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Economic Estimation of Quality Process of Coloring Building Products and Designs

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Abstract

The information about the financial losses associated with poor quality products, depending on the state of the production process

Keywords: quality of the painted surface; Process capability index; financial losses from marriage

Introduction

Construction and maintenance of a working condition of buildings and constructions demand a plenty of paint and varnish structures. A growing competition in the market of the finishing materials, raising requirements of consumers demand from manufacturers reception of the high-quality painted surfaces. However practice of manufacture of painting and decorating shows, that poor quality of finish is frequently observed at high quality of paint and varnish materials that results in premature unplanned repair and additional expenses

Methodology

The quality of coatings formed during the manufacturing process of painting works. To assess the potential performance of the process used index - the index of reproducibility C_{pk}. Process capability index is calculated by the formula [1]:

$$C_{pk} = \min\{\frac{\frac{\text{UT - }\bar{x}}{3\sigma}}{\frac{\text{x - LT}}{3\sigma}}\} \quad (1)$$

where σ - the standard deviation;
$\bar{x}$ - the average value of the quality measure;

UT and LT - upper and lower tolerance on quality
when $C_{pk} < 1{,}0$ the process is not reproducible;
when $C_{pk} = 1{,}0$ the process is reproducible, but requires careful attention;
when $C_{pk} > 1{,}0$ the process is reproducible.

The Japanese expert on statistics Taguchi has suggested to characterize made products stability of characteristics and has united cost and quality indicators in so-called function of losses which simultaneously takes into account losses both on the part of the consumer, and on the part of the manufacturer [2,3].

The loss function has the following form

$$L(y_i) = k(y_i - y_o)^2 \quad (2)$$

where L - losses for a society (the size which is taking into account losses of the consumer or the manufacturer for defective production);
k - constant of losses determined in view of charges of the manufacturer of products;
y - value of the measured functional characteristic;
y_o - target value of the examined characteristic.

If you go to a discussion of the level of quality aggregate consisting of N units, the additional costs borne by the consumer or the manufacturer may be defined by the formula

$$L = kd^2 \quad (3)$$

where d^2 -the size equal

$$d^2 = \frac{1}{N}\sum_{i}^{i=N}(y_i - y_o)^2 = \sigma^2 + (\bar{y} - y_o)^2 \quad (4)$$

regarded as the mean square deviation from the target characteristics y defining the quality of some population units.

In accordance with (2) the loss is determined by two sources of variation:

the middle $\bar{y}$ position relative to the target values y_o and spread of values around its middle $\bar{y}$ characteristics.

Results

Let's consider the financial expenses of the enterprise connected to poor quality painting works, depending on reproducibility of process. In accordance with (2) low loss if the process is fine-tuned (arithmetic mean value coincides with the nominal y_o).

An analysis of the process of staining the surface paint PF-115. The quality of the coating surface roughness was assessed value [4]. To evaluate the uniformity of distribution of the roughness parameters were calculated along the strike of the arithmetic mean $\bar{y}$, standard deviation σ. Consider the quality of the painted surface, which is characterized by a class N5. Tolerances for class roughness N5 in accordance with ISO 1302 N5 are: LT = 0,4 mkm and UT = 16 mkm. Tuning the dyeing process for the class roughness N5 implies target y_o = 0,4 mkm equal.

According to the cost of repair painting works ranging from 573 to 1219.54 rubles (on 100m^2), depending on the type of paint composition and production technology of painting works. Suppose that the manufacturer bears the cost of repairing the painted surface due to the lower quality of the appearance of the coating (increased roughness on 0,5 mkm). In accordance with (3) economic constant k will be

$$k = \frac{1219,54}{0,25} = 4878,16 ruble / mkm^2$$

The results of calculations of statistical indicators of the quality of the painted surface and additional financial costs associated with poor quality of finishing are shown in table 1, 2.

Table 1

Statistical characteristics of process of coloring

Way of drawing	Arithmetical mean $\bar{y}$,mkm	standard deviation σ,mkm	index of reproducebility C_{pk}	average standard deviation y from the target characteristics, d^2
brush	4,34/2,89*)	1,74/1,8	0,863/0,579	18,490/9,375
filling	4,31/5,78	1,97/2,22	0,759/0,883	19,091/33,774
pneumatic application	6,97/9,78	3,32/2,5	0,705/1,267	53,966/94,109

The note. *) Above the line shows the values for the viscosity of the ink = 0,001Pas, below the line - for viscosity = 0.00026 Pas.

Table 2
Financial losses of the enterprise depending on reproducibility of process of coloring

Index of reproducibility C_{pk}	0,579	0,705	0,759	0,863	0,883	1,267
Losses *L(y)*, ruble/100m^2	45734,2	263258,9	93130,8	90200,1	164756,1	459080,7

The analysis of the data resulted in table. 2, testifies, that increase of an index of reproducibility C_{pk} from 0,579 up to 1,267 does not correlate with parameters of additional expenses *L (y)*. So, at value of an index of reproducibility C_{pk} of =0,579 losses are minimal and make *L (y)* =45734,2 ruble/100m^2, while at C_{pk} =1,267 - 459080,7 ruble/100m^2. Bad adjustment of process completely destroys all potential advantages of improvement of reproducibility. If process is not adjusted on target value y_o then it is impossible to judge efficiency of process only on a parameter of an index of reproducibility C_{pk}., considering, that if C_{pk}> 1 process is effective. It is necessary to consider the additional expenses connected to loss of quality of production. Of course, the closer the average process to the target value y_o and the less spread of quality indicators, the lower the loss of the enterprise.

Above mentioned results of calculations convincingly testify to importance of exact adjustment of process of coloring of building products and designs.

Conclusions

Thus, the quality of the production process is determined by the financial losses due to deviations of quality indicators from the target value. To optimize the process to be applied technological methods, organization of the process, etc

References

[1] *Statistical methods for quality improvement., Trans. from English*. Ed. H. Kume. Moscow, Finance and Statistics, 1990,304

[2] Ile L. Taguchi Methods - thought, dressed in. Automotive SSHA. **2**(1988), 20-22.

[3] Y. Bragin. *Engineering methods of training and reduce costs by genitive Taguchi. Issue 1.Funktsiya loss.* Yaroslavl: Quality Center, 2005, 68

[4] V. I. Loganina, L. P. Orentliher. *Improving the quality of coatings of building*

products and constructions: Monograph. – Moscow, Publishing Association building universities, 2004, 104.

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