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COMPUTER STUDY OF THE PERFORMANCE OF COUPLINGS WITH HIGH COMPENSATING ABILITY

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Abstract
The work examines the performance of elastic compensating couplings with a toroidal shell. The SolidWorks program was used for calculations. Zones of critical stresses arising in the toroidal shell are determined. The results of the study make it possible to predict the service life of such couplings under different load schemes.
Keywords. elastic couplings, performance characteristics, stress diagrams

Introduction

The main purpose of elastic compensating couplings is to reduce the dynamic load and prevent oscillations. Also, elastic couplings allow compensation of the relative position of the connecting shafts.

Elastic couplings are divided into couplings with metallic and non-metallic elastic elements. The most common are elastic compensating couplings with a rubber (rubber cord or polyurethane) elastic element, due to a number of useful properties. The specified elastic elements are able to withstand larger deformations, have greater overloading capacity, high internal friction, etc. The disadvantages include their large diameter and the appearance of significant axial loads on the shaft supports. The intensity and nature of dynamic loads (shocks, vibrations) due to the nature of the machine's operation have a significant impact on the operation of the clutches.

One of the types of elastic compensating couplings with non-metallic elements is couplings withtoroidal shell. Flexible toroidal shell couplings transmit torque through rubber and rubber cord elastic inserts.Semi-couplings are installed on both cylindrical and conical shaft ends. The torque from the semi-coupling to the shell is transmitted by the frictional forces created when the screws are tightened [1].

The purpose of the work is researchthe effect of axial, radial and angular displacement of connecting shafts on stresses arising in coupling elements.

Results and discussion

Elastic couplings are characterized by: stiffness, damping, energy consumption. During the operation of elastic couplings, there is always a loss of energy due to friction, which is accompanied by deformation of its elastic elements and their movement relative to other parts of the coupling. Torus couplings are ideal for reverse operation because the working cord rotates in two directions. Also, the advantage of this coupling is the possibility of external inspection to detect signs of wear. Moreover, the replacement of the elastic element itself can be carried out without shifting the shafts.

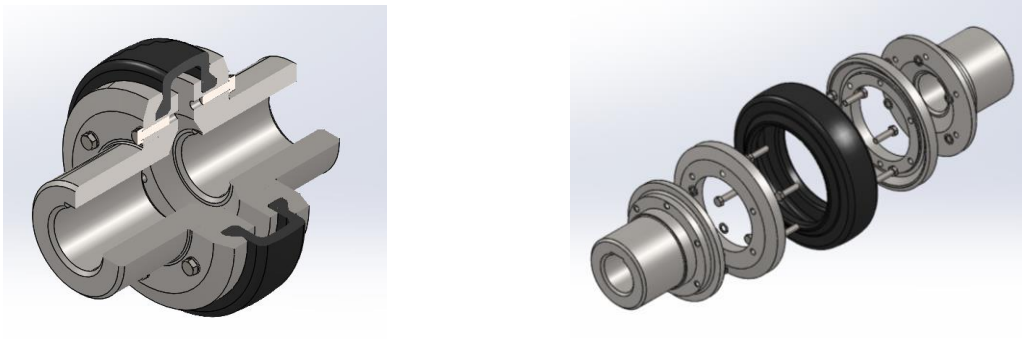
We will use the program for modeling and researchSolidWorks. The studied design corresponds to the parameters of Stromag Periflex Shaft Couplings [2]. These couplings have the following main characteristics: max speed: 1000 - 5000 rpm, static torque: 35 - 20500 Nm. Couplings of this type also include couplings from other manufacturers, in particular SKF Flex coupling [3].

A visual representation of nonlinear stress-displacement relationships is provided by hysteresis loops obtained during cyclic loading of nonlinear (elastic) material. The area of the hysteresis loop is numerically equal to the energy that is absorbed during the deformation of the shell and turns into heat.

Thus, to determine the torsional flexibility of the rubber shell, it is necessary to construct a characteristic of the dependence between its torsional deformation and the transmitted elastic moment. At the same time, static loading of the shell is used, which assumes that the speed of the load program does not exceed the

speed of relaxation processes in the polymer materials from which it is made. Such load modes allow determining the dependence of the elastic-damping properties of the shells on the technological parameters.

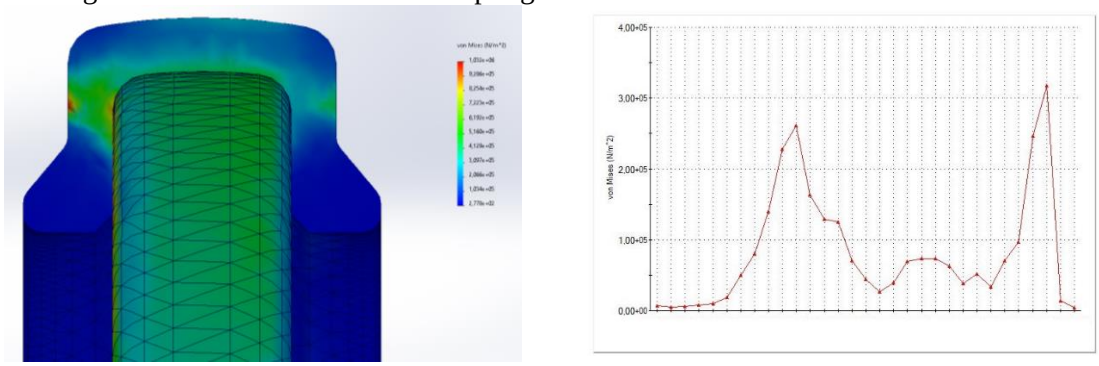
Data on resistance to static deformation under a single load indicate significant nonlinearity of integral characteristics that determine the relationship between torque and angular displacements. In turn, these forces and displacements generate radial and axial displacements, and their overall combination determines the zones of accumulation of damage and destruction. The real load conditions of torus-shaped rubber cord sheaths require a transition to the analysis of not only cyclic, but also thermocyclic processes of deformation and destruction.



a b

a- section of the elastic coupling model;
b – model with different elements

Figure 1. Diagram of a model of an elastic coupling with a toroidal element



a b

a- stress plots in the cross section;
b – stress graph on the outer surface

Figure 2.Plots of stress distribution Von Misesin a toroidal elastic element

The analysis showed that the greatest stresses occur in the torus-shaped elastic element (Fig. 2). The stress graph on the outer surface of the toroidal elastic element indicates the presence of the greatest stresses on two sides. This testifies to the probability of cracking precisely at the boundary of the zone of attachment of the elastic element to the right and left half-couplings.

Conclusions

After conducting a study of the relationship between the twisting angle of an elastic coupling with a toroidal shell and the torque, we obtained an exponential dependence, which indicates the presence of a critical value of the torque, after which the twisting angle does not change. With a further increase in torque, damage accumulation zones appear.

In turn, external radial and axial forces lead to radial and axial displacements of the half-couplings, respectively. It was established that with the same values, axial forces have a greater influence on the occurrence of displacements and subsequently on the occurrence of damage than radial forces. Due to the

design of couplings with a torus-shaped elastic element, the angular displacement of the shafts can reach 3 degrees. Radial misalignment, depending on the size of the coupling, can reach 2.8 mm.

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КОМП'ЮТЕРНЕ ДОСЛІДЖЕННЯ ПРАЦЕЗДАТНОСТІ МУФТ З ВИСОКОЮ КОМПЕНСУЮЧОЮ ЗДАТНІСТЮ

Анотація

В роботі досліджено працездатність пружних компенсуючих муфт з тороподібною оболонкою. Для розрахунків використовувалась програма SolidWorks. Визначені зони критичних напружень, що виникають у тороподібній оболонці. Результати дослідження дозволяють прогнозувати ресурс експлуатації подібних муфт при різних схемах навантаження.

Ключові слова: пружні муфти, характеристики роботи, епюри напружень

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