The Application of Statistical Process Control in Quality Management

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Keywords: SPC, Control Charts, Process Capability

Abstract. By exploring statistical process control (SPC) technology in the printing and packaging industry, heat seal strength index sauce packet of products, for example, the production process management and control, the use of control charts to detect instability of the process to achieve early warning features that make the process of continuous improvement, process capability is improved.

Introduction

One basic idea of modern quality management is the product quality statistical point of view. In actual production, occasional fluctuations and abnormal fluctuations in product quality are always intertwined. Abnormal factor is the object of attention, because of the quality of available variation caused by the exclusive control chart found, if found abnormal fluctuations in product quality, we should find out as soon as the abnormal factors, to be eliminated.

SPC Statistical Theory

SPC (Statistical Process Control, SPC) is through the use of techniques such as statistical process control chart analysis or output, in order to make appropriate action in order to maintain and improve the condition of statistical control process capability [1]. SPC practice during abnormal fluctuations in real-time monitoring of potential abnormal trend early warning to managers to take timely measures to eliminate abnormal, restore stability, so as to control and improve the quality of purpose, for industrial production reduce the maintenance rate, stability and strong technical support to improve the productivity of quality assurance.

The Introduction of Control Chart. In the production process, when the influence of the only independent causal factors, product features will follow a normal distribution that is the value of x: $x \sim N(\mu, \sigma 2)$, $P(\mu-3\sigma < x < \mu + 3\sigma) = 0.9973$. X is 1 to fall $(\mu-3\sigma, \mu + 3\sigma)$ is the probability under the control of the line within the 99.73%. Falls on, under the control of the line outside the sum of the probabilities is only 0.27%, which is a very small probability event occurs such probability is called the small probability event. According to the theory of probability and statistics, small probability event in a single experiment is not going to happen. If this happens, then the original distribution affected by systemic factors is out of control. Dr. Hugh Hart made according to this theory it is a control chart method [2], as shown in Fig.

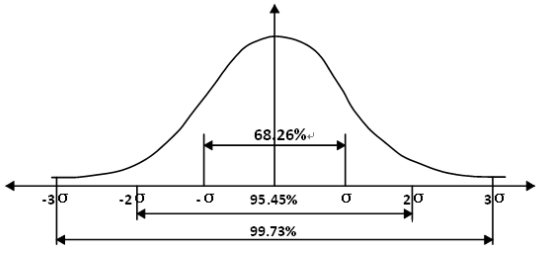

Figure 1. Distribution plot

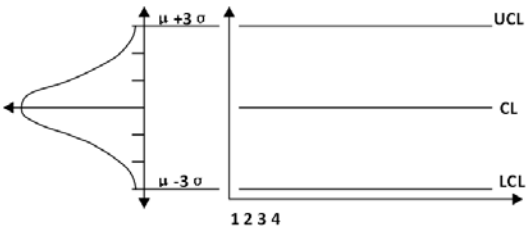

Figure 2. Principle control chart

Control chart has three boundaries to control the quality characteristic value is the actual distribution of the distribution center for the control of the center line μ, denoted by the symbol CL; $\mu + 3\sigma$ to control the upper limit, denoted by the symbol UCL, in order to control the $\mu-3\sigma$ the lower

limit, the symbol denoted LCL [4].

Or trace point arrangement between UCL and LCL if the control points on the graph falls outside the UCL and LCL are not random, then the process anomalies. Control chart has a great advantage that depicted in FIG ideas and control limits in comparison, which can visually see the changes in product or service quality [3].

Quality control chart according to the nature of the data can be divided into the measured value and the count value control chart control chart, the area where they have their own applicable, the application of a reasonable choice is crucial. Metrological control chart -R (mean - Range) is widely used control chart, display diagram for fluctuation between subgroups, observation and analysis of data distribution changes mean that the central tendency of the process; R diagram with dispersion of fluctuations in the display, observation and analysis of the data sub-group distribution of the degree of dispersion of the process that is the combined use of both, for the observed changes in data distribution. -R Control chart applies to products in large quantities, the stability of the process, providing more quality information and high sensitivity.

Process Capability Analysis. Process capability refers to is in a stable state of statistical control process actual processing capacity, process capability index often represented. For technical degree required to meet the targets, the greater the value, the more shows that the process capability to meet the technical requirements, and even a certain degree of reserve capacity. Process Capability Index is calculated:

The no offset short-term situation of bilateral specification process capability index.

When the distribution center coincides with the center of tolerance, it can be directly used to define Cp values are calculated.

$$C_p = \frac{T}{6\sigma} \approx \frac{T_U - T_L}{6\hat{\sigma}_{ST}} \tag{1}$$

Theoffset short-term process capability index case.

Define and regulate the distribution center offset centers M degree, and M and K is an offset of

$$K = \frac{\varepsilon}{T/2} = \frac{2\varepsilon}{T} \tag{2}$$

Then the process capability index (1) is amended to read

$$C_{PK} = (1-K)C_P = (1-K)\frac{T}{6\sigma} \approx (1-K)\frac{T}{6\hat{\sigma}_{ST}} (0 \le K < 1) \tag{3}$$

When 1.33 <(Cp) Cpk when ⩽1.67, show adequate process capability, is an ideal state.

When 1.00 <(Cp) Cpk ⩽1.33, indicating that the process capability is acceptable, should pay attention to control, prevent large fluctuations;

In (Cp) Cpk values close to 1.00, the possibility of defective products increases, this time should be to strengthen the production line product inspection and output sample tests.

When there is insufficient (Cp) Cpk⩽1.00, process capability, should analyze the causes and take the necessary measures [4].

The Application Examples

The author of a study of a plastic packaging plastic color printing business product - sauce packets, sauce packet data on the heat seal strength was tested after the implementation of SPC quality control.

Selecting the Subgroup Size, Frequency and Number of Sub-Groups. The sub-group size - from a combination of general sub-group of 4 to 5 continuous production of products, that the purpose is to make the parts within each sub-group are in a very short time interval between each other and produce there is no other system relations. In this case, the same batch of raw material at the same plant the same team to produce the sauce packet of products, the number of sub-groups of products to 5;

The sub-group frequency - to study the initial process, usually carried out continuously grouping

or grouped in a very short time interval, to check whether the process other unstable factors exist. In this case every 0.05h sampling a subset;

Determining the number of sub-groups - in general, 20-25 or more sub-groups may well be used to detect stability, in this case select 25 sub-groups.

$\overline{X}$ **-R Control Chart Analysis**. Here heat seal strength sauce packet of statistical data, and quickly judged according to results of control chart is calculated using the value of a control chart -R control chart. December 2011 within a certain time of the product $\overline{X}$ -R control chart shown in Figure 3:

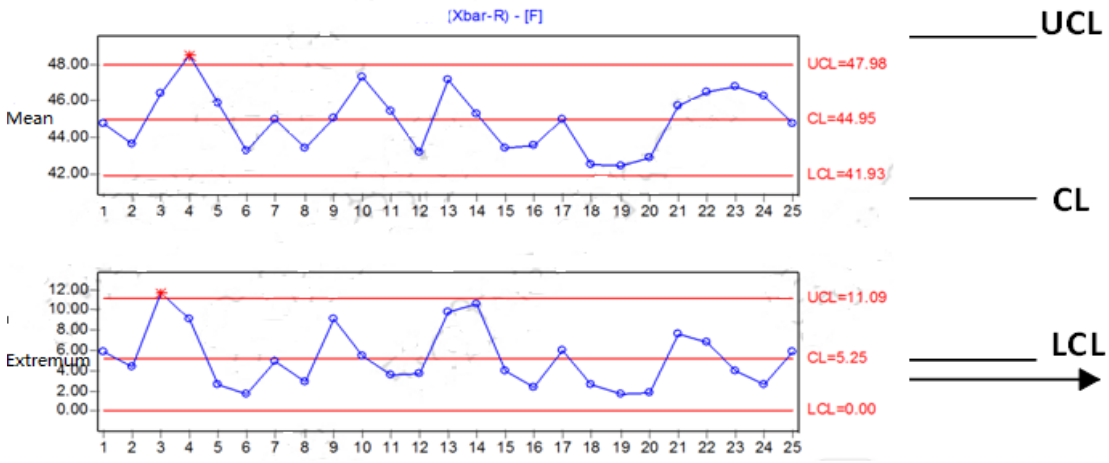

Figure 3. The mean range charts of sauce packet heat seal strength

As can be seen from the figure, a R chart has a point (point 4) exceeds the upper limit, so the process can be judged abnormal, the analysis which is caused due to changes in ink properties, so the need to eliminate this point, re-collect a set of data R a drawing.

Process Capability Analysis. Heat seal strength of the sauce packet process capability analysis to calculate the process capability index, process capability which is shown in Figure 4.

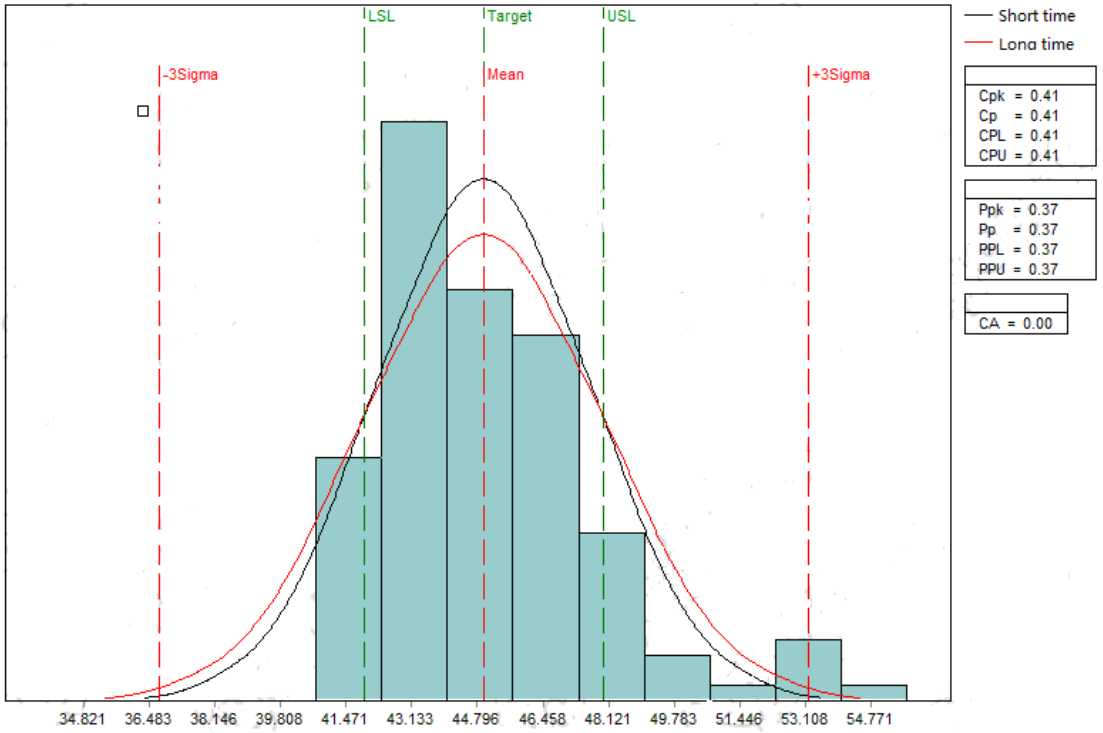

Figure 4. The heat seal strength sauce packet process capability diagram

By the actual process capability figure shows, when the distribution center and the tolerance center does not coincide, in accordance with Cpk criterion for judging the value of the figure Cpk of

0.41, indicating that the process capacity is very low and should take urgent measures to improve the quality and analysis of the reasons, if necessary, checking rationality specifications.

Conclusions

Currently, SPC developed countries in the application of relatively broad, it has expanded in many fields from manufacturing to service industries. Through the dynamic process quality, continuous monitoring, continuous analysis of influencing factors of quality problems, and targeted prevention, continuous improvement to achieve the purpose, can accurately control the quality of products and timely warning, so as to improve product quality, reduce production costs play a multiplier effect for the enterprise has brought huge profits [5]. Enterprises may SPC application as an opportunity to establish a scientific, standardized quality management system to improve the quality of enterprises, thereby enhancing their competitiveness in the market.

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