ACTIVE QUALITY CONTROL IN REAL TIME ON THE PARAMETERS OF TECHNOLOGICAL PROCESS

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The aspiration for improving and developing the up-to-date material production is also observed at the system for control and management of quality. The fast development of automatization means determines the leading place of the intelligent algorithm. The themes of present paper are connected to topical direction in the system for active monitoring of quality. Its ideas are applicable under the control of discrete and discrete-continuous technological processes.

Keywords: quality control in real time; intelligent management

1. INTRODUCTION

The basic purpose of one trade or production organization is an increase of the profitableness and the incomes from manufacture. One of the way about rise of incomes is by means of increase of the product quality. For this purpose, it is necessary a suitable system for controlling and managing the quality to be made.

In the industry two types of control are used: passive (after-operating) and active (technological) control based on the control with universal measuring means.

The control with universal measuring means is unproductive and therefore, it requires large personnel in order to correspond to the productivity of technological equipment. The increased number of surveyors leads to reduction of common labour productivity and rise the cost of products. This contradicts to the up-to-date tendency about automatization of production processes and making of fully automated technologies. As the world experience shows, the only one alternative is automatizating of control processes [5, 6, 7]. The automatic control eliminates the influence of subjective factor on the accuracy of productivity of control processes, releases the workers from phychical and physical tension connected with quality assurance. The increase of productivity accuracy of control operations, the decrease of waste and numerical personnel of the control staff as well the guidance of free labour resources towards direct production activity gives considerable economical effect. For this purpose the utilization of classical methods for quality control is based on definite indices of article quality, which are evaluated at the end of given stage of processing – they are applicable. This imposes the utilization of new methods for control and analysis of product quality.

2. APPROACH ABOUT REALIZATION OF QUALITY CONTROL IN REAL TIME

The following question arises: whether the analysis of quality can be accomplished in the process of processing and up to what degree it would be authentic.

The solution of problem is brought to the presumption, i.e. "*The quality of given article depends on the quality of materials and processes of processing*". Therefore, about the suitability of one article can be judged by the running of processes of processing. For this purpose, it is necessary to select one or several parameters, which had to be kept up with in the process of production and on the basis of their values – an analysis to be performed and a conclusion about the article suitability to be accepted. This approach is considerably simple about realization, but on the other hand it is also sufficiently effective and economically grounded. As a result of its applying, the expenditures for performing the control of products will decrease. The quality will be increase because of the circumstance, that in the process of production an analysis is performed, which will lead to the process correction during the origin of precondition for parameter deterioration and removal of unfit articles immediately after their production. This way allows the quality of products to be guaranteed because of the availability of 100% control in contrast to the remaining methods, which function on the basis of sampling control. At the same time, the availability of information on the running of process provides a possibility for performing the analysis and process correction on the basis of tendencies to alterations.

Briefly, the developed methods for evaluation of quality is founded on the supposition, that: *The evaluation of accuracy and stability of the technological processes in accordance with prescribed functional relationships between the regimes of processing and the parameters of machined articles can be accomplished in virtue of data obtained during control of the regimes of their running.*

The methods for analysis suppose the separation of activities according to the identification of technological process correctness into several stages: *selection of quantities for analysis; data collection for selected quantities; filtering of data; calculation of derivatives; analysis of processes during production of article; statistical analysis for the quality of products*.

The selection of quantities for analysis depends on the concrete technological process. The present paper is not strictly orientated towards given technological process. It is referred to broader spectrum from discrete technological processes, which allow the receiving of data and control in real time.

3. METHODS FOR EVALUATION OF QUALITY

The process of quality control in real time is founded on the multi-criterion function depending on a set of parameters and conditions. It is complex function of several parameters and requires by means of adjustment of desired objective accuracy to be achieved. The utilization of refined management conception, for example multi-parametric management, suggests known priorities during quality promotion of products, increase of life cycle and rise of the boundaries of safety and stability. The

task for determining the principle about control and management requires the selection of measurable machining and electrical parameters to be managed. These control parameters have to be suitable for presenting the substantial parameters of management, but not all directly measurable ones. The task for selecting the suitable control configuration is complicated during inaccurate choice of controlled quantities.

At the time of processes management, different methods for tracing and evaluating which depend on the controlled parameters have been used. As the parameter term, a property of given physical unit providing possibility to its recognition and distinction from the remaining units, has been understood. The process parameter can be both a quantity characterizing the given property of the process itself (temperature, pressure, etc.) and a quantity characterizing the results from the process as well as, it is found in correlation dependence with the process. The most commonly, the parameters are devided into qualitative and quantitative ones.

For analyzing the process in the present paper one assembly index, which is formed according to definite law set by the user and reflecting the correlation dependences between the observed quantities formulates a generalized qualitative index carrying information on the process quality and possible defects.

The evaluation of parameters is based on the following suppositions:

- The process is well-known enough;
- The measurable quantities bring sufficient information on the article quality;
- The separate index can be expressed by means of digital designation.

About an evaluation of article there are several groups of data:

The *first group* is data obtained as a result of measurements done in the process of production. They bring information on the current state of process.

The *second group* is data about limit tolerances of the separate quantities set at the time of technological process projection. They bring information on the normal state of process.

The *third group* of data is so called control parameters. One part of them is set during projection of the process and brings information on the availability of definite type of inconformity (defect).

On the basis of analysis about measured quantities and gathered experience, a correlation dependence for accomplishing the multi-criterion evaluation of the process is composed. Thus, analyzing macros evaluating the process parameters is programmed.

Depending on the number of defects and their activating level, a conclusion about the availability of one or another defect is drawn. The level of activation is received on the basis of a set of explorations and analyses.

Methods for process analysis suppose the separation of the process according to the identification of the process correctness into several stages: selection of quantities for analysis; data collection from the selected quantities; filtering of data; calculation of derivatives; analysis of processes during production of article; statistical analysis for the quality of products.

4. STRUCTURE OF THE PROGRAMME SYSTEM

One hierarchical apparatus-programme system with a structure shown in Fig.1 has been developed and it is characterized with the following major possibilities: opportunity for monitoring and managing the processes in real time; supporting of a set of technological processes; ability for analysis of tendencies; possibility to fast readjustment at alteration of the technological process; identification of factors led to an error; opportunity for performing the definite statistical analysis of data and connection with other statistical programmes, etc.

The system is distinguished from the known ones of the such sort up to now by virtue of its functional possibilities – analysis of the process state and active influence with a view to imposing alterations, including an opportunity for determining the tendencies about running of the processes.

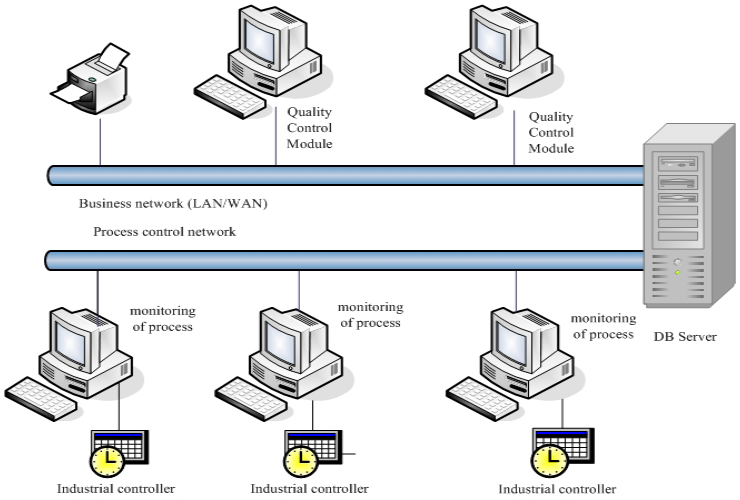

Fig.1. Structure of the system for active monitoring of quality

The computer system is constructed on several levels. On the first level "*Level of immediate management and data collection*" founded on the utilizaton of transducers, regulators and actuating mechanism, data collection from the observed quantities and immediate control over the process of production have been performed. On the second level "*Basic level for management*", an analysis of process state and making a decision about its management has been performed. On the third level "*Level of analysis, optimization and prediction*", an overall analysis of the technological process state and quality evaluation of the articles have been performed.

The developed programme system for quality management operates in the medium of Windows NT and it consists of the following basic modules:

- Control-managing module (Fig.2.) - destined to data collection from technological objects, data analysis and management of the production process;
- Local data base – destined to storage of data received in the production process up to the moment of their importing in the basic data base;
- Basic data base – store information on the running of production process of all details as well of data received after analysis of the previous ones. The storage time of these data is determined by the specificity of production and firm politics about this information;
- Module about control and evaluation of the articles quality (Fig.3) – destined for performing the analysis of data from production and giving the conclusion

about quality of products. On the basis of results obtained, an analysis of tendency towards the quality management has been performed and the corresponding decisions about management of technological process have been made;

- Module about projection of system for active monitoring of processes (Fig.4) – destined for building the topology of monitoring system.

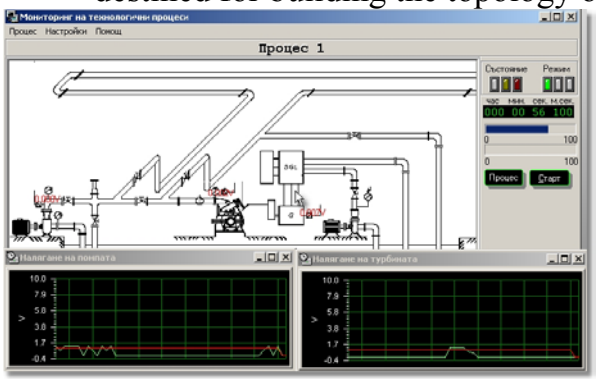

Fig. 2. *Control Manager*

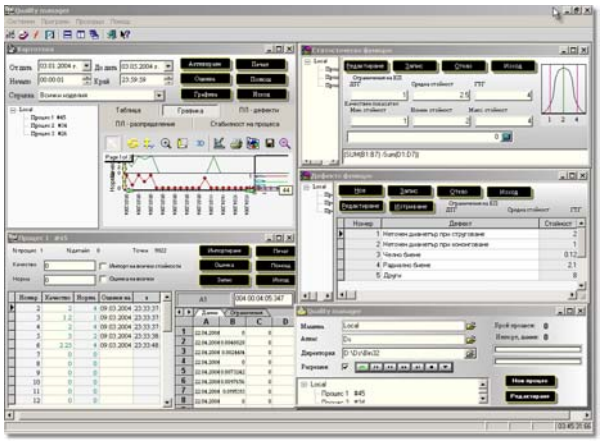

Fig.3. *Quality Manager*

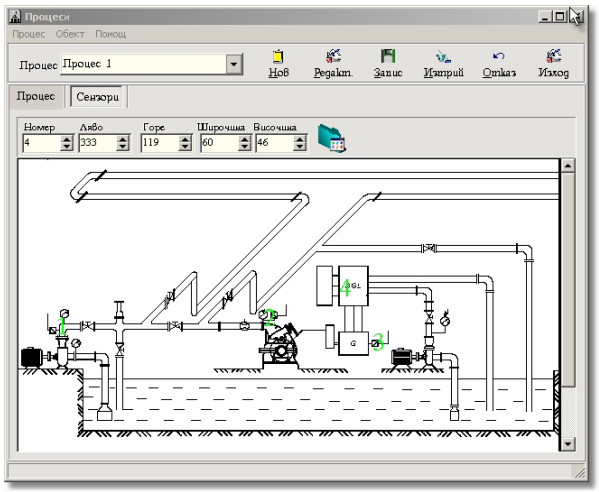

Fig.4. *Library Manager*

The system supports three regimes of operation as their utilization depends on the organization of technological process. The possible regimes of operation are:

- Monitoring of processes and analysis of quality;
- Monitoring of processes, analysis of quality and management in critical situation;
- Monitoring of processes, analysis of quality and full management of the technological process.

The accuracy of analyses is guaranteed by used means and methods for non-assumption and correction of arisen errors in the process of functioning.

5. CONCLUSION

The developed system for active monitoring of quality is distinguished from the known systems of the such kind up to now:

- By virtue of its functional possibilities – analysis of process state and active influence with a view to imposing alterations including an opportunity for determining the tendencies about running of the processes;
- During construction of the system, the most advanced principles and methods for projection and programming of systems operating in regime of real time have been used;

- The inclusion of neuron network in the identification process of system state and the generation of generalized quality index, carrying information on all possible defects defined in the projection process for concrete application, make it with increased degree of intelligence during control and management of quality.

The developed system can be applied to broad class of discrete and discrete continuous technological processes in various fields of production without particular difficulties. For this purpose, it was tested at two systems: system for surface-induction hardening and management of the following system: water pump-pressure pipeline-water turbine-governor. The results obtained confirm the authenticity of conclusions and serviceability of apparatus-programme system.

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