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UNITS WEARABILITY OF AIRCRAFT WING LIFT DEVICES

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The test of high-strength materials for wearability in conditions of fretting which are used for manufacture parts of responsible units of aircraft wing lift devices is made. Recommendations for materials changing, which provide increasing of wearability into two times, are given.

Introduction. One of the most responsible units of aircraft wing lift devices are elevators of leading-edge and trailing-edge flaps. The elevators serve for moving of leading-edge and trailing-edge flaps after take-off and before landing. The elevator represents itself a pair screw-nut (fig. 1) with intermediate marbles, which serves for the transmission of the effort from the screw of drive on a nut, which is fastened on the carriage of the flap. A carriage moves on the rail of wing lift devices and pulls out a wing flap on a certain trajectory.

The elevators of leading-edge and trailing-edge flaps are especially responsible units on an airplane. They work in unisolated from an external environment space. It means that they work under the influence of complete operating range of temperatures and in the conditions of all atmospheric influences. The refuse of any elevator in the process of flight results to the special situation [1].

Formulation of the problem. Last years a lot of literature [1–3] are devoted to the problem of the damages of units of airplane wings lift devices.

In work [2] the problem of choice of gas thermic covering for proceeding in the threadbare areas of rails of wing lift devices was examined. Tests on durability of tripping and wearability during contact dynamic loading were carried out.

The authors of the work [3] conducted researches on wearability in the conditions of fretting corrosion and tiring durability, for the choice of materials, which will precede the units of wing lift devices. In the process of work, they defined that the most acceptable material for renewal is plasma coverage of molybdenum.

Mainly this work is appointed to the problem of increasing the wearability and proceeding of the rails of lift devices of the airplanes wings. However, the units of airplane wing lift devices consist also from a screw and the nut that moves the wing flap by the rail.

In the article [1] we examined the damage of the airplanes wing lift devices units under the action of the special type of wearing – the fretting-wear and atmospheric influence (fig. 2). Metallographic and fractographic researches of damaged details were conducted. The recommendations according to diminishing of damages of wing flaps elevator in the process of exploitation were developed. However there were conducted no researches on wearability of highly strong materials which could be possibly used for producing the screw-nut pair of friction.

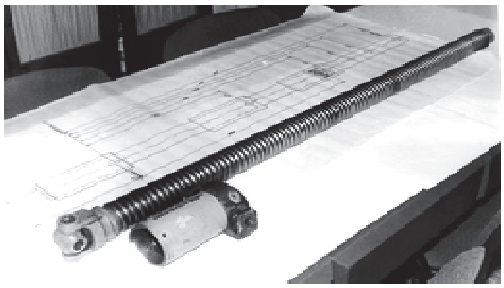
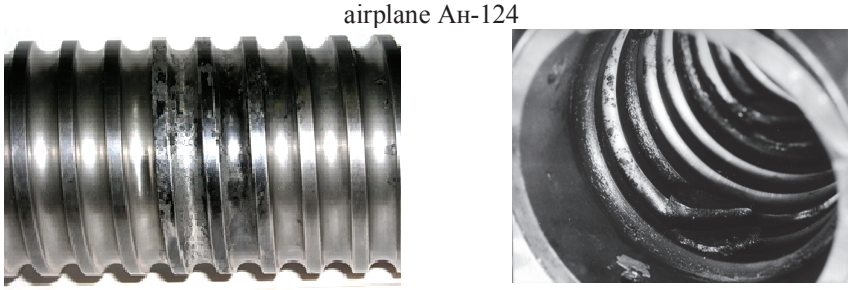


Fig. 1. General view of screw and nut of the wing flaps elevator of airplane Ан-124



a *b*

Fig. 2. Damage of screw (*a*) and nut (*b*) of an airplane Ан-124 wing lift devices

Thus, this article is continuation of researches that were started on the base of analysis of damages of screw-nut pair of friction of airplanes wing lift devices units.

The purpose of work is the conduction of researches on wearability of high-strength steel and steel with the surface strengthening for delivering of recommendations in relation to the increasing of wearability and resource of airplanes wing lift devices screws.

Method of tests. The test on wear resistance was carried out on the machine, which imitates the vibration of МФК-1 [4] as the plane to plane contact. The essence of method lies down in the fact that the mobile cylinder sample contact with an immobile cylinder sample by the butt end at the set loading and is driven to back rotatory motion with set amplitude and frequency.

The researches were executed at loading of 20 MPa and amplitude of 175 mcm. The frequency of vibrations remained unchanging and formed 30 periods per second. The base of tests formed 500 thousands cycles. The temperature of standards at the beginning of experiment was equaled 293K.

The cylinder rollers were used as the samples. Their diameter was 20 mm and were produced from high-strength materials with surface treatment and without it. The back sample in all the tests was accomplished from the steel 95X18 and solidity HRC 45-50.

Highly strong materials 30Х2НВФА and ВКС-170 with the mechanical – impulse strengthening and nitrating were used in experiments. In addition, the tests were carried out on clean materials without superficial treatment.

Researches in the studying of change of the linear wear and intensity of wear of coverages were conducted on the air at a friction without lubricating material. The wearing of immobile sample is measured for the set amount of cycles, the value of which is determined wearability of the probed material.

The wear resistance of highly strength materials for the units of airplanes wing lift devices.

The results of tests of highly strength materials are presented on fig. 3.

From a histogram evidently that highly strength steel 30Х2НВФА is less wearability for steel ВКС-170. The mechanic and impulse strengthening of highly strength steel increases wearability in the conditions of fretting. For steel 30Х2НВФА it is in 15%, and for steel ВКС-170 only in 5%. At comparison of fastening superficial

treatments, it is possible to talk that, nitrating and the mechanic and impulse strengthening of steel 30Х2НВФА practically does not differ between itself by wearability. The difference between among these superficial treatments lies within the limits of error.

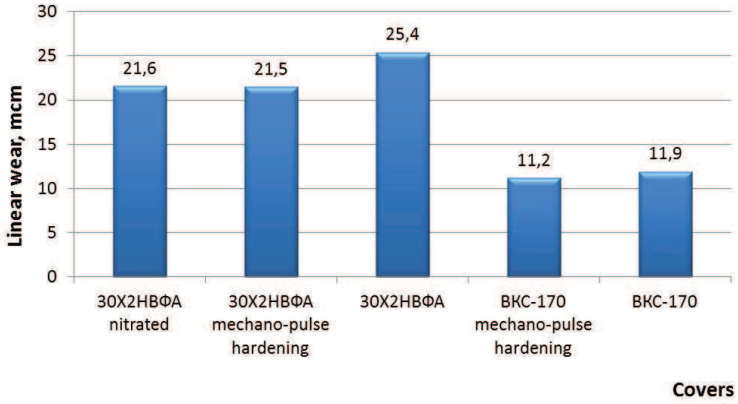


Fig. 3. The wearability of highly strong steels at the fretting corrosion tests mechanic-pulse hardening

The most interesting fact after the analysis of the got results is that the steel VKS-170 almost in two times more wearability than the steel 30Х2НВФА. Even the superficial strengthening not substantially influences on the order of wearability of these materials. It enables us to recommend the factories-producers of aviation products to use the steel ВКС-170 for making the airplane wings lift devices units (screw-nut) in place of the nitrated steel 30Х2НВФА, even without superficial strengthening treatment which gives an increase wearability of friction pair in two times.

The fractographies of friction tracks of highly strong steels with superficial strengthening treatment and without it are presented on fig. 4.

After the analyzing the friction surfaces of the samples it is possible to say that almost all friction tracks have the identical relief. The friction tracks are without scraps, ulcers, and places of fights. It all testifies to that the friction surfaces have carried mechanic and chemical nature of wear.

The steel 30Х2НВФА with the nitrated layer 200 мсм has the same wear as steel ВКС-170 without additional strengthening treatments. The surfaces that worked in the friction pair with these materials are almost identical, without scratches and clutches.

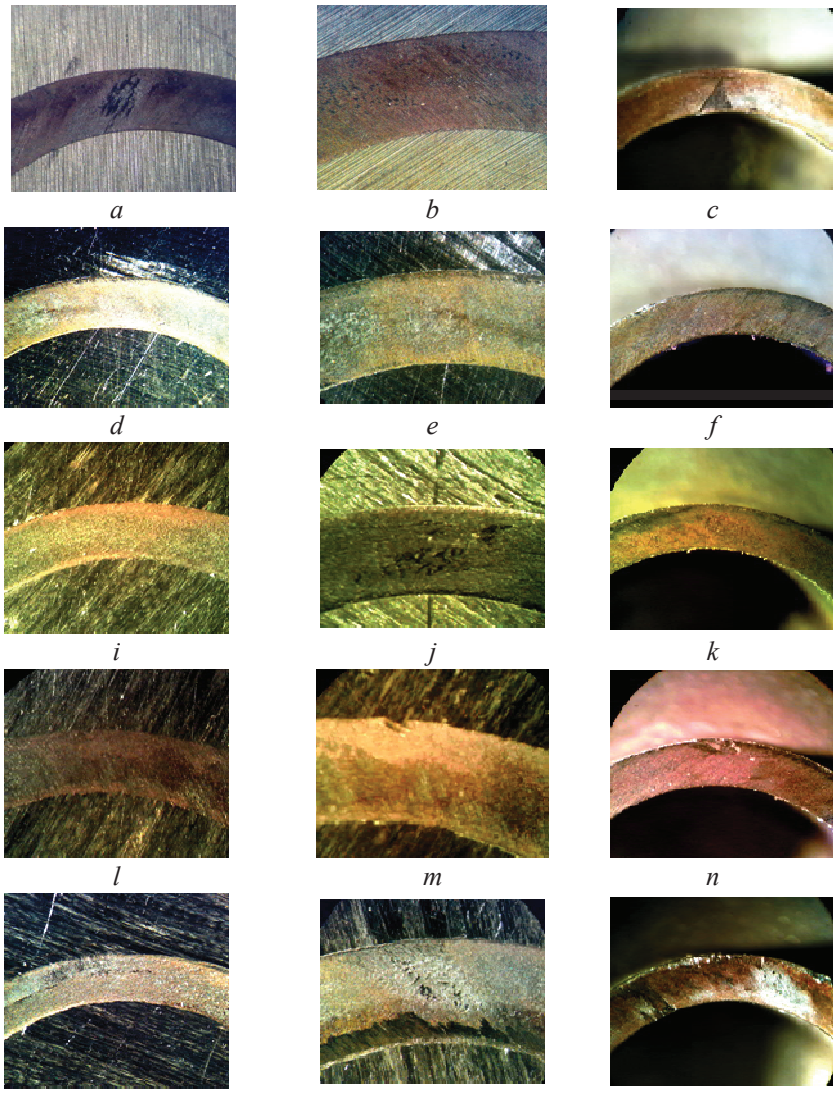


Fig. 4. Fractography of friction tracks of highly strong steels at a tests on wearability in the conditions of fretting corrosion: *a, b* – 30Х2НВФА nitrated; *e, f* – 30Х2НВФА mechano-pulse hardening; *i, j* – 30Х2НВФА; *l, m* – ВКС-170 mechano-pulse hardening; *o, p* – ВКС-170; *c, d, k, n, r* – 95Х18Ш

Conclusions:

1. It is not utility to use the mechanic and impulse strengthening of steel in place of nitrating of steel 30Х2НВФА and in general on steel ВКС-170 with the purpose of increase the wearability. Insignificant increasing of wearability that takes place during superficial treatment is not utility and economically unprofitable.

2. The highly strong steel ВКС-170 without superficial treatment almost in two times more wearability than the steel 30Х2НВФА with superficial strengthening treatment.

Recommendations. Change the nitrated steel 30Х2НВФА in manufacturing of aircraft type ANTONOV wing lift devices on ВКС-170 without superficial strengthening that makes the screw and nut two times more wearability.

Literature

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Проведено испытания на износостойкость в условиях фреттинг-коррозии высокопрочных сталей, которые используются при изготовлении деталей узлов механизации крыла самолетов. Представлены рекомендации по замене материалов деталей, что дает повышение износостойкости в 2 раза.

Рис. 4, список лит.: 4 наим.

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