PROPERTIES OF CONTACT SURFACES ON A WEAVING LOOM AND WAYS TO INCREASE THEIR PERFORMANCE

Kasimov Bakhtiyorjom Murat o'g'li
Associate Professor of the Department of
Mechanical Engineering Technology,

Ergashev Alisher Baxramjon o'g'li
Master Andijan Machine-Building Institute
E-mail: kasimovbaxtiyor.1991@gmail.com, tel:+998906254000

Abstract:

The goal of the work is to increase the environmental safety of weaving equipment by reducing wear of contact surfaces. Minimizing wear and tear during the operation of weaving equipment is of great importance for the environment. However, the physicochemical interaction of metal surfaces with the environment in certain areas is uneven due to its polycrystalline structure and heterogeneity. In this case, the physical and chemical activity of individual surface grains is significantly influenced by the magnitude of their residual stresses (micro-stresses), the degree of plastic deformation, etc. The article studies the causes of wear on the baton mechanism of a shuttleless weaving loom as a result of friction, which leads to a noticeable increase in warp thread breaks and a decrease in the quality of raw fabric. To ensure the environmental safety of weaving equipment, methods have been proposed to increase the wear resistance of the drum mechanisms of shuttleless weaving machines. As a result of the research, it was found that the main reason for the destruction of surface layers is the occurrence of fatigue cracks and the separation of microscopic flakes of the material or its oxides. The work substantiates that an effective method for increasing the performance of the baton mechanisms of shuttleless type looms can be the method of surface plastic deformation of the inner surface of the shed of the baton teeth. As a result, the uniformity of the physical and chemical interaction of metal surfaces with the environment is ensured, as the resistance to wear and fatigue failure increases. This has a positive effect on the quality of the produced fabric and the productivity of the process due to the reduction in the breakage of warp threads during shockless high-speed sliding of the thread guide along the comb teeth.

Introduction

Considering the issues of environmental safety of sewing and weaving equipment, many authors [1-3] identify a number of possibilities that are aimed at increasing the efficiency of the physical and chemical interaction of metal surfaces with the environment and reducing wear of contact surfaces. It is important to minimize wear and tear on weaving equipment as it operates over a long period of time. Statistics on downtime of shuttleless weaving looms (STB)

Web of Teachers: Inderscience Research
webofjournals.com/index.php/1

at textile industry enterprises show that 28% of downtime is caused by breakdowns of the elements of the drum mechanism, with the most often observed failure of elements such as the drum shaft and reed [4].

Works [5, 6] show that the most common malfunction of the baton mechanism of an STB type machine is the wear of the batan teeth (guide comb), leading to a noticeable increase in warp thread breaks and reducing the quality of raw fabric due to defects. Characteristic wear of the working surfaces of the baton teeth (Fig. 1) occurs in forceful sliding contact with the thread inserter.

Drawing. 1. Wear of the internal contact surfaces of the baton teeth

The thread spreader from the receiving box of the machine moves to the fighting box using a conveyor and from 13 to 17 thread spreaders are in operation on the machine at the same time. The movement of the thread inserter through the shed at the moment of insertion is conveyed by the combat mechanism of STB type machines, which in design is significantly different from the combat mechanisms of shuttle machines. The force of the engagement depends on the potential energy of the twisted torsion shaft and does not depend on the speed of the machine. Machines with plate weft inserters have a main shaft rotation speed of 160-260 min-1, depending on the filling width of the machine and the presence of a multi-color weft mechanism.

The theoretical speed of the plower increases over time as the torsion shaft unwinds and reaches its maximum value towards the end of acceleration. The accelerating plotter breaks away from the race at the moment the oil brake begins to operate, spinning the torsion shaft by approximately 14°, reaching a speed of 22-24 m/s. The initial speed of the thread inserter when processing combed wool yarn is set to about 24 m/s, when processing hardware yarn - 16-18 m/s [7].

Materials and Methods

To ensure reliable operation of the fighting mechanism of STB type machines, it is necessary that the oil brake completely absorbs all the kinetic energy of the fighting mechanism after the weft inserter accelerates.

Wear of the contact surfaces of the baton teeth occurs under conditions of high-speed relative sliding of the thread guide with lubricant. A thorough examination and analysis of the friction surfaces on the throat showed the following. The wear of friction surfaces (Drawing 1) on a tooth after their operation is uneven, which may be due to different values of local specific pressures and relative sliding velocities on the friction surface, unequal penetration of lubricant into the contact zone, etc.

Наиболее интенсивный износ происходит на коротком участке зева, который можно оценить основной характеристикой износа деталей – линейным износом U, измеряемым в направлении, перпендикулярном поверхности трения. As linear wear develops, its transformation and the appearance of a so-called wear crater with some curvature are observed. This formation has nothing to do with a wear crater on the front surface of tools when cutting metals, when its formation is associated with chip formation and the degree of interaction between the processed and tool materials.

The appearance of a clearly defined wear crater on the contact surface of the batan tooth is apparently also associated with the curvilinear profile of the working surfaces of the thread guide, corresponding to a half-cylinder. As a result of the appearance of a wear crater, considering the conjugate pair “thread guide – baton tooth” as temporary and fleeting, changes occur relative to their position at a high speed of thread guide sliding along the baton teeth, which cannot but cause additional dynamic loads in the area of their contact. This can lead to an increase in warp thread breakage, all other technological process conditions being equal.

Results and Discussion

Wear, which occurs during friction of mating surfaces, is the most typical type of damage to most machines and their mechanisms. In accordance with states standardization 16429-70, wear is a process of gradual change in the dimensions of a body during friction, manifested in the separation of material from the friction surface and (or) its residual deformation [8].

In general, when two mating surfaces come into contact and their relative movement occurs in the surface layers, mechanical and molecular interactions arise, which ultimately lead to the destruction of microvolumes of surfaces, to their wear.

Taking into account the cyclic repeated loading of the baton teeth during dynamic contact with the thread guide and analyzing the wear surfaces, it can be argued that mechanical wear occurs

- one of the three types of wear according to the above standard. In this case, it can be assumed that mechanical wear is realized through its type, such as fatigue wear.

The fatigue theory of wear [9] is based on the fact that the main reason for the destruction of surface layers is the occurrence of fatigue cracks and the separation of microscopic flakes of the material or its oxides. The wear process is considered as the summative effect of individual factors during repeated loading of friction links, which ultimately leads to the separation of wear particles. Particle separation can occur as a result of hardening of the surface layer, which becomes brittle and fractures (sometimes called brittle wear).

The distribution of macrostresses in the surface layer of workpieces, for example, after cutting, is explained to a first approximation by the action of two factors - mechanical (plastic deformation), which provides only compressive stresses, and thermal (heating of the surface layer) which causes the formation of only tensile stresses. This scheme can be violated if the cutting process is accompanied by phase transformations, which are sometimes a stronger source of the formation of macrostresses in surface layers than mechanical and thermal factors. The real picture of the occurrence of macrostresses must also take into account the direction of the force load acting on the surface layer during processing of the part, i.e. Depending on the direction of the force field, both tensile and compressive stresses can be created in the surface layer of the part.

The main process that occurs during friction of materials and leads to wear is elastoplastic deformation as a result of the interaction of surface microreliefs. In turn, this process generates and is accompanied by a whole complex of mechanical derivatives (for example, hardening, fatigue failure), physical and chemical processes occurring on the surfaces and in the surface layers of rubbing bodies.

It is necessary to distinguish between contact fatigue of surface layers, which occurs during pure rolling and manifests itself in the development of local sources of destruction, and fatigue wear, when, during sliding friction, the separation of microvolumes of surfaces, as noted above, is associated with the fatigue nature of destruction.

The quality indicators of product manufacturing, which are a consequence of the adopted technological process, have a direct impact on such a basic performance property as surface wear resistance. One of the main methods for producing reliable products is to ensure the reliability of the technological process itself, and to create a reserve in the values of the parameters that determine the performance of the product.

Among the trends in the development of modern technological processes, it is necessary to note such important areas as the development and dissemination of methods of hardening technology, especially for strengthening special parts of the working parts of technological machines, obtaining a high quality surface layer, [10, 11] the use of coatings, which are a necessary condition for the production of reliable mechanical engineering products.

Special types of processing that increase wear resistance, fatigue strength, and corrosion resistance of products can increase the reliability margin of the technological process. For these purposes, technological processes are used that strengthen the surface layer, which acquires special properties. This includes, first of all, hardening technology based on plastic deformation of surfaces (PPD methods), as well as chemical-thermal treatment processes and other special methods.

When using SPD methods, as a result of hardening (strain hardening) in the surface layers, crystalline grains are transformed, hardness increases, and favorable compressive residual stresses are formed, which contribute to increased wear resistance and resistance to fatigue failure.

Elastoplastic deformation during mechanical processing changes the structure-sensitive physical and chemical properties of the surface layer of the metal compared to its initial state. The number of dislocations in the crystal lattice—linear imperfections, vacancies, and other lattice defects—increases sharply. The shape and size of the grains change, they are crushed near the surface (fragmentation of grains into fragments and blocks with angular orientation) and stretched, oriented in the direction of the deformation force (in this case, the formation of a texture is possible).

In the deformed surface layer, the characteristics of resistance to deformation increase; strength characteristics change under long-term static and cyclic loading at high temperatures; plasticity characteristics decrease (relative elongation and narrowing); hardness, fragility increases (impact strength decreases), internal friction; density decreases.

To determine the parameters of strain hardening (depth, degree and gradient of hardening), the most widely used methods are measuring microhardness on the surface of oblique cuts and during layer-by-layer chemical etching, as well as methods of X-ray diffraction analysis.

As a result of the temperature and force effects of various technological processes of mechanical processing of parts, residual stresses arise in their surface layer. Although each technological process has its own characteristics, the mechanism of formation of residual stresses is based on the irreversible non-uniform distribution of deformation throughout the volume of the part. The appearance of residual stresses that exist and are balanced inside a solid body after eliminating the causes of their occurrence is associated with the conditions of manufacture and operation of parts. The surface of the metal has increased chemical activity due to the fact that the atoms here have one-way bonds in the volume of the body, so the metal in the boundary zone is in an unstable state. In real conditions, the metal surface adsorbs atoms of environmental elements, becoming covered with layers of absorbed gases, water vapor and fats. Exposure to the external environment also leads to the formation of various compounds on the metal surface, primarily various oxides under the influence of atmospheric oxygen.

Conclusion

It should be noted that in the surface layer, as a result of diffusion, chemical compounds of the base material with substances penetrating from outside can arise. The diffusion mobility of atoms can lead to a redistribution of the concentration of alloying elements in the surface layer; it is observed, for example, as decarburization in steels, depletion of chromium and aluminum in heat-resistant nickel alloys at high temperatures.

The physicochemical interaction of metal surfaces with the environment in certain areas is uneven due to its polycrystalline structure and heterogeneity. In this case, the physical and

Web of Teachers: Inderscience Research
webofjournals.com/index.php/1

chemical activity of individual surface grains is significantly influenced by the magnitude of their residual stresses (micro-stresses), the degree of plastic deformation.

Thus, it can be assumed that an effective method for increasing the performance of the baton mechanisms of STB-type looms can be the method of surface plastic deformation of the inner surface of the jaw of the baton teeth. As a result, resistance to wear and fatigue failure can be increased, which will have a positive effect on the quality of the produced fabric and the productivity of the process due to a reduction in the breakage of warp threads during shockless high-speed sliding of the thread guide along the comb teeth. By following this technology, we implement an environmentally friendly approach that will ensure the environmental safety of weaving equipment by reducing wear on contact surfaces.

References

1. Turakhodjaev N. et al. Quality improvement of the steel melting technology in an electric arc furnace //ACADEMICIA: An International Multidisciplinary Research Journal. – 2021. – T. 11. – №. 7. – С. 48-54.
2. Kasimov B. Experimental determination of the depth and degree of riveting of the surface layer of Batan teeth //Middle European Scientific Bulletin. – 2021. – T. 18. – С. 169-171.
3. Murat o'g'li K. B. et al. Combined strengthening of Batan teeth of the Stb loom //International Journal on Orange Technologies. – 2021. – T. 3. – №. 4. – С. 223-225.
4. Касимов Б. М., Муминов М. Р., Шин И. Г. Определение скрытой энергии деформации на основе термодинамических соотношений при отделочно-упрочняющей обработке. – 2021.
5. Шин, И. Г., Шодмонкулов, З. А., Искандарова, Н. К., & Касимов, Б. М. (2021). Повышение эффективности волокноотделительной машины абразивоструйной обработкой зубьев дисков пильного цилиндра. Вестник машиностроения, (10), 66-69.
6. Касимов Б. М. и др. Расчетные модели для оценки напряженно-деформированного состояния в поверхностном слое деталей при поверхностном пластическом деформировании обкатыванием и выглаживанием //Современные инновации, системы и технологии-Modern Innovations, Systems and Technologies. – 2022. – Т. 2. – №. 4. – С. 0324-0330.
7. Назаров С. Р., Касимов Б. М., Шин И. Г. Алгоритмизация расчета интенсивности остаточных напряжений при дробеударном упрочнении деталей технологических машин. – 2020.
8. Kholmirzaev N. et al. Increasing the Lifetime of Tillage Machine of Plowshares Made Stell Made by Foundry Technologies //JournalNX. – T. 7. – №. 11. – С. 55-59.
9. Turakhodjaev, N., Kholmirzaev, N., Saidkhodjaeva, S., & Kasimov, B. An International Multidisciplinary Research Journal.
10. Kasimov, B. (2023). Improvement of the environmental safety of weaving equipment by reducing the wear of contact surfaces. In E3S Web of Conferences (Vol. 390). EDP Sciences.

Web of Teachers: Inderscience Research
webofjournals.com/index.php/1

11. Касимов, Б. М. У., Шин, И. Г., & Муминов, М. Р. (2023). Расчет глубины наклепа при дробеструйном упрочнении зубьев батана ткацкого станка типа СТБ. Universum: технические науки, (5-2 (110)), 44-49.
12. угли Касимов, Б. М., Шин, И. Г., Муминов, М. Р., & кизи Касимова, Д. Х. (2023). Расчет глубины наклепа при дробеструйном упрочнении зубьев батана ткацкого станка типа СТБ. Educational Research in Universal Sciences, 2(4), 756-766.
13. Шин, И. Г., & Муминов, М. Р. (2023). Эффективность дробеструйной обработки рабочих поверхностей зубьев батана ткацкого станка СТБ. Innovations in Technology and Science Education, 2(9), 1186-1198.
14. Шин, И. Г., Максудов, Р. Х., & Муминов, М. Р. (2023). Напряженно–деформированное состояние поверхностного слоя деталей при динамическом упрочнении микрошариками. Innovations in Technology and Science Education, 2(9), 1167-1185.
15. Nazarov, S. R., Kasimov, B. M., & Shin, I. G. (2020). Algorithmization for calculating the intensity of residual stresses during shot-impact hardening of parts of technological machine. Progressive technologies and equipment: textiles, clothing, footwear, 81-84.
16. Kasimov, B. M., Muminov, M. R., Abrorov, A. S., & Mirzakarimov, K. R. (2022). Calculation models for the assessment of deflected mode in the surface layer of parts during surface plastic deformation by running and smoothing. Современные инновации, системы и технологии, 2(4), 0324-0330.

Web of Teachers: Inderscience Research
webofjournals.com/index.php/1