STUDY OF THE HEAT RESISTANCE OF ANAEROBIC SEALANTS AN-6K AND AN-103

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Abstract: The article presents an analysis of the causes of interference fit failure, existing restoration methods and their drawbacks, as well as a study on the heat resistance of anaerobic sealants.

Keywords: restoration, bearing, anaerobic sealant, fixed connection, durability, method, service life.

Introduction. The durability of agricultural machinery is largely determined by the longevity of the stationary bearing assemblies [1]. During operation, the stationary fit is compromised due to wear of the mating surfaces. Wear of the bearing seating surfaces in housing components and shafts leads to reduced machine lifespan. As wear increases, clearances in the assemblies grow, misalignments occur, vibration intensity rises, and bearing surface spalling accelerates. As a result, the service life of bearings, shafts, gears, and other components is reduced. For example, in the case of a 208 bearing with a clearance of 0.095 mm, its service life decreases by 1.4 times, and with a clearance of 0.139 mm - by 1.8 times compared to the calculated value.

The bearing seats for rolling-element bearings are restored using methods such as welding, application of electrolytic coatings, electro-contact surfacing, gas-plasma spraying of powders, installation of additional rings, and other techniques [2,3]. Most of these methods have certain disadvantages, the most common of which include the complexity of the technological process, the need for expensive equipment, low efficiency, high production cost, and difficulty in machining the applied coatings.

Most of these drawbacks are eliminated when restoring bearing seats using anaerobic sealants [4,5]. The sealant layer prevents contact and fretting corrosion of the mating surfaces and significantly increases the durability of fixed joints.

Anaerobic sealants are multi-component liquid compositions capable of remaining in their original state without changes in properties for a long time and curing rapidly at temperatures of 20–25°C when contact with atmospheric oxygen is disrupted [5]. Studies have shown that the durability of stationary joints restored with anaerobic sealants depends on their heat resistance. Therefore, one of the key indicators determining the performance of anaerobic sealants during operation is their thermal stability. However, the literature lacks data characterizing the changes in the physical state of anaerobic sealants at elevated temperatures.

Method. The heat resistance of anaerobic sealants was evaluated based on the change in elastic modulus within the temperature range of 20 to 100°C. The elastic modulus was determined using Hertz's formula [4,5].

$$E = 0{,}795\frac{P}{\Delta^{3/2} d^{1/2}},$$

where: P–load on the ball, equal to 50 N;

Δ – depth of ball indentation, mm;

d – diameter of the ball, equal to 10 mm.

Results. The dependence of the elastic moduli of anaerobic sealants AN-6K and AN-103 on test temperature is shown in Fig. 1. As the heating temperature increases, the elastic moduli of the anaerobic sealants decrease. At a temperature of 20°C, the elastic moduli of AN-6K and AN-103 sealants are 3980 MPa and 1200 MPa, respectively. At 40°C, the elastic modulus of the AN-6K sealant drops sharply to 2612 MPa, which is 1.5 times lower than at 20°C.

2 – AN-103 (cured at 100°C); 3 – AN-103 (cured at 20°C). As the test temperature increases from 40 to 100°C, a further decrease in the elastic modulus is observed, although the rate of decrease is insignificant. At 100°C, the elastic modulus is 2180 MPa, which is 1.8 times lower than at 20°C.

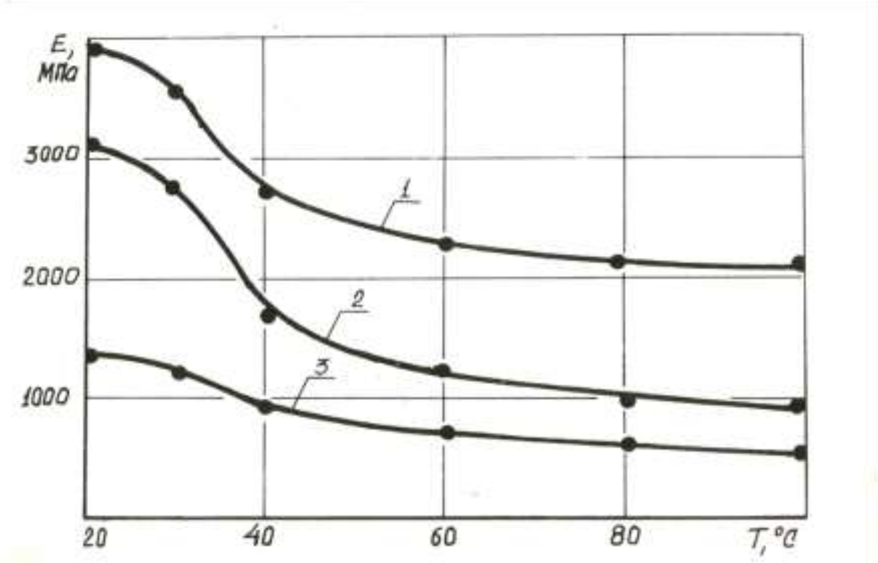

fig. 1. Dependence of the Elastic Modulus E on the Test Temperature T

Connections restored:1 – AN-6K (cured at 20°C);

2 – AN-103 (cured at 100°C); 3 – AN-103 (cured at 20°C).

Similar results were obtained when studying the effect of heating on the elastic modulus of the anaerobic sealant AN-103. For the AN-103 sealant, at 40°C, the elastic modulus is 952 MPa, which is 1.2 times lower than at 20°C. At 100°C, the elastic modulus of this sealant is 602 MPa, which is 2 times lower than at 20°C.

Anaerobic sealants, cured at high temperatures, have higher elastic moduli both at 20°C and at higher temperatures. For example, the elastic modulus of the anaerobic sealant AN-103, cured at 20°C, is 3112 MPa, which is 2.1 times higher compared to the modulus of the sealant cured at 20°C. The elastic modulus of AN-103, cured at 100°C, is highly temperature-sensitive. For instance, at 40°C, the elastic modulus is 1.9 times lower than at 20°C. In the temperature range from 40°C to 100°C, a decrease in the elastic modulus is also observed, and at 100°C, it is 980 MPa, almost 3 times lower than at 20°C. Thus, the results of the thermal stability studies of anaerobic sealants show that as the temperature of the test increases, the elastic moduli of anaerobic sealants decrease.

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