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A Methodical Approach to Ensure the Stability and Quality of Technological Processes

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Abstract

The success of the enterprise in the market depends on the ability to offer goods and services more relevant to the interests and needs of consumers. It is therefore important to pay special attention to such aspects as the level of product quality, is in search of new instruments able to ensure or improve the quality and competitiveness of manufactured products. In this regard, the authors propose an approach based on the use of the quality index of the technological process, taking into account the stability of the technological process and quality of the finished product, which will guarantee the consumer stated the level of quality of manufactured products.

Keywords: the level of product quality, process stability, quality index

1 Introduction

Quality is an important tool in the struggle for markets and ensures the competitiveness of the goods. This takes into account the technical level of production and utility of the goods for the consumer by providing functional, social, aesthetic, ergonomic and ecological properties.

To assess the quality level of similar products used differential, comprehensive, mixed, and integral methods [1...3]. To assess the level of quality diverse products typically use a quality index or index of defects. In addition, to assess the level of quality homogeneous and heterogeneous products using the method of expert assessments of the quality.

While competitiveness is determined by the combination of quality and cost characteristics of products that contribute to customer satisfaction [4]. Continuous improvement of product quality provides great customer satisfaction and can increase the price. Therefore, improving the quality of products helps to increase profits.

2 Experimental study

For continuous improvement of the organization should improve the quality of its processes. Improving the quality of the process is due to deliberate changes in the process characteristics and performance products.

In most cases, enterprises organized sampling, which for all its efficiency is not possible to obtain objective information about the quality of the entire batch as a whole, which in modern conditions of competition between producers may lead to the release of defective products. The use of continuous monitoring is not always possible, either because of the nature of the production cycle, either because of the high cost to the organization of the control.

In these circumstances it is considered appropriate to use statistical control methods that allow you to quickly identify the upset of the process and thereby prevent the production of defective products, thereby implementing the most important requirement of ISO 9000 warn any non-conformance" [5].

When this identification of disorder in a technological process based on the results of periodic monitoring of small samples, carried out on quantitative or alternative features. For each of these methods of control used by its statistical control methods.

Process stability is usually measured at the control cards Shewhart, and the reproducibility of the process in terms of reproducibility index C_p and $C_{pkм}$ [6, 7].

$$C_p = \frac{Z_в - Z_н}{6\sigma}; \qquad C_{pk} = \frac{\left|\overline{X} - Z_{пр}\right|}{3\sigma}$$

where $Z_в$ – the upper limit field access

$Z_н$ – the lower limit field access

$Z_{\text{пр}}$ – one of the bounds of tolerance

C_p – index of process capability

C_{pk} – the critical index of process capability

Probably the greatest value of these indicators is to support efforts aimed at preventing the production of marriage, and that gives a method of monitoring and continuous improvement in a wide range. In addition, these indicators allow to establish effective exchange of information about the potential of the process and its performance on the language that is easy to understand.

The coefficient C_p does not depend on the level settings of the process, it can be taken as a potential measure of quality of the process at its optimal alignment. For real quality characteristic process take the measure of $C_{рк}$. During the work with the index of $C_{рк}$, as the main determinant of the quality of the technological process, whose testimony taken appropriate management decisions, were found the following weaknesses in some special cases [8]:

1. The insensitivity of the measure to increase the share of marriage; if you change the process indicator of $C_{рк}$ remains unchanged, as it is one-sided.
2. The growth rate when the proportion of fatal marriage or bringing a more significant loss increases.

Such drawbacks of the described indicators can lead to incorrect management decisions, therefore, there is a need to develop such indicators, which in these cases would accurately show the level of quality of the process.

The solution to this problem could be the use of the quality index of the technological process I_k, taking into account the stability of the technological process and quality of the finished product. The proposed indicator I_k is calculated by the following formula:

$$I_k = \frac{C_p - 1}{1 - Q}$$

where Q - assessment of the level of product quality.

3 Results and discussion

The value of the level of quality Q in the ideal case will be equal to 1, but in practice this is impossible. The numerator of the formula $C_p - 1$ may be greater than zero only if a satisfactory process. Therefore, if the value I_k becomes negative, it means $C_p < 1$ the result of the production cycle is the production of defective products. Thus, for satisfactory process the value of the index I_k should vary in the range $0 < I_k < \infty$ (upper limit this is the ideal case since this is possible only if $Q = 1$).

The surface features $I_k(C_p,Q)$ may be split calibration scale (line level) on the field, in which the values of the process vary from poor to optimal. The choice of optimal calibration of the scale should be defined within the existing process. For example, you can choose the following scale:

range 1 («very good») – values I_k in the range [3;∞];
range 2 («well») – values I_k in the range [1;3];
range 3 («satisfactory») – values I_k in the range [1/2;1];
range 4 («bad») – values I_k in the range [1/4;1/2];
range 5 («very bad») – values I_k in the range [0;1/4].

The graph of the function index of the quality of the process $I_k(C_p,Q)$ and its line level, according to the scale of desirability, are presented in figure 1.

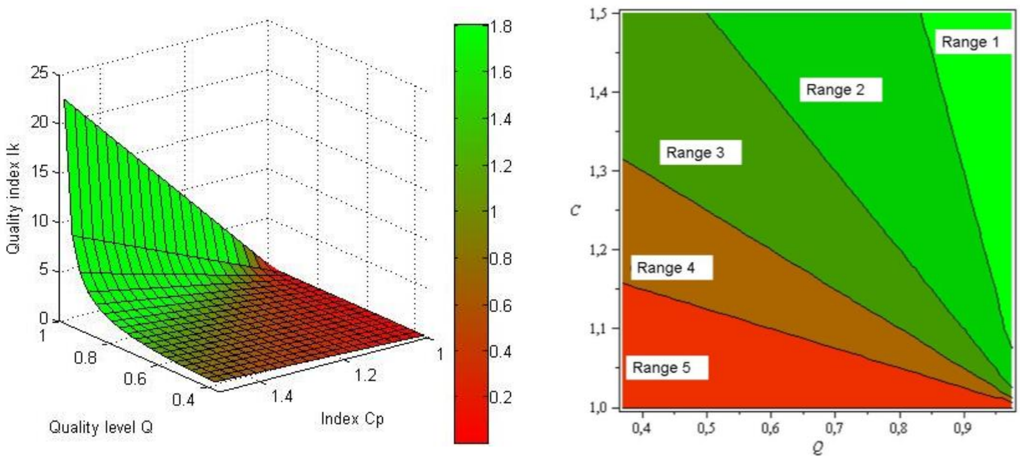

Figure 1: Function of the quality index of the technological process $I_k(C_p,Q)$ and the calibration scale

The best process performance achieved in region 1 (the function I_k takes the maximum value). In region 5 metric values I_k close to zero, indicating the need for corrective actions in the field of quality.

4 Conclusion

Thus, the proposed approach will allow you to get the most reliable results when assessing the quality and stability of the process, which, in turn, will provide greater customer satisfaction with quality products and will help to increase profits.

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