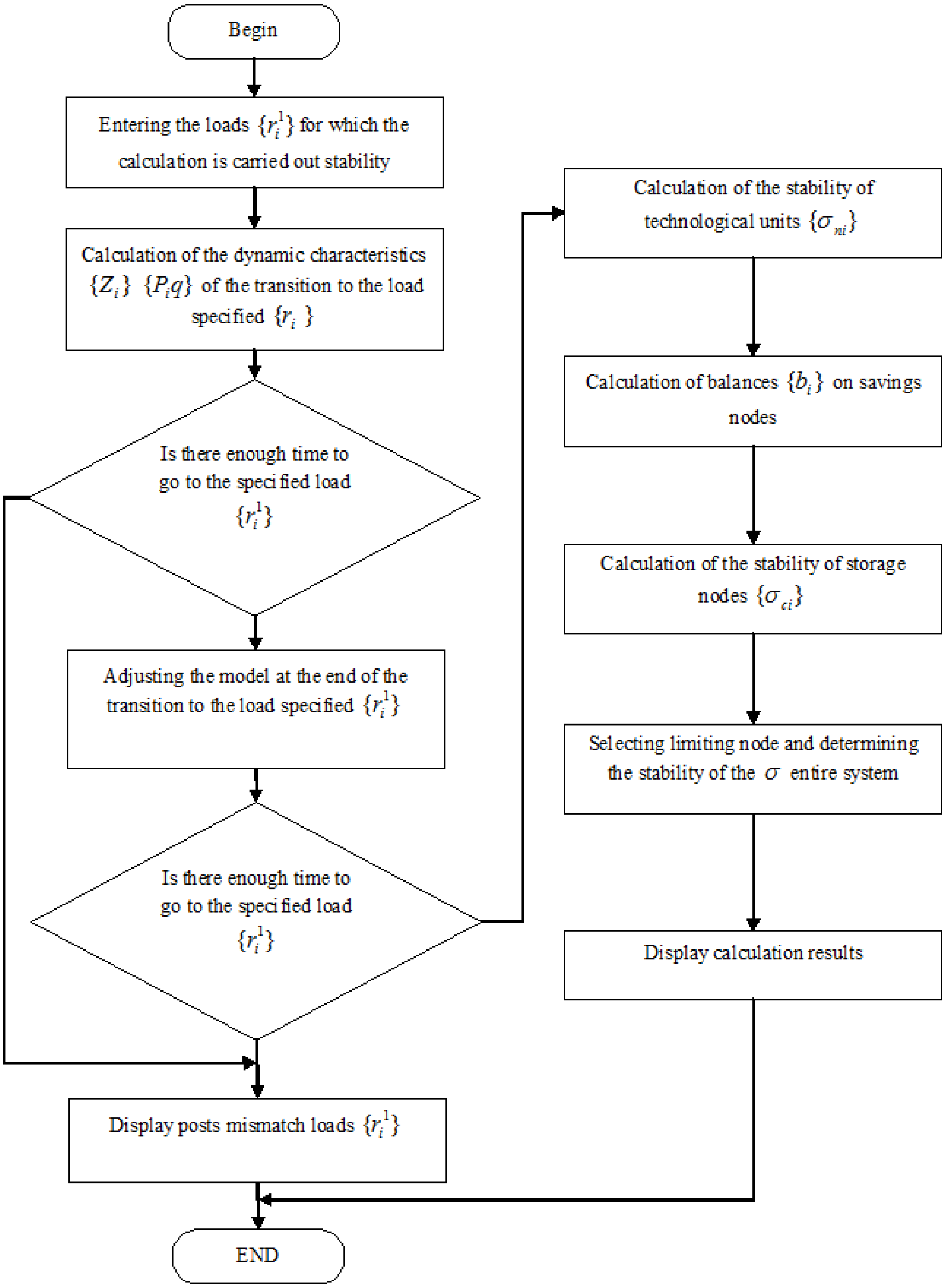

Figure 2. Block scheme of algorithm of calculation of stability of production.

1. The set loadings $\{r_i^1\}$ are entered and characteristics pay off $\{Z_i(t)\}$ and $\{P_i q\}$;
2. It is analyzed, whether time which remained until the end of the planned period for implementation of transition from the current loadings to set (in case of impossibility of such transition the corresponding message is displayed) suffices;
3. If for transition to loadings $\{r_i^1\}$ time suffices, parameters of model are corrected at the time of the end of transition process;

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 3, Issue 4 , April 2016

4. The analysis of a condition of the production corrected at the time of the end of transition to loadings $\{r_i^1\}$ is carried out; if thus process came out stability area, the corresponding message is issued; - if after transition to loadings $\{r_i^1\}$ production remained in the field of stability, calculation of stability of technological knots $\{\sigma_{ni}\}$ for a formula becomes

$$\sigma_{ni}(t) = \frac{(T-t_0)q_i^{\max}(t_0) - Q_i - Z_i[q_i^{\max}(t_0) - q_i(t_0)] - \dfrac{[q_i^{\max}(t_0) - q_i(t_0)]^2}{2P_i^q(t_0)}}{q_i^{\max}(t_0) - q_i(t_1)} - Z_i(t_0) \quad (9)$$

Then calculation of balances of accumulative knots $\{b_j\}$ and calculation of stability of accumulative knots $\{\sigma_{cj}\}$ for formulas:

$$S_{cj}(t) = \frac{S_i^{ext} - S_i(t_0) - S_1 - S_2}{b_j(t_0) - a_{ji}(t_0)q_i(t_0) + a_{ji}(t_0)g_i(t_1)}; \quad (10)$$

$$S_{cj}(t) = \frac{S_i^{ext}(t_1) - S_i(t_0) - S_1 - S_2}{b_j(t_0) - a_{ji}(t_0)\xi_i(t_0) + a_{ji}(t_0)\xi_i(t_1)}; \quad (11)$$

$$r_i(t) = -\frac{b_j(t_0) - a_{ji}(t_0)r_i(t_0)}{a_{ji}(t_0)}; \quad (12)$$

$$t_1 = t_0 + z_i(t_0) + \frac{q_i(t_1) - q_i(t_0)}{P_i q(t_0)}; \quad (13)$$

$$S_1 = [b_j(t_0) - a_{ji}(t_0)q_i(t_0)] \cdot [Z_i(t_0) + \frac{q_i(t_1) - q_i(t_0)}{P_i q(t_0)}]; \quad (14)$$

$$S_2 = a_{ji}(t_0)q_i(t_0)[Z_i(t_0) + \frac{q_i(t_1) - q_i(t_0)}{P_i q(t_0)}] + a_{ji}(t_0)Z_i(t_0) \times [q_i(t_1) - q_i(t_0)] + a_{ji}(t_0)\frac{[q_i(t_1) - q_i(t_0)]^2}{2P_i q(t_0)}; \quad (15)$$

where S_1 - change of level of knot C_j at the expense of the technological knots C_j connected with which loadings don't change; S_2 - change of level at the expense of the knot n_1 changing the loadings; the limiting knot and stability of all system is determined by the minimum value of stability, and results are output for further use in the course of the solution of problems of management.

We have implemented an automatic text detection technique from an image for Inpainting. Our algorithm successfully detects the text region from the image which consists of mixed text-picture-graphic regions. We have applied our algorithm on many images and found that it successfully detect the text region.

REFERENCES

[1] N.R.Yusupbekov, R. A. Aliyev, F.T.Adilov, Sh.M.Gulyamov Analytical information technologies of automation of productions.//ТашГТУ, Tashkent, -196p, 2002.
[2] F.S.Mukharamov, etc. To a question of criteria of management in quick and dispatching systems.//On Saturday.: Automation of chemical productions. M.: NIITEHIM, №. 2, page 14-17, 1980.
[3] N.R.Yusupbekov,S.S.Kasymov, Sh.M.Gulyamov, Computing systems and production management, "Uzbekistan", Tashkent, 197 p. 1984.
[4] N.R.Yusupbekov, Sh.M.Gulyamov, F.S.Mukharamov, B. M. Temerbekova, Analysis of overall performance of system of supervisory control//Industrial ACS and controlers, №12, 2012.