UDC 677.055.621

TO ANALYSIS OF DETAILS ON LONGEVITY AFTER CRITERION OF THE FATIGUE STRENGTH

Leonid Berezin
Kiev National University of Technologies & Design, Ukraine

The increase of single production capacities of equipment results in the substantial increase of loadings in mechanisms, especially in an equipment with the traditional recreation of technological process. Therefore along from project self-reactance and functional descriptions of equipment there is also a growing requirement to the level of its longevity. The analysis of observations on productions certifies that determining for most details are signs of the fatigue destruction.

The purpose of work is to trace the narrow direct of analysis of longevity applicable to the details of complex forms, which do not fall under traditional complex decision.

The calculation of longevity is executed in the traditional (deterministic) or probabilistic staging. The first is based on retrospective information about longevity of operating equipment, the second – on statistical descriptions of strength of material and loading of details.

Comfortable on the stage of elaboration of requirement specification are calculations after the coefficient of reserve of longevity. This coefficient is set for every detail separately on the basis of experience of designer comparing of the expected values to the results of observation on production in exploitation. This estimation of longevity is convenient in practice, however, it doesn’t characterize the level of reliability in an obvious kind. The change of any factor of influence compels to define more precisely a value the coefficient of supply and makes impossible its application as normative description. Sometimes it’s recommended to use the method of the differentiated determination the coefficient of supply of longevity as product of a row of coefficients, each of which takes into account a separate factor and also sets in certain limits. Experience testifies that expected thus value a coefficient not justified, as resulting in the considerable varying.

The transferred failings are removed at application of method [1], where after equalization of the crooked fatigue of detail the value of the limited longevity in the cycles of loadings is obtained:

$$N = N_G \left(\frac{\sigma_{-1Д-}}{\sigma_{-1ДN}}\right)^m \cdot, \qquad (1)$$

where N_G − an abscissa of inflection point the crooked fatigue $\sigma_{-1ДN}$ − amplitude of stress in a detail at a symmetric cycle and number of cycles of loading N; m − a parameter of inclination of area of the crooked fatigue of detail. Limit of fatigue of detail of natural sizes is determined experimentally or analytically after a typical method for the details of general machine-building. For the calculation of limit of fatigue of detail enter a coefficient, which takes into account influence on limit of fatigue of material of structural, technological and operating factors.

However much complication of forms of details and inconstancy of factors of influence results in considerable errors at determination $\sigma_{-1Д}$. Therefore this approach is expedient only in calculations during modernization of equipment with the use of versatile statistical information.

At planning of perspective models with heredity of construction after the set resource after the criterion of the fatigue strength positions of calculations [2] are offered, where dependence of equivalent stress $\sigma_{екк_i}$ is used in a dangerous cut from the proper number of cycles of loading N_{pi} to destruction:

$$\sigma_{екк1}^{m} N_{p1} = \sigma_{екк2}^{m} N_{p2}, \qquad (2)$$

where m − a parameter, which takes into account inclination of working area of the crooked fatigue of detail, which is built from data of operating supervisions; indices i =1, 2 correspond to the parameters to and after planning. Usually such approach will be realized at presence of accumulated empiricists about the resource of details and analytic about their impact loading.

The determined calculations of the tired longevity are transferred giving general conclusions about faultlessness of object for a calculation resource without its quantitative estimation that behave to the calculations of reliability only conditionally. The calculated value of equivalent tension answers 50 % probability of destruction of detail. In calculations with the beforehand set probability it is recommended to enter a conditional coefficient $K_{\sigma} = 10^{U_p \sigma_{\lg N_p}}$, where $\sigma_{\lg N_p}$ is a standard deviation logarithm of middle longevity in the cycles of loading; U_p − a quintile of normal distribution.

While applying probabilistic calculations on longevity it is necessary to take into account inconstancy of parameters of strength of details and terms of their loading. The typical methods are little adjusted for the details of difficult forms.

The author offers calculation-experimental method [3] of determination of longevity after the curve of fatigue of detail, which was built as a result of power analysis and information about its resource to destruction. A calculation includes the followings actions: determination of the maximal loadings on a detail; calculation of equivalent stress in its dangerous cut and proper number of cycles of detail for the term of service to destruction from data of operating supervisions; construction of working part of branch of the crooked fatigue of detail, which characterizes limits of the limited fatigue of detail at the proper numbers of cycles of loading. Analytical expression of the shock loading was presented as polynomial, which was got numeral analytical by a method with the use of calculable experiment. The calculation of longevity was executed in the case of not banal description of casual values nonlinear equalization which does not submit classic normal distribution. The limited limit of fatigue of detail is determined for the numbers of cycles, which are responsible for longevity on a refuse by the linear hypothesis of addition of the fatigue destructions.

The curve of fatigue, which characterizes median longevity of details and expresses the number of cycles to destruction, was built after calculated these parameters for of the same type details which had different terms of loading. It is rationally to use a method foremost in the specified calculations for acceptance of final decisions at planning of mass production.

The resulted information served mathematical support at the choice of designer decisions at an improvement and project of automatic half-hose machine.

References

1. Troschenko, V.T. (1978), Prochnost' metallov pry peremenny'kh nahruzkakh [Strength of metals at variable loadings], Kiev, 174 p.
2. Berezin, L.M.(2001), Improvement of knitting equipment based on calculations longevity knitting machinery details [Udoskonalennya trykotazhnoho obladnannya na osnovi rozrakhunkiv dovhovichnosti detaley vyazalnoho mekhanizmu], Bulletin of the Kyiv National University of Technologies and Design, 2001, №1, pp. 70–73.
3. Berezin, L.M. (2006), Probabilistic calculations longevity selectors on the criterion of fatigue strength[Imovirnisnyy rozrakhunok dovhovichnosti selektoriv po kryteriyu vtomlenisnoi mitsnosti], Bulletin of the Kyiv National University of Technologies and Design, 2006, №3, pp. 35 – 41.

UDC 677.027.615

OPTIMIZATION OF TEXTILE COMPOSITES FORMATION PROCESS

A.N. Biziuk, senior lecturer

N.N. Yasinskaya, associate professor

Vitebsk State Technological University, Vitebsk, the Republic of Belarus

Keywords: modeling, formation, textile composites, polymer composition, microwave and IR exposure, generalized desirability function, Derringer desirability function.

The aim of this work is modeling and optimization of the processes occurring during the formation of textile composite materials with impregnation method using modern methods of intensification of physical and chemical processes with using electromagnetic waves of microwave (MW) and infrared (IR) bands that reduce the energy consumption of basic processes and conducting of a comparative analysis of the effectiveness of high intensity methods of forming the textile composite material.

The experiments used the polymer composition (aqueous dispersion of styrene-acrylate) of the three concentrations: 100 g /L 200 g/L 300 g/L; radiation power was set at three levels: 300 W, 450 W, 600 W microwave and 1800 W 2200 W, 2600 W for IR.

Optimizing the process of formation of textile composite materials requires finding such process parameters, when multiple result indicators are optimal: energy