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# The Analysis of Kinds and Consequences Potential Refusals of Protective – Decorative Coverings for Building Products and Construction

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**Abstract**

We use method FMEA for the analysis of the reasons discrepancy of protective - decorative coverings the paper must have abstract.

**Keywords**: Coverings, destruction, risk, the method of FMEA, refusal

## Introduction

It is known, that the volume of finishing the external walls of buildings makes about 30 % from all expenditures of the labor at construction. It is important not only to estimate quality of already existing coverings, but also to carry out the constant analysis of the information on processes of their creation. Such an analysis (monitoring of processes) will allow to reveal the most significant criteria influencing quality.

In our opinion, one of the most effective methods of analytical evaluation processes (including test) is the method of FMEA (Failure Mode and Effects Analysis) [1].

This method defines the technical level of production from the point of view of prevention of mistakes, that is identify potential mistakes and estimations of the

severity of the consequences for the customer (the external side), and also elimination of mistakes or reduction their influence on quality (conclusions for the inside).

FMEA method allows to reveal potential discrepancies, their reasons and consequences, to estimate risk of the enterprise and to take measures to eliminate or reduce the danger.

The analysis of character and consequences of refusals is produced using the priority factor of risk (number of risk) Kp, which shows what possible refusals (and their reasons) are the most significant (relative priority of the separate the refusals/ the reasons) and, hence, for some of them should be taken preventive measures first of all.

Risk coefficient $K_p$ is calculated by the formula

$$K_p = K_n K_н K_o, \quad (1)$$

where *Kp* - coefficient taking into account the importance of the consequences of refusal (the severity of the manifestations of reasons of refusals) for the consumer;

*Kn* - coefficient taking into account the probability of $P_н$ with which refusal or its reason cannot be detected before the appearance of the consequences directly for the consumer;

*Ko* - coefficient taking into account the probability *Po* of refusal.

Each of these three coefficients may have a value in limits from 1 up to 10, so the risk coefficient $K_p$ changes from 1 up to 1000.

Usually considered dangerous reasons when Kp> $K_{рп}$ = 100 (150) (where $K_{рп}$ - limiting value Kp accepted at the enterprise). Thus it is necessary to pay attention to the elimination of the reasons that are characterized by the highest values of the risk coefficient. It is right, when all of the reasons of defects are checked for the possibility of measures to eliminate them. However, to reduce costs we should focus on decreasing the value of Kp, i.e. Kp establishes the priority of sequence of necessary actions.

## The results of studies

We make attempt to carry out the analysis of some kinds and consequences of potential refusals of protective - decorative coverings of building products and using method FMEA. We considered two variants.

The first variant - the colouring of designs is made in the factory and the company is responsible for the quality construction and the quality finishes. The destruction of a covering during service does not lead to loss of functional properties of the system «a covering - a design».

The second variant - the painting of building construction is carried out by an organization that specializes in finishing works. The organization is responsible only for the quality of finish.

Let's consider FMEA painting of building products or constructions in the factory (the first variant), which will allow to estimate the root causes of refusals of system "covering - substrate".

The protective - decorative covering is a finishing layer, which put on the surface of a building construction (the substrate). Thus «a covering - the substrate» is taken as the system.
1. The main functions of a covering:

1.1. provide protective properties of not less set level,
1.2. provide decorative properties of not less set level.
2. A substrate is a surface of a building product or construction for painting. Requirements are:
2.1. the clean surface (not grease, dust, etc.),
2.2. porosity of surface is not more 5%,
2.3. humidity of a surface is not more 8%.
Let's consider the definition of refusals and their consequences for the overall system.

**1.1. Possible refusal of system can take place at infringement of any function.** In the given example we shall consider refusal at infringement only one function «an opportunity of loss of protective properties». The appearance on the painted surface mesh cracks is refusal [2, 3, 4].

**1.2. An estimation of possible consequences of refusal.** Cracked coverings lead to loss of their decorative and protective functions, but the functions of the building construction are retained. This impact must be assessed value of the coefficient K = 4.

**1.3. Measures on detection of refusal and an estimation of probability of not detecting (pass) it.** Refusal can not be revealed until the moment of use. In this case, $К_н$=10.

1.4. **The possible reasons of refusal and measures to prevent them. An estimation probability of refusal.** The reasons of refusal are:

- a significant thickness of the covering. We accept Ko=2;
- rough porous surface of the substrate. We accept Ko=2;
- traces of dirt and dust on the surface. Ko = 1;

**1.5. An estimation of risk.** Calculation of the risk coefficient Kp we shall carry out for the reasons. For the first reason the risk coefficient Kp is Kp =4x10x2=80, for second reason Kp =4x10x2=80, for third reason Kp =4x10x1=40. The received values of the risk coefficient separately do not exceed allowable, however at their combination the enterprise have a significant risk at release painted product. Therefore we should carry out the following steps of analysis.

Table 1
FMEA systems «a covering - a substrate»

| FMEA systems «a covering - a substrate» | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| The element of system "covering" | | | | | | | | |
| Function - the providing of the specified protective properties | | | | | | | | |
| The number of refusal | A possible refusal | The possible consequences of refusal | $К_п$ | Measu-res to detect | $К_н$ | Possible reason of refusal | $К_о$ | $К_р$ |
| 1 | The cracking | Loss of protective properties | 4 | | 10 | Thick layer of a covering | 2 | 80 |
| | | | | | | Traces of a dust, dirt | 1 | 40 |
| | | | | | | Rough porous surface | 2 | 80 |

**1.6. A conclusion**: At a combination of the possible reasons of refusal at the next analysis stage it is necessary to investigate the components of "Covering" with refusal of function «Loss of the protective properties».

Let's consider FMEA process painting of building products in conditions of construction site (the second variant).

The protective - decorative covering is considered as the system consisting of a proper covering layer, primer and putty.

Functions of a covering and the requirement to a substrate are stated above.

Let's consider definition of refusals and their consequences for the common system. We restrict consideration a grid of cracks on a surface of a covering.

**Estimation of possible consequences of refusal.** Cracking coverings lead to loss of decorative and protective functions. Such influence we estimate of the coefficient Кп=8, because discrepancy to requirements causes disappointment to the consumer, but issues of safety are not affected.

**Measures on detection of refusal and an estimation of the probability** of not detecting (pass) it. Refusal cannot be detected until the moment of use. . In this case, Kn = 10.

**The possible reasons of refusal and measures to prevent them. An estimation probability of refusal.** The reasons of refusal are:

- significant thickness of the covering. We accept $К_о$=8;
- rough porous surface of the substrate. We accept $К_о$=6;
- traces of dirt and dust on the surface. We accept $К_о$ = 4.

**Estimation of risk.** The calculation of the risk coefficient Kp we shall carry out for reasons. For the first reason the risk coefficient Kp is Kp =8x10x8=640, for second reason Kp =8x10x6=480, for third reason Kp =8x10x4

=320. The received values of the risk coefficient exceed allowable and confirm the significant risk of the enterprise at performance of the finishing work and the need for subsequent analysis stages.

Thus, depending on the specialization, the risk of the organization will be different and the degree of her responsibility before the consumer will be different too. Application of the FMEA will allow develop measures to improve the quality and reduce the risk coefficient to an allowable level.

## Conclusion

In the following, results of implemented measures (monitoring progress) should be defined by comparison the risk coefficient with the limit value. Naturally, that it is necessary to select such measures which reduce risk up to a required level, and realized with the least expenses of time and money.

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