CALCULATING FAILURE INTENSITY BY THE FAILURE FLOW PARAMETER VALUE

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Analytical dependences are worked out to define the failure intensity of objects by the failure flow parameter.

The defined analytical dependences can be used to work out the standard consumption of spare parts.

Keywords: force of mortality, failing; interval; rebuilding

1. INTRODUCTION

In come cases it is easier to define the failure flow parameter of machines and if computing the failure intensity is needed we can go two ways:

A. The following dependences are worked out for objects that are fully rebuilt after refusal:

$\omega(t) = g(t)/T_N(t)$ and

$$\omega(t) = \int_0^t \lambda(\tau)\varphi(\tau)d\tau,$$

where $\varphi(\tau)$ is the distribution density of the operating interval of the object until the moment τ

$\lambda(\tau)$ - failure intensity;

$q(t)$ - failure probability;

$T_N(t)$ - the operating period of an object in the observation interval;

$\omega(\tau)$ - failure flow parameter.

The immediate use of expression $\omega(t) = g(t)/T_N(t)$ is practically hardly workable because of the complicated transformation of the function $\omega[\lambda(\tau)]$ into $\lambda[\omega(\tau)]$.

This is why it is possible to use the expression $\omega(t) = \int_0^t \lambda(\tau)\varphi(\tau)d\tau$ differentiating it by the time t:

$$d\omega(t_1) = \lambda(t)\varphi(t),$$

from where $\lambda(t) = d\omega(t)/\varphi(t) + \lambda_0$.

If the function $\omega(t)$ has a permanent component then it should be added $\omega_0 = \lambda_0$.

B. For an arbitrary distribution of the failure interval of the object the process of their setting in can be presented as a branched process. By the time axis t the operating period of the objects that are working without rebuilding from the beginning of exploitation is reported. By the axis $t - \Delta t_1$ the operating period of the objects that were turned on after the beginning of exploitation t=0, after the interval Δt_1, etc.

2. Materials and methods

Meanwhile in spite of the defected objects on the time axis are marked the new ones, which are already registered on the lower time axis Δt_i. The time interval Δt_i is chosen by the condition two or three residuals to occur in it. The interval values Δt_i can be different.

At the t=0 moment the failure intensity and the failure flow parameter are equal: $\lambda_0 = \omega_0$. In the $t_1, \ldots, t_2$ interval the objects that have not failed are working and the ones that are rebuilt and the ones that were put to work later. The statistic density of the operative periods of those objects is equal respectively to $\varphi_{11}(t_1)$ and $\varphi_{01}(t_1)$. That is why the average failure flow parameter in the $t_1, \ldots, t_2$ interval is:

$$\omega^*(t_1) = \lambda_0 \varphi_{01}(t_1) + \lambda(t_1)\varphi_{11}(t_1),$$

from where

$$\lambda(t_1) = \frac{[\omega^*(t_1) - \lambda_o \varphi_{01}(t_1)]}{\varphi_{11}(t_1)}.$$

Until the t_2 moment

$$\omega^*(t_2) = \lambda_0 \varphi_{02}(t_2) + \lambda(t_1)\varphi_{12}(t_2) + \lambda(t_2)\varphi_{22}(t_2) \text{ or}$$

$$\lambda(t_2) = \frac{[\omega^*(t_2) - \lambda_0 \varphi_{02}(t_2) - \lambda(t_1)\varphi_{12}(t_2)]}{\varphi_{22}(t_2)}, \text{ etc.}$$

Therefore at a occasional moment j the failure intensity is:

$$\lambda(t_j) = \frac{\omega^*(t_1) \sum_{i=0}^{j=1} \lambda(t_1)\varphi_{ij}(t_j)}{\varphi_{ij}(t_j)}. \qquad (1)$$

The statistic density of the operating period of the objects $\varphi_{ij}(t_j)$ is the part of the objects that have an operating period equal or bigger than t_i of the sum $N(t_j)$ of the ones that are working at the t_j moment.

$$\varphi_{ij}(t_j) = \frac{N_j(t_i)}{N(t_j)}. \qquad (2)$$

where $N_j(t_i)$ is the number of objects that have an operating period t_i at the t_j moment.

If we use (1) we can build the histogram of $\lambda(t)$ and then approximate it with a mathematical dependence.

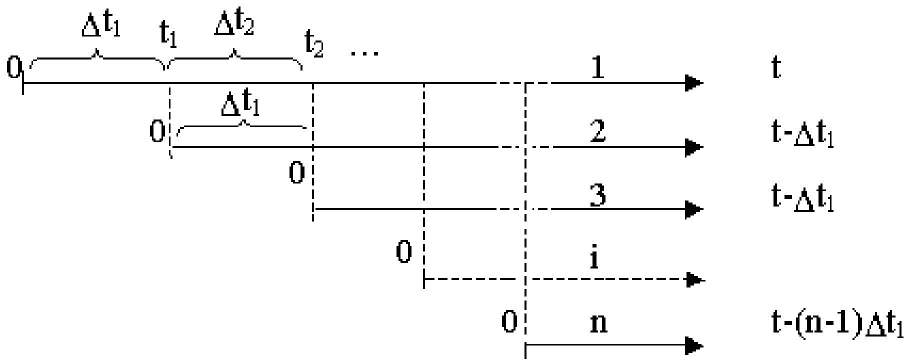

Fig.1 Scheme of a branched process of the operating periods of objects, which have been rebuilt after failure

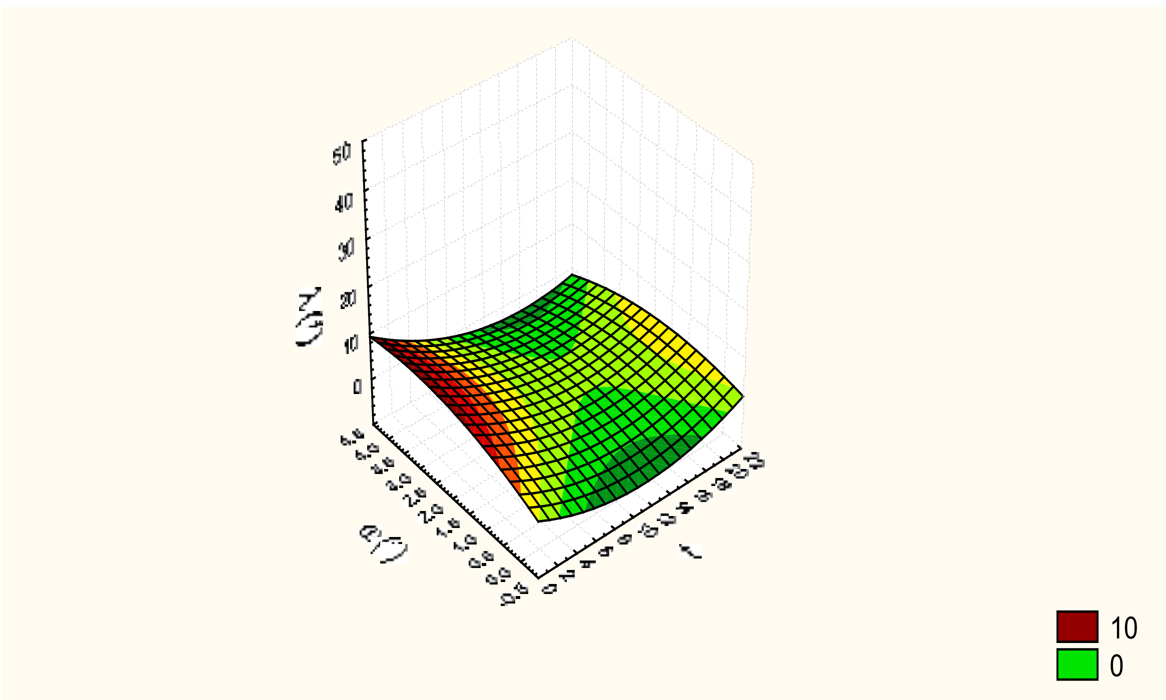

Fig.2 Character of variation intensity of the failure flow λ(t) in dependence of failure flow parameter ω and operating period of the objects t

3. Conclusions

1. Analytical dependences are worked out to define the failure intensity of objects by the failure flow parameter

2. The defined analytical dependences can be used to work out the standard consumption of spare parts.

4. References

[1] Chervenoi A., *Nadejdnost Clojnoi Sistem*, M., 1972.

[2] Truxanov B., *Nadejdnost Izdelia Machinostroenia*, M., 1996.

[3] Tassev G., T. Vassilev, D. Kortchakov, *Calculation of the Curve of the Failures Flow in Individual and Joint Repair of the Objects*, Agricultural engineering, No 3-4, pp 58-63, 1999.

[4] Tassev G., *Optimization of the Periodicity of the Machinery Maintenance*, Agricultural engineering, No 1, pp 53-55, 1996.