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APPLICATION OF LASER MODIFICATION TECHNOLOGY FOR FINISHING SURFACES OF GEARS

Abstract: *The article is devoted to the finishing treatment of gear surfaces. Engagement with the offset pole during rotation provides a relative slippage of the surfaces of the contacting teeth of the wheel. The surface of the teeth of the return formed by processing, creating a roughness provides removal of the allowance from the treated wheel.*

Key words: *gears, finishing, gears, technology.*

Language: *English*

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Introduction

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The efficiency of any machining process is primarily characterized by the stability of the parameters of the treated surface. In relation to the process of diamond gear teeth honing hydraulic pumps it can be interpreted as providing qualitative and quantitative characteristics of the surface roughness of the teeth in their large-scale and mass production. Tooth honing refers to a group of methods that perform micro-cutting of solid surface layers of teeth by a large number of cutting elements that are not oriented in space [1]. The process of diamond tooth honing the surface of the teeth of gears is low-speed (V = 0.5-5 m / s) and, as a consequence, is characterized by high tool life, which, in turn, should have a positive impact on the stability of the results of mechanical treatment of surfaces. The processing modes and the quality of the supplied blanks for their further machining are also components of the diamond tooth honing process. Determining the impact of the quality of the surfaces of gears before diamond gear honing and processing modes is an urgent task. The aim of the work is to determine the influence of the parameters of the worm diamond hone and processing modes on the roughness of the processed gear wheel. To determine the degree of influence of the above qualitative and quantitative parameters of the parts and the honing process, tests were carried out according to the following method.

This article discusses the creation of a more economical and effective method of eliminating defects of locomotive gears. The life of the gear is approximately 60 % of the life of the wheel. In this regard, the new gear has to be installed in a pair with a gear wheel that has significant wear. Because of this, the working conditions of the gear train deteriorate significantly - the wear of the contacting surfaces of the gear teeth and the wheel increases; - dynamic loads increase, negatively affecting the operation of the traction drive, including the traction motor. In practice, the gear wheel in this case is not processed at all or processed manually with a grinding wheel, and also produce processing honing, lapping[2]. This treatment decreases the thickness of the surface hardening of teeth of the ring gear wheel, a reduction of the tooth thickness and the distortion of involute profile. Transmitting high traction loads, the gear is subjected to significant dynamic effects from the railway track, as well as high-frequency vibrations caused by kinematic errors of the gear. At repeated influences of the contact stresses arising each time at an input of a tooth in gearing, there is an origin and growth of fatigue micro cracks on a surface which appearance is caused by insufficient thickness of a lubricating layer and metal contact of separate projections of surfaces of teeth. With a significant growth of individual cracks and their subsequent unification, the separation from the surface of the damaged layer of the micro-volume of the material and the formation of micro-cracks occurs. Further growth of shells is accompanied by their merger and increase in the area of the damaged surface. The reason for the destruction of the gears can serve as the presence of cracks grinding character, insufficient thickness and uneven distribution of the hardened layer as a result of non-compliance with the cutting conditions of workers. Currently, for the treatment of gear wheels during their repair uses different methods: savingjane, grinding, lapping, honing, break-in period. These methods of Metalworking have their drawbacks, such as:

– when shevingovanii wheels made of materials of high hardness, there is increased wear of the shaver. Too low of a stock for savingjane (less than 0.06 mm) leads to the fact that the shaver cannot fully correct the existing errors of the wheels, and too large (more than 0.25 mm) allowance leads to a decrease in durability of the shaver and to the deterioration of the processing accuracy of the wheels;

– when lapping the material of the work piece are embedded abrasive grains of the lapping; the grinding allowance is not more than 0.03 mm; requires a large adjustment of the machine;

– grinding cracks great depth, a considerable number of wheels rejected for shlifovan piagam and shlifovan cracks. The most promising method is laser surface treatment, which has a number of advantages - high concentration and locality of the supplied energy in a limited (millisecond) time range allows processing only the surface layer with high heating and cooling rates without significant heating, adjacent layers, and therefore without violating their structure and properties;

- the possibility of wide regulation of laser treatment modes allows for an extensive range of surface changes in the structure, phase composition and mechanophysical properties;

– the ability to process in normal atmospheric conditions, in the absence of harmful emissions, high manufacturability of the process;

– the ability to transport the beam over long distances and in hard-to-reach areas. It is known that the peculiarity of friction surfaces subjected to laser modification is that after processing they do not have a grid of micro cracks characteristic of steels hardened in the traditional way[3]. This is especially important for gears, because stresses are concentrators of macro-cracks, and at mutual laser processing of conjugated pairs [4] these indicators for a number of steels considerably increase. Laser surfacing is expedient at the stage of restoration repair of equipment, and laser thermal hardening - in the overhaul period of operation. At the same time, using the same technological laser equipment with minor adjustment of processing modes, it is possible to conduct welding operations, formed micro cracks, both in the gear wheel and in the gear, as well as localization of voltage concentrators in the areas of micro cracks by melting them within the tolerances provided by the repair technology. The wear resistance of the mating friction surfaces of machine parts is crucial to improve the durability of the product. The possibility of its significant increase due to laser thermal hardening can be attributed to one of the most promising solutions. Laser thermal hardening is a process in which a thin surface layer of a material is heated to temperatures above the structural-phase transformation temperatures, followed by ultra-high-speed cooling due solely to the heat sink into the bulk of the material. The methods of surface thermal strengthening are based on three modes of laser heating and their accompanying physical phenomena in the material.

The first of them is the mode of "formation of quenching microstructure", which does not cause melting and any change in the parameters of surface roughness, which does not require post-mechanical processing. It provides heating of the surface layer of the processed material and subsequent spontaneous cooling.

The second is the mode of formation of the melt zone. It differs from the first by the increased depth of the zone of thermal influence (ZTV), more pronounced heterogeneity of the structure of the modified layer.

The third - "evaporative" mode of laser action on the material - characterizes shock hardening, requires mandatory finishing machining with the removal of some of the hardened layer. Laser thermal hardening, in comparison with traditional methods of heat treatment, is characterized by low specific energy consumption, the possibility of local hardening of the surface area of the required size and hard-to-reach places, the absence of quenching media and hazardous waste, a high level of automation; provides minimal warping of the product. Restoration of worn parts is an actual problem of mechanical engineering. Significantly reduce the cost of repair becomes possible by restoring previously operated parts[5].

Many studies have proved that the performance and wear resistance restored by laser surfacing parts often exceed these indicators for new parts causing this additional reserve to reduce labor costs for subsequent repairs and increase the level of reliability of machines. The main advantages of laser surfacing in comparison with traditional methods include a significant reduction in residual stresses and strains of the restored parts due to the locality and short-term impact of the heating source, as well as a high cooling rate due to the heat sink deep into the material. Along with this, the high concentration of energy in the heating zone makes it possible to conduct the process with a significant processing speed. The possibility of controlled formation of the deposited layer with the specified properties is provided by optimizing the surfacing modes and selecting the appropriate filler material, with a slight sub-melting of the base. This, in turn, causes a high adhesive strength of the deposited layer and wear resistance, a minimum thermal effect on the metal base is achieved, which is especially important for materials undergoing structural and phase transformations [6]. In General, laser modification for the purpose of restoring the working surfaces of friction includes three stages: preparation of the powder and the surface of the part for restoration; restoration by laser surfacing; mechanical treatment of the restored surface. Preparation of the powder is its drying, sometimes calcination at a temperature of 150, respectively...200 S or 350...400 PP.

The part subjected to surfacing is cleaned of impurities, dried, and then machined to give the surface the necessary roughness, which significantly affects not only the adhesion strength of the filler material to the substrate, but also the fatigue strength. At the same time, the details are given the correct geometric shape, using traditional types of machining[7]. Similarly, the final stage of finishing machining of the deposited surface is realized. In laser surfacing, as a rule, the surface layer of the substrate is sub-melted and at the same time a gravitational method of feeding the filler material into the liquid melt zone is carried out. For this purpose, a special powder dispenser is used. The deposited layer in this case is formed as a result of its gradual build-up due to the constant flow of the liquid phase of the filler material. A particularly important technological aspect of the proposed powder feeding method is to minimize the probability of micro cracks in the modified layer. Laser surfacing at gravitational feeding of filler powder after moving object is the most preferable for restoration of the worn-out details. The concept of technological and technical and economic aspects of the integrated approach confirms the feasibility and efficiency of industrial use of both methods of laser modification at different stages of operation of the product. The validity of such an idea, on the example of the considered technologies, becomes obvious due to the following:

– industrial application of laser thermal hardening and restoration is aimed at solving one common problem-improving the reliability and performance of products, both newly manufactured and subjected to restorative repair;

– both processing processes are characterized by a high degree of identity of processing technologies and laser equipment used;

– the energy intensity of the processing processes is approximately at the same level within a simple reconfiguration of the laser processing plant. Due to the above, it becomes technically and economically justified to create a single universal complex of laser material processing in one enterprise. The creation of such a complex, in addition to the above technological methods, can provide the implementation of other promising laser technological processes, such as cutting, welding, alloying, etc.

References:

1. Valikov, E.N., & Belyakova, V.A. (2010). *Obrabotka tortsov zub'ev krupnogabaritnykh zubchatykh koles*: ucheb. posobie dlya vuzov. (p.115). Tula: Izd-vo TulGU,.
2. Valikov, E. N., & Belyakova, V.A. (2011). *Rezhushche-deformiruyushchaya chistovaya obrabotka bokovykh poverkhnostey zub'ev zubchatykh koles*: monografiya. (p.215). Tula: Izd-vo TulGU.
3. Shastin, V. I., Pozdeev, V. N., & Chervichkova, L. V. (2010). Laser modification of surfaces of gears of locomotive traction drive / / *Modern technologies. System analysis. Modeling., No. 1*, pp. 92-96.
4. (n.d.). Laser welding. Thermostrengthening. ruslaser.com. Retrieved Feb.22, 2019, from http://ruslaser.com/index.php/component/content/article/13-portfolio/1-lasweld/34-1-lazarnaya-svarka?Itemid=0
5. (2012). Patent RF 120024 na poleznuyu model'. MPK V21N 5/02. Instrument dlya obrabotki zubchatykh koles / E.N. Valikov, V.A. Belyakova. N.S. Petrukhin, Yu.S. Timofeev, A.S. Zhurina. Opubl. 10.09.2012. Byul. № 25.
6. Grigoryants, A.G. (1989). Fundamentals of laser processing of materials. (p.304). Moscow: Mashinostroenie.

7. Kovalenko, V. S., Golovko, L. F., & Chernenko, V. S. (1990). *Hardening and alloying of machine parts by laser beam*. (p.192). K.: Tehnika.
8. Kovalenko, V. S., Verkhoturov, A.D., & Golovko, L.F. (1986). *Laser and electroerosive hardening of materials.* (p.276). Moscow: Nauka.
9. Shastin, V. I. (2009). Laser treatment of conjugated friction pairs. *Modern technologies. System analysis. Modeling.*, *No. 4*, pp. 202-208.
10. Shastin, V. I. (2008). Current state and prospects of industrial use of laser technologies in mechanical engineering. *Modern technologies. System analysis. Modeling.*, *No. 4*, pp. 60-66.